Marketing Research

FIFTH EDITION

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G C Beri

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Dedicated to

The Cherished Memories
of Professor R G D Allen,
Mr Frederick Brown and
Mr H S Booker
of the L.S.E.

Preface to the Fifth Edition

Since 1989, when this book was first published, there has been significant progress in the field of Marketing Research. This can be attributed to two factors. First, a large number of business firms have sprung up over the years leading to greater competitive environment. Second, the emergence of computer and telecommunication technology has improved the validity of data which is very important in good research. At the same time, it is worth noting that the marketing research process has continued to follow the same sequence.

This edition continues to follow the same organisation as was the case in the earlier editions. Nevertheless, a number of changes have been made. A chapter has been bifurcated, while in others new sections have been added. These changes are as follows:

1. Chapter 5 on Scientific Method and Research Design has been bifurcated; Chapter 5 covers Exploratory and Descriptive Research Designs while Chapter 6 covers Causal Research Designs. As a result a more comprehensive treatment of these three research designs has become possible.
2. Chapter 8 on Collection of Primary Data provides a comparative idea of observation and communication methods based on some important criteria; in addition it discusses relative merits and demerits of several survey methods.
3. A section on guidelines for the use of tables in the preparation of research reports has been added in Chapter 20. Further, a detailed discussion along with illustrations of graphic devices has been given. The use of visual aids in research reports has been highlighted as these are helpful in having a clear understanding of the subject covered.
4. Chapter 21 discusses in detail different forecasting methods along with illustrations within each of the three groups—subjective, causal and the use-of-time series.
5. Chapter 22 on New Product Development and Test Marketing includes a new section on the adoption process for new products. It explains the process of diffusion of innovations over time.
6. Chapter 23 on Advertising Research has been expanded by covering two aspects, namely, setting of advertising objectives and advertising budget.
7. Chapter 26 on Organised Retailing has been updated by analysing the recent data. This apart, it covers Relationship Marketing and Customer Relationship Management (CRM).

8. A new chapter on Ethical Issues (Chapter 27) has been added. The discussion is focused on ethical issues in relation to functionaries in marketing research. It also highlights major ethical issues involved in different stages of the research process.
9. Apart from the above-mentioned changes, some additional material has been given in some chapters. A select list of topics covered is given below:
   (i) Identification and explanation of characteristics of good research
   (ii) Experimentation in marketing research
   (iii) Searching published external data
   (iv) Guidance to handle non-responses in a survey
10. As regards case studies, some earlier case studies have been replaced by new ones. The Fifth Edition contains 44 case studies (as against 41 in the fourth edition). These have been deliberately kept short so that the attention remains focused on the main issues involved and one is not lost in a pile of information.
11. This edition for the first time gives 'Key Terms and Concepts' at the end of each chapter. Page number against each term or concept is given to facilitate its easy location. Further, a summary has been given at the end of each chapter to help the student to recapitulate the main points covered in the chapter.

With the inclusion of the above-mentioned changes along with the glossary, chapter-end questions and a comprehensive bibliography, it is hoped that the fifth edition will be further useful for students.

Although the text is primarily meant for the postgraduate students, it can also serve the purpose of undergraduate students. However, the more complex chapters may be skipped without disrupting the flow of the book. It is hoped that the book would be useful for practitioners of marketing research as well.

I gratefully acknowledge suggestions concerning a number of topics received from anonymous reviewers. These have been incorporated in the fifth edition wherever feasible and appropriate. I am extremely thankful to Mr. Girish P and Mr. Ashok Kumar of SPSS South Asia, Bangalore for providing solutions to some problems using SPSS. These are given in Chapter 17 on Experimental Designs, Chapter 18 on Multivariate Analysis I and Chapter 19 on Multivariate Analysis II. The inclusion of SPSS solutions has become an important feature of the text. I would like to express my sincere gratitude to Professor Sengupta for allowing me to use certain figures and data from his book, *Brand Positioning: Strategies for Competitive Advantage.* These have been used in two chapters: Chapter 19 on Multivariate Analysis II and Chapter 24 on Market Segmentation and Brand Positioning.

I would like to put on record my appreciation of the staff of the McGraw Hill Education (India) Private Limited, in particular to Mr. Tapas K Maji, Ms. Surabhi Khare, Ms. Shalini Negi and Mr. Manohar Lal, for their earnest efforts and courteous cooperation in the production of this edition. I am grateful to my wife Sushila, who had to undergo a lot of tribulations during the period when the manuscript for the fifth edition was under preparation.

At the end, I would like to say that despite my earnest efforts there might have remained certain shortcomings. I need hardly add that these should be attributed to me.

G C Beri

Preface to the First Edition

During the course of my teaching marketing research first at the South Gujarat University, Surat, and subsequently at the M S University of Baroda, I have often felt the need for a suitable textbook for Indian students. No doubt there are some excellent textbooks available on the subject but I feel that Indian students find them inappropriate. This book aims at a lucid exposition of the various concepts and techniques used in marketing research and is a modest attempt to fulfil a long-felt need of management and commerce students of the country.

As the book is technique-oriented, the main focus is on familiarising the students with the various techniques frequently used in marketing research. Wherever possible, examples have been given to explain the concepts and procedures involved. Except the last chapter, brief summary and questions (including numerical problems where necessary) are given at the end of each chapter. The cases, which are given in the last chapter, have been deliberately kept short so that attention can be focussed on the main issue or issues involved and one is not lost in lengthy information. Finally, a select bibliography is given at the end of the book. To facilitate an inquisitive reader who wants to know more on the subject, reference are given chapter-wise.

Although the book is intended as a text primarily for MBA and M Com students, it would be useful to practitioners as well. In some universities, marketing research is taught in BBA and B Com classes. By omitting certain advanced topics, it can be adopted even for undergraduate courses. Thus, the first part of Chapter 3, especially the section on Bayesian analysis, Chapter 9 involving statistical principles for sample size decisions, some parts of Chapter 10 which are no scaling techniques, Chapter 15 on multivariate analysis and Chapter 16 on experimental designs can be omitted to make the book cater exclusively to the undergraduate courses.

I could not have written this book without the assistance from several persons and institutions. It would be difficult for me to adequately acknowledge my indebtedness to all such people and institutions. All the same, I must mention some of them whose help was of considerable importance.

I am grateful to the Operations Research Group, Baroda for permitting me to use two questionnaires in the text and also some material from its brochure on syndicated research. The Indian Market Research Bureau and The Pathfinders: India, both from Bombay, have sent me detailed information on syndicated research undertaken by them. Thompson Associates Ltd, Bombay provided me with some very useful material on its latest indices—the Thompson Urban Market Index and the Thompson Rural Market Index.

I am also thankful to Professor Dhaval Mehta and Mr K C Sethia for giving me material which formed the basis for writing some cases. Thanks are also due to Mr Dilip Thakore, Editor, *Business World*, Mr P J Divatia, Chairman and Managing Director, Pranava Industrial Services Pvt.

Ltd, and Mr Vijayan Kannampilly, Deputy Editor, *Business India*, for granting me permission to use material from their periodicals.

I have used copyright material from various quarters. I am grateful to the Advertising Research Foundation, New York: Dr Seymour Banks, Chicago; Mr Orlando R Petrocelli, President, Petrocelli Books, Princeton; The American Marketing Association, Chicago; Professor Allen L Edwards of the University of Washington; the International Statistical Institute, Voorburg, Netherlands; McGraw-Hill Book Company, New York; and D B Taraporevala Sons and Co. Pvt. Ltd, Bombay for permitting me to use copyright material.

I am grateful to the Literary Executive of the late Sir Ronald A Fisher, FRS, Dr Frank Yetes, FRS and the Longman Group Ltd, London for permission to reprint tables on cumulative normal distribution, distribution of chi-square, upper percentiles of the distribution and percentiles of the F distribution from their book *Statistical Tables for Biological, Agricultural and Medical Research* (6th Edition, 1974). I am also grateful to the Cambridge University Press for its kind permission to reproduce the first two thousand random numbers from its publication entitled *Tables of Random Sampling Numbers* by M G Kendall and B Babington Smith (1954 Reprint).

I must also thank the staff of Smt Hansa Mehta Library, M S University of Baroda, Mr S R Yagnik of the Operations Research Group Library, Mr M M Vaidya of Sarabhai Research Centre's Library and the staff of the IIM Library, Ahmedabad where I used to study for the purpose of writing this book.

Dr R N P Sinha, Professor and Head, Department of Geography at the M S University of Baroda helped me by providing the services of a trained cartographer, Mr J M Sinnarkar.

Most of the manuscript was typed by Mr J S Kelkar. Some chapters were also typed by Mr T V Purushothaman. Both of them carried out neat and accurate typing and I am thankful to them for the same.

I am grateful to my wife, Sushila, who had to undergo tribulations during the period when the manuscript was under preparation.

Despite my earnest effort and the help received from various quarters, certain shortcomings might have remained for which I alone am responsible. I shall be thankful to the readers if they inform me about any shortcomings in the book so that these can be removed in a subsequent edition.

G C Beri

Contents

PART THREE—DATA PROCESSING ANALYSIS AND REPORTING

1

Introduction and Basic Concepts

1 Introduction

Learning Objectives

After reading this chapter, you should be able to understand:

- The meaning of basic research, applied research and marketing research
- The scope of Marketing Research
- Threats to Marketing Research
- Marketing Information System
- The limitations of Marketing Research
- Contrasting characteristics of Marketing Research and Marketing Information System
- Marketing Decision Support System
- The status of Marketing Research industry in India
- The issues in Marketing Research
- The characteristics of Good Research

Before defining 'marketing research', let us determine research.

- Research always starts with a question or a problem.
- Its purpose is to find answers to questions through the application of the scientific method.
- It is a systematic and intensive study directed towards a more complete knowledge of the subject studied.

Research can be classified into two broad categories: (i) basic research, and (ii) applied research. Basic research is sometimes called 'fundamental' research, 'theoretical' research, or 'pure' research. It aims at expanding the frontiers of knowledge and does not directly involve pragmatic problems.[1] The essence of basic research is that it addresses itself to more fundamental questions and not to the problems with immediate commercial potential.

Applied research, which is also called 'decisional' research, on the other hand, proceeds with a certain problem and it specifies alternative solutions and the possible outcomes of each alternative. Unlike basic research, it is prompted by commercial considerations. Though one may usually be

[1] Emory, C. William, *Business Research Methods*, Homewood, Illinois, Richard D. Irwin, Inc., 1976, p. 7.

able to distinguish between basic research and applied research, the distinction between the two sometimes gets blurred. Several firms may be engaged in basic research which does not have any immediate commercial use. However, it may be potentially commercial or else the firms would not have undertaken it at all.

Applied research can be divided into two categories: (i) problem-solving research, and (ii) problem-oriented research. Problem-solving research, as the name implies, is concerned with a particular issue or a problem and is usually proprietary in character. The latter characteristic indicates that such a research is undertaken within a firm or by an outside consultant on its behalf. Problem-oriented research, on the other hand, is concerned with a class of issues or problems in which several firms may be interested. Research of this type is usually concerned with conceptual aspects but is oriented towards applied problems.

MARKETING RESEARCH

As marketing research does not address itself to basic or fundamental questions, it does not qualify as basic research. On the contrary, it tackles problems which seem to have immediate commercial potential. In view of this major consideration, marketing research should be regarded as applied research. We may also say that marketing research is of both types–problem-solving and problem oriented.

Marketing research is a systematic and objective study of problems pertaining to the marketing of goods and services. It may be emphasized that it is not restricted to any particular area of marketing, but is applicable to all its phases and aspects.

The *American Marketing Association* (AMA) has defined marketing research as follow:

> Marketing research is the function which links the consumer, customer, and public to the marketer through information–information used to identify and define marketing opportunities and problems; generate, refine and evaluate marketing actions; monitor marketing performance; and improve understanding of market as a process.
>
> Marketing research specifies the information required to address these issues; designs the method for collecting information; manages and implements the data collection process; analyses the results and communicates the findings and their implications.

The *American Marketing Association* while defining marketing research emphasises that its function is to provide information to management so that it can identify and react to marketing opportunities and problems. The AMA's definition of marketing research also indicates the scope and process of marketing research. In short, marketing research provides the requisite information for making marketing decisions.

The Growth of Marketing Research

Over the past several decades, there has been a gradual development in the field of marketing research. The first evidence of formal research techniques employed could be traced as far back as 1824. However, for almost one century thereafter, marketing research developed rather slowly and sporadically. It was only from 1910 that it made rapid strides.

Several factors have contributed to the growth of marketing research. First, as a result of large scale production, producers do not have direct contact with the consumers. This leads to problems in marketing of goods. It is necessary for a manufacturer to know the potential areas where his goods could be marketed, the probable demand for the same and the extent of profitability and competition. This is possible only when a systematic investigation is undertaken. Second, there has been a shift from a seller's to a buyer's market. This necessitates a better understanding of buyer behaviour. This aspect is studied in marketing research. Third, the emergence of specialists such as statisticians, psychologists and behavioural scientists in a fairly large number has also enhanced the importance of marketing research in no small measure. These specialists have helped in the development of marketing research as a separate discipline and strengthened its techniques. Fourth, the increasing use of computers has further contributed to the growth of marketing research. It is now possible to maintain sound marketing information system (MIS) and marketing decision support system (MDSS), which prove very helpful in undertaking marketing research projects. Fifth, changes in the composition of population, particularly the shift from the rural to the urban areas, has widened the scope for marketing of various types of goods and services in the urban areas. Sixth, there is now increasing realisation on the part of both marketing researchers and management to have meaningful dialogue whenever a project is to be undertaken. This results in improving the quality of marketing research. Finally, the changing marketing environment has given enormous boost to marketing research in recent years.

WHEN MARKETING RESEARCH IS UNNECESSARY

Many firms, whether in production or services, would like to know as to what consumers feel about their products and services. As such information is available with consumers, many marketing research studies are done to collect it. In addition, consumers willingly provide the information sought. However, there are certain situations where getting the required information becomes extremely difficult so much so that one has to relinquish the idea of collecting it. In such situations, it is not advisable to undertake research. Given below are some situations where research is unnecessary.

1. When a firm finds that the cost of undertaking research is going to be more than the benefit it can derive by implementing the research findings.
2. When the research project attempts to collect information relating to distant past. Here, the respondents would not remember the desired information. Even if they are approached, they are likely to arbitrarily give some information, which obviously will not be correct.
3. When information is very personal, the respondents would be quite reluctant to give it. This is understandable as they consider it as an intrusion into their personal lives.
4. At times, respondents may find it difficult to communicate their emotions and sensations to the researcher. For example, respondents may be asked to taste two types of tea and then let the researcher know which is better. While they may tell this but they may be unable to reveal as to how they have come to this conclusion.
5. The nature of some products is such that there is hardly any time to conduct research. This is especially true in case of those products which have a very short life cycle. As research requires some time, the extremely short life cycle of the products does not permit it.
6. When a firm may have an apprehension that its new product is likely to be copied by its competitors once they come to know about it. This is frequently observed in test marketing as the competitive firm tries to take such steps which may distort the test marketing results of the rival firm.

EXAMPLES WHERE MARKETING RESEARCH WOULD BE NECESSARY

The following are some of the examples[2] of marketing problems faced by companies. It can be safely stated here that marketing research, if undertaken by the concerned companies, can resolve these problems to their satisfaction.

1. Videocon entered the telecom sector in March 2010 with ambitious plans. Videocon Mobile Services (VMS) was poised to rapidly build its subscriber base. It had planned to invest Rs.14,000 crore in VMS over the next three years. However, the report of the Telecom Regulatory Authority of India (TRAI), January 30, 2010 showed that Videocon's share in the wireless component was merely 0.78 percent, which was less than small players, not to talk of bigger players such as Airtel, Vodafone, Reliance and BSNL among others.
2. Cadbury Perk was introduced in the market in 1996. It created a new demand in the market for wafer chocolates in India. However, with the introduction of Nestle's Munch, it had to face tough competition. As a result of continued competition between Cadbury and Nestle, the chocolate wafers' market saw stagnation in the demand, despite an array of competitive advertisements.
3. Almost a decade ago, UK's leading retailer Marks & Spencer (M & S) entered Indian market. But, unfortunately, the brand has been struggling to gain a foothold in the country. As against this, many global brands that entered the country around the same time or after M & S have raced ahead of it. M & S faces stiff competition from global brands like Benetton, Zara, Tommy Hilfiger, as well as Indian retailers. Notwithstanding such challenges, M & S is determined to operate in India, considering the potential of the Indian retail space.
4. Lakme was the first major beauty brand in India. However, over the last few years, the brand has seen erosion in its iconic stature. With an influx of some global brands, the consumers have a range of options to choose from, unlike a few years back when Lakme was the only credible brand. Earlier, Lakme used to have a very high aspirational volume among the Indian women. But with the entrance of new mid-premium brands in the field, Lakme has lost on that aspirational quotient.
5. For Del Monte, which has a product portfolio of fruit drinks, ketchup and sauces, Italian range and corn, there are challenges ahead before it can reach its goal of being in the list of top ten Food and Beverage (F & B) companies of India. With a complete focus on the ketchup range in its communication strategy, how well does Del Monte create a buzz for the rest of its portfolio? The company strongly believes in extensive sampling activities and for each product launch, it chooses a likely set of early adopters of the brand.
6. Nano was the most awaited car in India, and surged pride for being indigenous—from the Tata house. It was the dream of the millions. Yet, after 23 months of its launch, it has not been able to sell even a lakh units. The monthly sales of Nano started falling from July 2010 and reached a record low of just 509 units in November 2010. An important reason for this performance was lack of strong communication to its core target group (TG)—the two-wheeler owners in small towns aspiring to buy a car.

[2] PITCH, New Delhi, Vol. VIII, Issue 6, March 2011.

SCOPE OF MARKETING RESEARCH

Many people think that marketing research is just a consumer survey, asking consumers about certain product or service. Though consumer research is an integral part of marketing research, the latter is quite a pervasive activity, covering the various types of marketing problems that confront the marketing manager. Here, we give a broad idea about the scope of marketing research. The discussion is confined to main divisions of marketing research.

Product Research

Product research is concerned with the design, development and testing of new products as well as improvement of the existing once. It also examines whether the quality of a new product conforms to the desired attributes. In addition, it analyses the product-mix in comparison with the competitive products. Further, in case of durable consumer products and technical products, product research is concerned with the analysis of after-sales servicing. Research on after-sales servicing becomes relevant as at times due to poor after-sales service, the business firm's image is damaged. It may be emphasized that the product research is concerned with every stage of product life cycle viz. introduction, growth, maturity and decline.

Apart from the product itself, packaging is of considerable importance. Over the years, it has become a powerful promotion tool as well. On the basis of product and packaging research, a business firm can evolve suitable market segment strategies.

Sales Research

As the name implies, sales research is concerned with all the selling activities of the firm. It would like to examine various sales outlets or territories in the light of their performance in terms of sales. Such a research can be product-wise in addition to the overall performance. Further, the firm may know through sales research its position in the market in relation to its main competitors.

Another area within sales research is determining the effectiveness of the sales force and identifying specific factors that may improve its performance. Research may also be undertaken on the distribution methods from time to time so that, if necessary, alternative methods may be introduced so that the distribution function is more effective.

Customer Research

Customer research is concerned with the studies of buyer behaviour. It probes into different factors such as sociological, economic and psychological that influence the customers in their decision to buy the product. The firm may like to know whether its customers are satisfied with its product and to what extent. Similarly, customer research can provide customers' suggestions when they feel certain deficiency or when they would like to have some improvement in the product. Normally, customer research is in the form of attitudinal studies which offer clues in distinguishing the appeals of competitive brands to certain types of buyers. Customer research may be undertaken not only at the macro level but at different segments level as well.

The firms may also like to ascertain its overall market share. This apart, market share by each customer type as well as by each geographic area is also relevant and as such the firm may undertake research on these aspects.

Pricing Research

Regardless of the nature of business, every firm has to decide what price is to be fixed for its goods and services. Pricing is one of the major factors that affects the success of the firm. Costs form the basis for determining the price. There are a number of other factors as well such as the nature of demand, extent of competition, technological development, financial status of the consumers, etc. If a new product is to be launched, the firm may undertake test marketing. In different locations, it can use experimentation to find the extent of its acceptability at varying prices. This may help the firm to choose the appropriate price. In case of an established product too, the firm may like to know how sensitive to price changes are its target segments. In fact, this is nothing but determining the price elasticity of demand. Another problem may relate to a situation when cost of production has been declining. Here, the firm may be in a dilemma–whether to reduce the price of its product or provide a better quality. Research may be helpful in decision making in this situation. This discussion is only illustrative. Many situations can be thought of where pricing research will be relevant.

Advertising Research

Another area in marketing research is related to advertising. The main objective of a firm using advertising is to increase awareness of its product or service to the target group, leading eventually to increased sales. Unless the prospective consumers are aware of the availability of a product or service, there cannot be any sale. Hence advertising research assumes considerable importance.

There are two types of advertising research:

(i) *Media research*

(ii) *Copy testing*

Media research is concerned with alternative media — television, radio, newspapers and magazines. Here, the main problem is how to choose a particular media or a combination of media. Another problem is how to decide on a specific insert within a particular type of media.

As regards copy testing, there are different methods that are to be studied to determine the suitability of a particular copy before it is finally released by the firm as an advertisement.

It may be noted that in view of liberalization of the economy, there is an enormous increase in competition. As a result, more and more firms are taking recourse to advertising and allocating larger budget to it.

The foregoing discussion on main divisions of marketing research is not complete as there are so many problems and if all these are listed and even briefly described, it will result into a big book. The above discussion is merely illustrative and it is hoped that it gives some idea of the diversified problems covered in marketing research.

LIMITATIONS OF MARKETING RESEARCH

The preceing discussion should not lead any one to assume that marketing research can solve all the problems of marketing. While it can be extremely rewarding to a firm, it is wise to know that it is subject to certain limitations. One must be aware of these limitations in advance so that one is clear about what marketing research *can* and *cannot* do.

- First, very many times, marketing research tends to be fragmentary in its approach as a result of which it becomes difficult to have an overall perspective in which a marketing problem is to be viewed and studied.
- Second, marketing research is criticized on the ground that it becomes too superficial and faulty in industry. While the principles of marketing research are good based on scientific

lines, in industry, marketing research is very often used by those who have had no formal training in the subject. Such persons avoid using detailed investigations and sophisticated techniques which require both time and patience on the part of marketing researchers.

- Third, there is an absence of a meaningful dialogue between the marketing management and the marketing research team.[3] As a result, marketing researchers get divorced from the main stream of marketing. This denies them any opportunity to test their findings in the practical marketing situation. Marketing researchers tend to think that "research is the be all and end all." This attitude further reduces the utility of research to the management.
- Fourth, marketing research is not an exact science. There are several imponderables which come in the way of getting accurate results. For example, consumer behaviour is an area which is rather elusive and the theory does not go very far in disclosing it very precisely. Analytical tools of marketing research are still deficient and cannot give us a precise idea, especially on the behavioural aspects.
  - ⇒ Apart from these limitations of marketing research, one finds that it is sometimes *mis-used*. These mis-applications, strictly speaking, are not the limitations of the subject as such.
  - ⇒ A major misuse of marketing research is found when one uses it to support or substantiate his viewpoint or position. In such a case, objectivity, which is the soul of research, is non-existent. To collect data and to interpret them deliberately to prove or disprove a certain point does not qualify as legitimate research.
  - ⇒ Another misuse of marketing research is found in deliberately delaying decision-making. In the hands of vested interests, it may be used to avoid taking a certain decision or delaying it until the findings of marketing research are available.
  - ⇒ Finally, it is used to grab power and authority in an organisation. Executives who are over-ambitious may use marketing research to consolidate and strengthen their position in the organisation as also to extend their authority over their colleagues.

THREATS TO MARKETING RESEARCH

The success of marketing research depends upon the cooperation of the public. Unprofessional or unethical marketing research practices may seriously jeopardise the public's willingness to cooperate in surveys.[4] It is, therefore, necessary to ascertain the reaction of the public towards marketing research. George Day,[5] who looked into this issue, identified three major threats to marketing and survey research: (1) excessive interviewing, (2) lack of consideration and abuse of respondents, and (3) the use of marketing research as a sales ploy. It may be noted that these factors pose a threat to marketing research particularly in western countries, where it is far more developed. In a country like India, marketing research is still used infrequently and as such these threats are almost non-existent. However, we shall briefly look into these issues. McDaniel, Verille and Madden[6] carried

[3] This aspect will be discussed in greater detail in Chapter 2.

[4] McDaniel, Stephen W., Perry Verille and Charles S. Madden, "The Threats of Marketing Research: An Empirical Reappraisal" in *Journal of Marketing Research*, Vol. 22, February 1985, p. 74.

[5] Day George, S., "The Threats to Marketing Research" in *Journal of Marketing Research*, Vol.12, November 1975, pp. 462–67.

[6] McDaniel, Stephen W., Perry Verille, and Charles S. Madden, *op. cit*., pp. 462–67.

out an empirical reappraisal of these threats. They reported the results from five cross-sectional studies conducted at two-year intervals during 1974—82. The scope of the present study does not allow us to go into details of these surveys. We will, therefore mention only the major findings of the study.

Of the three areas investigated–excessive interviewing, lack of consideration and abuse of respondents, and the use of marketing research as a sales ploy–it was found that the third one is perhaps the greatest threat. If not checked, it is likely to erode the trust of consumer respondents. The interest of marketing research will suffer if it is used to camouflage sales calls. Respondents will be suspicious of interviewers and will not like to cooperate in legitimate research.

McDaniel, Verille and Madden have expressed their concern over the fact that 40 per cent of the college educated, middle upper income respondents and more than half of the respondents living in the western region of the United States have experienced marketing research as a sales ploy. They feel that this may jeopardise genuine marketing research, particularly as these people may be opinion leaders on account of their better education and affluence.

Although the study did not find the other two areas as serious threats to marketing research there is a potential danger in these fields. As a respondent's cooperation is vitally important in marketing research, its depletion will adversely affect the interest of marketing researchers. Accordingly, they recommended that both excessive interviewing and lack of consideration, and abuse of respondents be avoided.

This could be done by screening questions so that persons who have been interviewed recently or too frequently can be eliminated. Also, it is advisable to use non-interviewing research techniques wherever possible so that the need to approach respondents is minimised.

MARKETING INFORMATION SYSTEM

Marketing Research is to be distinguished from Marketing Information System (MIS). The latter has been define as:

> A structured, interacting complex of persons, machines, and procedures designed to generate an orderly flow of pertinent information, collected from both intra- and extra-firm sources, for use as the basis for decision-making in specified areas of marketing management.

This definition indicates the interdependent activities associated with the collection of marketing information, both from internal and external sources. It also shows that such information is collected to facilitate decision-making in different areas of marketing management. We have seen earlier that marketing research is a means of obtaining information to be used in making marketing decisions. **A comparison of the two concepts shows that while marketing research generates information, marketing information system concentrates on the storage and flow of information to marketing managers.** This clearly shows that marketing information system is a much wider concept than marketing research.

A good marketing information system should determine the information needs of the organisation and generate and process such information on a continuing basis. It should also provide for its storage so that it can be used when requred.

It seems worthwhile to specify some of the contrasting characteristics of marketing research and a marketing information system. These are given in Table 1.1.

Table 1.1 Contrasting Characteristics of Marketing Research and a Marketing Information System

Marketing Research	Marketing Information System
1. Emphasis is on handling external information	1. Handles both internal and external data
2. Concerned with solving problems	2. Concerned with preventing as well as solving problems
3. Operates in a fragmented intermittent fashion—on a project-to-project basis	3. Operates continuously—is a system
4. Tends to focus on past information	4. Tends to be future-oriented
5. One source of information input for a marketing information system	5. Includes other sub-systems, besides marketing research

Source: Stanton William J., *Fundamentals of Marketing*, Tokyo, McGraw-Hill Kogakusha Ltd. 1978, p. 45. Reprinted with permission of McGraw-Hill Book Company, New York.

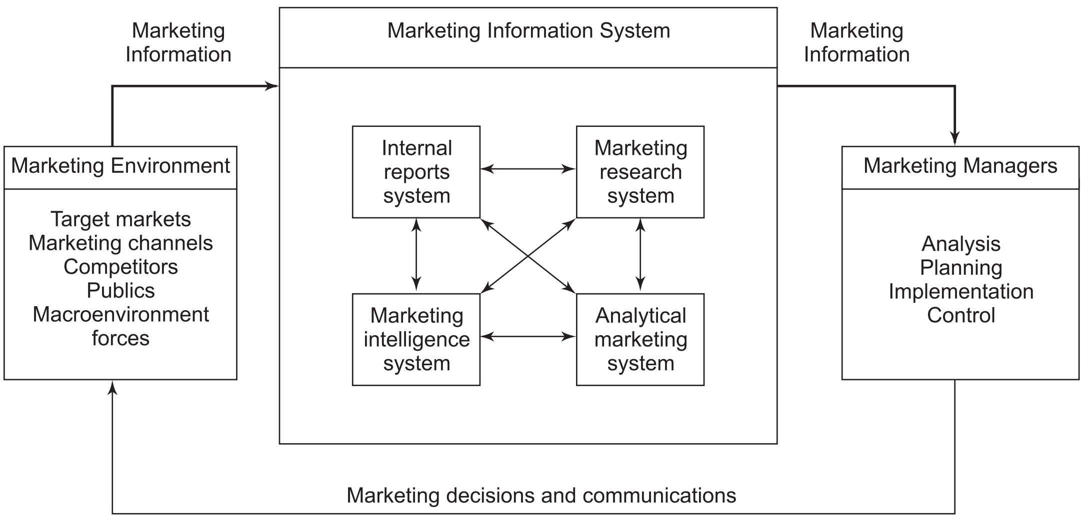

Fig. 1.1 The Marketing Information System

Source: Philip Kotler, *Marketing Management: Analysis, Planning, and Control.* 5th ed. (Englewood Cliffs, N.J.: Prentice-Hall, 1984), p. 189.

Figure 1.1 shows the marketing information system (MIS). As can be seen from this Figure, MIS has four sub-systems of which marketing research (MR) is one. Further, each sub-system is linked with the other three and the flow of information is both ways.

The box on the left side of Figure 1.1 shows marketing environment which marketing managers must understand and analyse from time to time. This is concerned with target markets, marketing channels, competitors, publics and macro-environmental forces. The information emanating from these factors is picked up by the company by one of four subsystems making up MIS. From these subsystems, the information eventually flows to concerned marketing managers as shown on the right side of Figure 1.1 The information thus received is analysed by marketing managers so that the marketing activity of the firm can be properly planned and implemented.

Internal Reports System

An internal reports system is maintained by every business firm. Such a system provides data on sales, costs, inventories, cash flows, and accounts receivable and payable, etc. to management. Many firms maintain a computer-aided internal reports system.

In order to make the internal reports system useful and effective, a firm should seek the opinion of its managers as to what information and in what form it should be maintained. Since managers would be frequently using the information contained in the internal reports, their requirements and suggestions must be sought.

Marketing Intelligence System

A marketing intelligence system provides marketing managers their day-to-day information pertaining to the external marketing environment. In fact, marketing managers themselves generate marketing intelligence, by reading newspapers and business magazines. The marketing intelligence received from managers, can be further improved by the firm by taking certain steps. For example, a firm can motivate its distributors and retailers to pass on important marketing intelligence. In advanced countries, a firm can supplement this sub-system by purchasing information from well-established outside agencies.

Marketing Research System

A firm at times needs to undertake a specific study on a certain problem/situation so that it can take the right decision. In such cases, managers cannot wait for information that comes in parts at different times. In such situations, marketing research is frequently resorted to. Marketing research as defined by the American Marketing Association has been given earlier in this chapter. To reiterate briefly, collection, analysis and interpretation of data and findings on a specific marketing situation or problem faced by a firm.

Analytical Marketing System

The analytical marketing system consists of two sets of tools. The first tool is the statistical bank. It has a number of advanced statistical procedures for ascertaining the relationships within a set of data.The second tool is the model bank. It has those models which are helpful to marketing managers in having a better understanding of the given problem. This, in turn, facilitates them in decision making.

MARKETING DECISION SUPPORT SYSTEM

Closely related to the marketing information system is the marketing decision support system (MDSS). On account of the highly competitive environment especially in Western countries, marketing managers frequently find themselves seeking a wide range of information in order to take the right decision. This means that the marketing manager should not only be concerned with the availability of the requisite information but also with its accuracy and adequacy. It paves the way for the creation of a marketing decision support system (MDSS). Such a system comprises collection, storage, analysis and reporting of marketing data. The introduction of computers has facilitated the setting up of MDSS.

The main difference between MIS and MDSS is that whereas the former is centralised, the latter is decentralised and allows marketing managers to interact directly with the database.

MDSS can be classified into five components: (i) data sources, (ii) data management, (iii) display, (iv) statistical analysis, and (v) modelling. Data sources are a major component of MDSS. These sources can be both internal and external. *For example*, a company's accounting system is an internal data source. This source provides data pertaining to orders, sales, inventory levels, receivables and payables. Library sources as well as syndicate service are the examples of external data source. Library sources contain a wide range of information such as government publications, reports, periodicals, etc. Likewise, syndicate service provides data of various types. These data may relate to consumer sales, buyer profiles, sales of retail outlets, evaluation of advertising campaigns, major economic, social and demographic trends, etc. Both library sources and syndicate service can be immensely useful to the company.

In view of a variety of internal and external data sources, it becomes necessary for the company to devise a proper database management. This involves identifying data from a variety of sources, deciding on the extent of data and keeping the data in an easily available form.

Data formats allow the retrieval of data easily and promptly. Display formats could range from simple ad hoc retrieval to more formal displays. A company may have a graphic display package consisting of such options as time-series plots, bar and pie charts, scatter diagrams where comparison of two measures is involved.

Statistical analysis involves the performance of different statistical operations such as calculation of averages, standard deviation and regression. Such calculations are helpful in understanding the relationship among marketing variables. This, in turn, brings out the underlying marketing issues in sharp focus.

Modelling is the last component of MDSS. Models are mathematical formulations. Marketing decision can be tested against the model to ascertain what could be the possible outcome in a given situation.

With this background of some basic concepts, we now briefly discuss the status of marketing research industry in India.

STATUS OF MARKETING RESEARCH INDUSTRY IN INDIA

Despite increase in marketing research activity in India, there are some inherent constraints in its use. As such it is necessary first to know what these constraints are.

Constraints in Using Marketing Research

1. A major constraint is on account of the heterogeneity of the country with the vast geographical area. Added to this is the language problem. So many languages are spoken in the country that a nation-wide survey using the questionnaire method becomes extremely difficult. In addition, this method becomes quite expensive.
2. Another problem in the use of marketing research is the non-availability of relevant secondary data. On account of this, sampling frames, on the basis of which samples are to be drawn, are usually incomplete and inadequate. For example, take the case of voters' lists. These are seldom complete and a number of complaints are received regarding the omission of a large number of voters. Thus, a voters' list cannot serve the purpose of a proper sampling frame.

3. Many business firms believe that marketing research is too expensive. They are, therefore, quite indifferent to the use of marketing research. It may be emphasized that this is not always so. Some problems can be taken up for research within a limited budget. Where a comprehensive field survey is involved covering far-flung areas of the country, such study would be prohibitively expensive.
4. At times, the relationship between the researchers and management may also act as a constraint. This may happen in those business firms where management and researchers do not understand and appreciate each other's viewpoint. This problem may be found more frequently in those firms which do not have professional management.
5. Many business firms in India think that marketing research is not necessary. They believe that experience of running the business, coupled with intuition on the part of the top management, can be helpful in solving the problem.

Marketing Research Agencies

On the basis of the foregoing brief discussion on constraints, one should not think that MR in India is negligible. Of course as compared to foreign countries it is much less. The major impetus to MR came on account of changing business environment.

Marketing research is undertaken both by companies and outside marketing research agencies or consultants. Large companies have their own marketing research departments which take up research as and when any problem is referred to them. However, this in-house marketing research is confined to the large companies. Most of the companies hire the services of a marketing research agency from amongst several such agencies operating in this field.

As regards marketing research agencies there are some leading agencies which have been doing studies on a wide variety of subjects. Their diversified themes include usage and attitude studies, brand image and positioning research, new product development research, advertising research, brand tracking research, product testing, simulated test marketing, market estimation and forecasting, market modeling, customized panel research, motivation research, life style research, concept evaluation, corporate image research, industrial market research, etc. The list is, no doubt, impressive. Further, it goes to the credit of these agencies that some of their studies were of a pioneering nature, involving the development of appropriate concepts as well as sampling and measurement techniques. They have a large field set-up, supported by full-time investigators in different parts of the country, having several years of professional experience.

A lot of software has been developed indigenously by these agencies. **Mary Goodyear**, chief executive, Marketing Behaviour Limited (MBL), one of the UK's top market research agencies, has observed that India has made impressive performance in marketing research which is at par with the west as far as technology is concerned. This is a major strength but it relates to quantitative research. The Indian MR industry is lacking in qualitative aspects — an area that would provide proper understanding of consumer behaviour with a focus on interpretation, leading to the adoption of a problem-solving approach.

With India becoming a part of the global market place, **Mary Goodyear** feels that Indian market researchers can draw a lot from the international experience. The increasing use of qualitative research will give greater importance to observational techniques. There is a need for developing more consumer-driven ways of collecting and analyzing data, something that is already happening in the developed countries on a fairly large scale.

Serious Thinking on the Present State of MR Industry*

Some serious thinking has begun in respect of the present state of the domestic MR industry. A number of questions are raised such as what ails the domestic MR industry? Why more and more companies are questioning the efficacy of MR reports and are cutting down their annual expenditure on MR?

It was to address these questions that Market Research Society of India organized its 16th Seminar on 'MR Works' in Mumbai some time back. Participants were drawn from the companies (MR users) as well as MR agencies (MR doers). Eminent persons who have devoted considerable time to MR and acquired rich and long experience participated.

On the basis of their discussion, some of the points that emerged in the seminar are briefly given below.

1. MR industry is now gradually emerging from problem-focused industry to solution-focused one. The client wants the solution soon after he poses a problem to the MR agency. In such a case, it is the MR agency which should have a good understanding and rapport with its clients.
2. MR agencies lack leadership today, which is of profound importance for their growth. The leadership must be convinced that the need of the present time is that MR agencies must understand the clients' need in proper perspective and deliver quality work. This alone will help improve their image.
3. Another issue for discussion was how to ensure that companies raise their expenditure on marketing research. This question becomes all the more important in the wake of good work done by MR agencies and yet client companies are spending less on MR. In order to resolve this problem, it was felt that MR agencies should be able to shift their emphasis from problem-focused to solution-focused approach.
4. Participants also took up for discussion the poor remuneration for the MR agencies. The emphasis was on emoluments for market research. The consensus was that good work needs good remuneration. The companies should realise that their expectation of good work is to be accompanied by good remuneration to MR agencies.

Concluding this very useful discussion, the moderator summed up as follows:

"The industry is all set for a journey filled with challenges and difficulties. There is a need to continue the good work that has been going on and the strong recommendation is to avoid going after perceptions. The better alternative, instead, is to have perception based on performance and there is not an iota of doubt that marketing research can grow into a robust business soon."

Issues in Marketing Research

The preceding section has highlighted the recent trends in marketing research in India. However, there are certain issues which should be sorted out to ensure further growth of marketing research. These are briefly described below.

First, the quality of any information collected through marketing research surveys will be considerably affected on account of lack of transparency in business. This problem can be overcome by having more and more professionalisation and institutionalisation of marketing research.

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* Based on PITCH, Vol. III, Issue 2, November 15 – December 15, 2005, pp. 22, 24 and 26.

Second, marketing research is frequently seen as a separate activity undertaken by professionals and is not linked with short or long term marketing strategies. It is advisable to involve operational staff in a company with marketing research activity. This will be advantageous to both professionals and operational staff and will make marketing research more useful to the business.

Third, a major issue at the institutional level is the allocation of budget to marketing research activity. Small firms may use marketing research at their discretion and that too on a modest scale. But large firms may have to use it more frequently and, as such, they may have to allocate adequate funds for it.

Fourth, marketing research has so far remained confined to the urban market. The marketing problems in the rural India are vast and complicated and have hardly been addressed. However, with the improved standard of living in rural areas, there will be a larger consumption of packaged goods and consumer durables. In view of this, marketing researchers have to think seriously as to how far their techniques can be applied to a rural setting. It is, no doubt, a challenge to professionals but it offers them a great opportunity as well.

Fifth, marketing research agencies should not merely have contextual familiarity with the projects as at present. They should be very well-informed about each sector such as telecom research, pharmaceutical research, etc. The emphasis should be on industry/sector specific research where more sophisticated techniques can be used.

Sixth, there is not yet adequate realization of the importance of marketing information system and marketing decision support system. In view of increasing competition in business, companies or marketing research agencies must have databases so that the requisite information can be retrieved without any delay.

Finally, as mentioned earlier, so far adequate attention has not been given to the study of consumer behaviour, which leads to qualitative research.

Necessary steps need be taken to overcome the hurdles caused by these issues. The MR industry must aim at quality performance to meet the requirements of its clients. This will considerably improve the image of MR industry.

Future Outlook

A number of far—reaching changes are taking place in the Indian economic environment, which will have considerable impact on the growth of MR industry. Let us briefly see what these changes are.

As a result of liberalization of economic policies of the Government, the Indian Market is now opened up to foreign companies. This has resulted in considerable increase in competition in a number of industries. Marketing research is now becoming an increasingly important ingredient of marketing and advertising strategy. As competition in the market place becomes more and more intense in the coming years, marketing research will expand across the Indian industry.

Further, rural India has reduced its dependence on agriculture. There has been a decline in the number of cultivators in the country. A little less than 50 percent of rural GDP is now from non-agricultural activities. As a result, a new kind of rural marketing is gradually emerging. This development, coupled with the exposure of rural population having high access to television, the gulf between the rural market and the urban market is getting narrowed down.

Another development that has been taking place over the past few years is organized retailing. It is expected that the proportion of organized retail in the total retail will grow at 5 to 6% annually. The increased share of retail market is on account of a large number of malls coming up. The number of malls is rapidly increasing. This trend is going to be further accelerated as global retailers are keen to enter the Indian market. This is because of two main factors, viz. availability of qualified manpower and the operational cost in India being much less than in foreign countries.

As a result of increasing urbanization of rural areas, people are also changing their attitude and pattern of life. With increasing popularity of TV, the Indian youth in particular is adopting a changed life style. This will boost the demand for new and sophisticated products.

The combined effect of all the above-mentioned factors will provide enough scope for marketing research activity. It is hoped that MR industry will generate a much larger income than at present. The future outlook of MR industry in India seems to be quite promising.

CHARACTERISTICS OF GOOD RESEARCH

Before we take up different aspects of marketing research in subsequent chapters, it is necessary for us to be clear about the characteristics of good research. If we ignore one or more of these characteristics while conducting research, our research would be of poor quality. The characteristics of good research are briefly described below.

Clarity of Purpose

The research should be clear about the purpose of the proposed research. The research problem should be formulated carefully, indicating its scope and limitations. Both the manager and the researcher should have the same understanding of the research problem and how they should proceed in different stages of the research.

Research Process

The research process should be properly planned. The researcher should ensure that significant procedural steps are taken care of. In their absence, it would not be possible to estimate the validity and reliability of data, which, in turn, will weaken the confidence of the reader in the research itself.

Selection of Proper Research Design

There are several research designs, out of which one is chosen. In some cases, a combination of two research designs may be used. However, the choice of a research design has to be based on the nature of the research problem. If a research design involves primary data collection, a proper method of sampling should be chosen. The main questions to be answered are: Whether probability sampling or non-probability sampling? Within the probability sampling, which specific design is to be used?

Data Collection

After having selected a research design, the researcher should take the necessary steps to collect data. He should exhaust all the sources of information already available on the research problem. In the case of primary data, a suitable questionnaire should be developed, Further, enumerators, who are assigned the job of data collection, should be trained so that reliability of data can be ensured.

Proper Analysis and Interpretation of Data

The method or methods of analysis used should be appropriate keeping in mind the nature of the problem and the purpose of the research study. Hypothesis should be carefully formulated and appropriate tests should be used for testing them. A detailed analysis should be undertaken so that a deeper insight into the research problem can be obtained.

Reporting the Results

The research report should be written in a simple and unambiguous language. It should be objective in the presentation of results. In case there are any limitations, then these should be specified. After reading the report, the reader should be convinced about the sincerity, objectivity and competence of the researcher.

Compliance with Ethical Standards

It is necessary to ensure that ethical standards or norms are followed through all the stages of the research process. At times, the researcher comes across a situation which creates an ethical dilemma. The dividing line between ethics and non-ethics becomes so blurred that it may lead to a wrong decision, that is, non-compliance with an ethical norm. The researcher has to be extremely vigilant in such cases. The compliance with ethical norms will improve the image of the research project as well as the entire research team.

Summary

This introductory chapter has dealt in the beginning with the concept of marketing research. This has been followed by the definition and the scope of marketing research. To highlight the importance of marketing research, some typical applications have been specified. This has been followed by limitations of, and threat to, marketing research. While comparing marketing research with marketing information system, it has been pointed out that the former is a narrower concept and only forms one of the inputs of the latter. This apart, the contrasting features of the two have been highlighted. The main difference between marketing information system (MIS) and marketing decision support system (MDSS) has been explained. Further, the status of marketing research industry and major issues in marketing research have been discussed. The chapter ends with a brief discussion on the characteristics of a good marketing research.

Key Terms and Concepts

Basic Research 1
Applied Research 1
Marketing Research 4
Marketing Information System 10
Internal Report System 11
Marketing Intelligence system 11
Marketing Research System 11
Analytical Marketing System 11
Marketing Decision Support System 12
Marketing Research Agencies 14
Good Research 17

Questions

1. What is “research”? What are the two broad categories in which it can be divided?
2. Distinguish between “problem-solving” and “problem-oriented” research.
3. What is “marketing research”?
4. Is marketing research a basic research or an applied research? Why?
5. Discuss the definition of marketing research as suggested by the *American Marketing Association*.
6. At times the term marketing research is used to mean consumer survey. Explain, why it is wrong to use the two terms as synonyms.
7. “Marketing research is undertaken to guide managers in the analysis of marketing problems.” Critically examine this statement.
8. How can marketing research benefit marketing management?
9. What is the scope of marketing research?
10. “Many a time management is not convinced about the utility of marketing research and regards it as an unnecessary activity over which no funds should be spent.” Comment.
11. “The field of marketing research is very large as it covers a wide variety of problems.” Elucidate.
12. Discuss the multi-disciplinary nature of marketing research.
13. What factors have contributed to the growth of marketing research in the western countries?
14. What are the major limitations of marketing research?
15. What are the major threats to marketing and survey research? Are these threats equally applicable in the case of India as in the Western countries?
16. What is marketing information system? How does it differ from marketing research?

17. What is marketing decision support system?
18. How is marketing decision support system beneficial to marketing research?
19. What are the major constraints in using marketing research in India?
20. Describe the present status of MR industry in India. What are the prospects of its growth in the near future?
21. "Good research generates dependable data that are derived by professionally conducted practices and can be used reliably for decision making." Elucidate this statement highlighting the characteristics of good research.

2 Marketing Research Management

Learning Objectives

After reading this chapter, you should be able to understand :

- The importance of Research Management
- The qualities that a Marketing Research Manager should have
- How marketing research function can be organised
- The main tools for effective marketing research function
- The probable areas of conflict between marketing research and marketing management
- How to improve the relationship between top management and marketing research

With the increasing use of marketing research these days, it is being realized that it is a complex task and has to be properly managed if optimum results are to be obtained. Accordingly, the management of marketing research, which forms the subject matter of this chapter, has assumed considerable importance nowadays.

At the outset, the question arises as to what do we understand by research management. Blankenship and Doyle[11] provide a very lucid answer to this question:

> Research management concentrates on direction and administration of the processes, projects, personnel, finances, and agencies engaged in research. Its duties include seeing that the research design is right for the task and that the study is carried out properly. It sees to it that the presentation of results to management is handled properly and that all these activities are administered within a controlled budget. It means that proper research organisation has to be set up to handle individual projects and task.

It will be seen that research management includes a host of interrelated activities. Thus, the types of research projects to be undertaken, the selection of research personnel, financing of research manager has to be concerned. He has to ensure that a suitable research design is developed and

[1] Blankenship, A.B. and J.B. Doyle, *Marketing Research Management*, Bombay, D.B. Taraporewala Sons and Co. Pvt. Ltd. 1971 (First Indian Reprint), pp. 1–2. Reprinted with permission from D.B. Taraporewala Sons and Co. Pvt. Ltd.

that the study is carried out on the right lines, according to a predetermined schedule and within the budget allocated for the purpose. As these activities are interrelated, if any one of them is not conducted properly, it will have an adverse impact on the other. *For example*, if a research project is not conducted according to the time schedule laid down earlier, it will increase the cost and make it impossible to complete the project within the allocated funds.

IMPORTANCE OF RESEARCH MANAGEMENT

Just as the marketing concept is useful in attaining the objective of integrated marketing, research management is relevant for making marketing research really useful. By superior management, various disjointed research techniques can be pulled together and coordinated so that marketing research can be made really effective. As Blankenship and Doyle rightly observe:

The marketing manager who understands only techniques will be a failure; so will the research manager who understands only techniques. Each must understand how to put together all the efforts falling within his sphere of responsibility. No longer is marketing research an isolated, ivory-tower operation. It is an integrated whole, making a major contribution to marketing in its own right.[2]

From improved marketing research management, a firm can enjoy **two major advantages**. These are: (i) marketing research will be more helpful to marketing management in decision-making, and (ii) marketing research can be conducted more economically and more effectively.

QUALITIES OF A MARKETING RESEARCH MANAGER

The success of marketing research management depends to a large extent on the quality of leadership. A research manager must have some special qualities if he is to do justice to his assignment. To begin with, he must be innovative and always be prepared to look at any problem from a fresh perspective. He must be confident of his skill and knowledge and prepared not only to accept new ideas but also to try them out. He should be well-informed and up-to-date in his own area of specialisation. In addition, he should be familiar with recent developments in particular industries, especially the problems faced by them in the marketing of their products. He should also be familiar with the recent trends in research techniques and should be prepared to absorb the latest knowledge as mush as possible. Without such an outlook, a research manager will not be able to inspire his team and offer the leadership that is expected of him. Finally, he should have considerable selling skill so that he can convince the management regarding the accuracy and soundness of the recommendations emerging from his research.

One of the most crucial decisions to be taken by management is whether marketing research should be undertaken and if so, what place is to be assigned to this function.[3] This is an administrative decision which calls for a clear perspective on the part of top management. Even when a decision is taken in favour of the marketing research function, a related issue is what budget allocations are to be made to carry out marketing research efficiently. Also, the organisation of marketing research activity has to be considered so that management gets the maximum benefit from it. These are some of the main issues which must be given due consideration by the management. Some of these issues are discussed here briefly.

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[2] Blankenship, A.B. and J.B. Doyle, *op cit.*, p. 17. Reprinted with permission from D.B. Taraporewala Sons and Co. Pvt. Ltd.

[3] This issue will be discussed in Chapter 3.

ORGANISING MARKETING RESEARCH FUNCTION

First of all, the question arises as to how the marketing research function is to be organised within a firm. It should be noted that the organisational structure for this function will differ according to the type of agency which is handling it. Thus, a marketing research organisation in a manufacturing firm will be very different from that in a research or a consultancy firm, as the requirements and emphasis on research will be different. A major difference between a manufacturing firm and a research firm is that whereas in the former, research being one of the several activities is a means to an end, in the latter, research is the only activity and is an end in itself. The research firm has to ensure that research must ultimately lead to profit otherwise it cannot survive. In contrast, a manufacturing firm does not aim at profit although it would expect that research will indirectly lead to increased profitability.

Another point of difference between the two organisations is the degree of emphasis on the practical utility of marketing research. A manufacturer's firm would normally place greater emphasis on the marketing research findings in the day-to-day marketing of its products. But this need not be the case in a research firm as it is not engaged in marketing of any products.

Coming to the organisation of research activity, several alternatives are open to a firm. *For example*, there could be a marketing research department or cell with a skeleton staff if the marketing research activity is not very important. Alternatively, the firm may have a well-developed department comprising a number of specialists as also the other supporting staff. These are the two extremes within which the marketing research organisation would vary. The specific organisation will depend on the requirement of each firm. It is worth emphasising that a firm, intending to set up an organisation to look after marketing research function, may not be in a position to set up the most suitable one in the very first attempt. As its management acquires experience in managing the research function, it goes on making improvements in its organisation. In course of time, such an approach will enable the firm to develop the most suitable organisation to manage its research function.

A firm which has decided to introduce a marketing research function has to decide which of the three options that are normally available, should be selected: (i) to set up a formalised marketing research department consisting of some full-time specialists whose main responsibility would be to carry out marketing research studies and report the findings to the management, (ii) to assign the marketing research responsibility to one or more line or staff executives on a part-time basis, who would have to undertake it in addition to the major responsibility in some other sphere, and (iii) to assign the responsibility of undertaking marketing research to an outside individual or an organisation.[4] There are marketing research consultants who do research on behalf of the firm and are paid their consultancy fees for the same. Small firms prefer to adopt the second or third approach whereas medium and large-sized firms, which may have frequent marketing problems, prefer the first one. The latter would also involve the maximum financial commitment.

In some firms, where a separate marketing information system exists, the marketing research function may form a part of such a system. In such cases, marketing research acts as one of the inputs to the marketing information system. Wherever marketing research is undertaken frequently,

[4] Crisp, Richard D., "Organisation of the Marketing Research Function" in *Handbook of Marketing Research*, New York, McGraw-Hill Book Company, 1973, pp. 1–63.

it is desirable to formalise this function and to integrate it not only with marketing activity but with the overall management of the organisation.

A point which is worth mentioning is that if the firm has decided to have a separate marketing research department, then sufficient freedom should be given to the latter to carry out its tasks. Many a time the departments are set up with high hopes and expectations but are not given the necessary finances and freedom. As a result, they are unable to do much for their firms. Marketing research departments should be encouraged to develop, carry out and analyse their research as they deem fit. The top management must delegate necessary authority to the research personnel to enable them to carry out their work smoothly.

Another aspect that is relevant is whether a large firm should have a centralized marketing research department or whether alternatively each division or operating unit should have its own. The main advantage of the centralised marketing research department is that there will be more effective coordination of marketing research with marketing management. Also, effective control and supervision of research can be ensured. On the other hand, if marketing research is undertaken by each division or operating unit, it will enable researchers to be more knowledgeable about divisional markets and their problems. In addition, such an approach will offer greater autonomy to divisions and operating units in their research activity which will ultimately be beneficial to the firm.

Both these approaches are in vogue and it is difficult to say which is more popular. In this context, it is pertinent to note that the organisation of marketing research function need not remain static for all time to come. It should be dynamic and flexible so that it can be adapted to the changing requirements of the firm.

If a company has decided to set up a separate marketing research department, it is very essential that it should be clear about its role in the overall organisation. The marketing research department should take up problems faced by the company, study them objectively and report its findings to the management. It should develop a plan, without which it will lack focus and utility to the management. Like any other plan, the key elements of a marketing research plan are the same, namely, objectives, policies, specific projects, resources required both in terms of manpower and budget and a time schedule for research projects. In identifying research projects, it is expected that clear priorities are laid down on the basis of which they can be taken up for investigation. These priorities should be matched by proper allocation of funds and manpower.

The marketing research plan should be written out in sufficient detail. Before it is finalised, it should be circulated amongst the concerned officials in the company. It should fit into the marketing plan of the company as it is an important input in it. Although it should be followed and implemented as for as possible, there should be an element of flexibility in it so that certain changes, if found necessary, can be made.

Buying Marketing Research

Many a time, companies do not set up marketing research departments as they do not have adequate amount of research work to warrant a separate department. They prefer to hire the services of a marketing research consultant as and when they feel the need for research. Especially in a country like India, the number of companies having their own marketing research departments is extremely limited. Many 'buy' marketing research from outside. Such companies should know how to select a marketing research agency before sponsoring a research study. A list of marketing research agnencies is given in the appendix to this chapter.

Choice of Research Agency

Why hire marketing research? First, if a firm does not have persons well-versed in research techniques, it has no choice but to hire the services of a marketing research agency. Secondly, even when a firm has a separate marketing research department or cell, it may find at a particular point of time that it is fully engaged on certain other studies and, as such, it cannot take up an additional problem, for detailed investigation. In that case too, it has to assign the study to an outside marketing research agency. Thirdly, the firm may find that an outside agency may complete the study faster, at a lower cost as well as with the utmost objectivity. As such it may decide to assign its study to an outside agency. A selection can be made from entities such as marketing research consultancy firms, advertising agencies, suppliers of syndicated services, etc.

The next question to be considered is that how does the firm go about choosing an outside marketing research agency. In developed countries, there are a large number of such agencies which either undertake complete ad hoc research projects or perform one or more specialised services such as drawing a proper sample of respondents, interviewing respondents, or processing data. In all those cases where it is necessary to hire outside research agencies, the marketing researcher must be able to evaluate such specialised services. On what criteria should he evaluate specialised agencies?

Considerations for Hiring Outside Agencies

Technical Expertise

The marketing researcher should know who is to undertake the study and what is his proficiency in marketing research. The client firm may find that a research agency is good at basic studies but is not competent enough to undertake complex studies. Some research agencies are poorly staffed and as such they should be avoided.

Objectivity

The question of objectivity is very important. Outside agencies should be reputable for their objective approach in research projects.

Confidentiality

The client firm must ensure that the research agency maintains strict confidentiality regarding the project.

Economic Factors

A client firm may invite research proposals from more than one agency. In such a case, it would choose the most economical agency. However, client firms should not overlook the fact that some agencies are very economical because the quality of their work is rather poor. It is not advisable to economise at the cost of quality.

Timely Submission of Reports

The client firm should enquire about the reputation of the research agency especially in relation to its timely submission of reports. Sometimes, outside agencies are quick in taking up assignments from clients but are not so prompt in carrying out the task.

Experience of the Supplier

The client firm should ascertain the standing of the agency. While general experience is very important, relevant and specific research experience is what should be looked for.

Reputation of the Agency

It is necessary to ensure that the agency has a good reputation. This consideration is important for lending credibility to the research findings. This is of special importance particularly when the client firm intends to use the study for creating an impact.

Since no single agency is likely to be strong on all these considerations, it is necessary that the client firm adopt a reasonable approach in this regard. It should ascertain which of the above criteria are crucial for its research project and then apply these criteria in selecting an agency from amongst those short-listed. In order to facilitate comparison amongst the agencies, the client firm should send the same study specifications to all of them for gathering research proposals and cost estimates.

In India, there are some organisations that take up research studies on behalf of their clients.A complete list of such organisations, the nature of research usually undertaken by them along with their strengths and limitations, is not yet available. Here, we are mainly concerned with ad hoc research projects undertaken by research agencies at the instance of their clients. It may, however, be mentioned that some of these organisations are well established and have been engaged in syndicated research and related spheres of activity for the past several years. They have professionally qualified staff, and they undertake sponsored research on widely diversified themes.

An illustrative list of the customised research services offered by a leading research agency in India is as follows:

Consumer Research	Qualitative Research
• Usage and attitude studies	• Motivation research
• Brand image and positioning research	• Lifestyle research
• New product development research	• Concept evaluation
• Advertising research	• Corporate image research
• Brand tracking studies	• Strategic research
• Product testing	
• Simulated test marketing	
• Market estimation and forecasting	
• Market modelling	
• Customised panel research	

The list is impressive as it shows a wide variety of research activities. Besides these two areas—consumer research and qualitative research, this research agency handles ad hoc research projects in other areas such as financial research, travel and tourism research, medical marketing research and social research. In a typical year it handles more than 400 widely diversified projects.

Another leading marketing research agency offers to undertake client-specific services in the following ares:

• Behaviour and attitude reseach • Product and packaging studies • Test marketing studies • Corporate image studies	• Campaign evaluaton • Media studies • Opinion surveys • Industrial market research

It may be mentioned that in India, marketing research is still not well developed and there are only a few large marketing research agencies in the country. However, some of the studies carried out by these agencies were of pioneering nature, involving the development of appropriate concepts as well as sampling and measurement techniques. They have a large field set-up supported by full-time investigators in different parts of the country having several years of professional expertise.

A company intending to buy marketing research may adopt one of the two courses. First, it may straightaway ask a marketing research agency to prepare a research proposal including an estimate of cost. Second, it may give some thought to its problem, spell it out and provide certain specifications according to which the concerned agency has to carry out the research. In this case the company will pay the agency its fees for carrying out the task as per its specifications.

Advantages of Research Proposals

There are some advantages[5] of getting a research proposal from an outside consulting firm. First, there is fresh thinking on the marketing problem referred to by the company. This is because the outsider's approach is not subject to any constraints which may be applicable within company. Second, it enables the company to evaluate the research capability of the consulting firm and its dependability. When the company invites research proposals from more than one consulting firm, it can compare them in respect of the nature and extent of work involved, the quality of proposals, cost and time. This comparison will enable it to choose the most appropriate proposal. Third, a research proposal is always desirable as it offers some sort of a commitment from the consultant to the company. In its absence, there may arise some misunderstanding and differences between the two parties regarding the specifications, time or price. Finally, the research proposal, once approved by the company, becomes a contract, binding both the parties. The company can then turn to other problems, since it is sure that the research will be taken care of by the consulting firm.

Contents of the Research Proposal

At this stage, it may be worthwhile to know the contents of a research proposal. While the style and format will differ from one consulting firm to another, the research proposal should invariably deal with some important aspects of research. To begin with, a research proposal should give some background of the problem, indicating the manner in which it is to be investigated. Then a clear statement of the problem, needs to be given. Needless to say, utmost clarity is required in defining the problem. The research proposal should specify the research methods to be used in the study.

[5] Based on Blankenship, A.B. and Raymond P. Barker, "The Buyer's Side of Marketing Research" in *Business Horizon*, August 1973, pp. 73–80.

This part should contain information on the sample design and the sample size, the designing of the questionnaire, data collection procedure, and the processing and analyses of data. This is the most important part of a research proposal. The proposal should then indicate the form and content of the final research report. It should also indicate if the consulting firm will make a personal presentation of research findings. Finally, the proposal should indicate the time needed to carry out the task and also the cost. It is desirable that a broad time schedule covering major research operations be given. The consulting firm should also state the assumptions on which cost and time estimates have been worked out. A statement of this type will help avoid any misunderstandings that might otherwise arise.

After getting a research proposal from a consulting firm, the company has to look into it very carefully in order to decide whether it is to be approved. It should examine in particular, the soundness of the proposal and ascertain whether the estimates of time and cost are acceptable. At times, it may have to seek some clarification on a certain aspect of the proposal. In such cases, personal discussion between the parties may be desirable. The consulting firm may be required to submit a revised proposal embodying the points emerging from the discussion.

When the company is satisfied with the research proposal as well as the estimates of time and cost of the study, it should convey its acceptance in writing to the consulting firm and authorise it to conduct the research. Such an authorisation makes the research proposal an accepted contract between the company and the consulting firm.

Finally, it may be mentioned that the highest quality of research is not always necessary. High quality work is usually obtained at a high cost and if the company intending to buy research is unable to afford it, it may trade-off between quality and cost and eventually go in for relatively cheap and less qualitative research work.

EVALUATION AND CONTROL OF MARKETING RESEARCH

Myers and Samli[6] mention that while much has been written about the objectives and techniques of marketing research, almost no emphasis has been laid on its evaluation and control. The need for evaluation and control in marketing research is found at two levels: (i) the individual project, and (ii) the total research activity within a firm. In respect of individual research projects, the management should determine what exactly is to be done and keep track of it on a weekly, fortnightly or a monthly basis. Management can use certain tools to evaluate and control research projects. Myers and Samli have explained these at length. They are briefly described below:

Check List

To begin with, a check list, which is a versatile and a useful tool, can be used. It can be short or long, consisting of a few or many questions, depending on the actual requirement of management. The list should contain specific questions on the objectives of project and its research design. It serves as a reminder for the types of problems that are likely to come up during the course of the project and helps in resolving them.

[6] Myers, James H. and Coskun Samli, "Management Control of Marketing Research" in *Journal of Marketing Research*, Vol. 12, August 1969, pp. 267–77.

Flow Chart

Another tool is the logical flow chart which indicates the sequence of a research project covering various activities. *For example*, library research, collection of data, analysis of data, and so on. Such a flow chart enables management to maintain an overall control over the project. One major limitation of this tool is that it does not give the time dimension for the total activity.

Gnatt Chart

A Gnatt chart is used in order to provide a time dimension for controlling marketing research. Such a chart enables the management to develop an overall research schedule by allocating a time period to each component of research. It is very helpful to the management in controlling the total research activity.

PERT Technique

Finally, the Programme Evaluation and Review Technique (PERT) can be used. Although PERT has been used in administrative and production problems, hardly any application in marketing research is available. It can however be used effectively in this field as well, especially when the project is neither a routine nor a small one. It is a probabilistic scheduling approach. Usually three time estimates—optimistic, most likely, and pessimistic—are used.

Advisory Committee

As regards control of the total research activity, it is necessary to set up meaningful control procedures. An advisory committee, comprising representatives from all functions served by marketing research, is probably the most effective way of evaluating and controlling the total marketing research activity. Its main task is to provide a broad direction to the marketing research programme so that it is problem-oriented and useful to the company. However, it does not discuss research techniques nor does it review the studies done. It is not an executive committee to which the marketing researcher reports.

Marketing Research Audit

Another method is the marketing research audit. Several years ago, Sessions[7] proposed the need for such an audit. According to him, a marketing audit should provide an objective basis for answering three key questions: (i) Is the research programme in tune with the character of the company as well as its need? (ii) How can the administration of research be made to set the pace for operating efficiency? (iii) Is the research staff sufficiently in touch with the realm of ideas which determine sales growth and future market position for the company?

In order to make marketing research audit effective, it must be undertaken as the joint responsibility of the research group and of all departments having a direct interest in the use of marketing

[7] Sessions, Robert E., "A Management Audit of Marketing Research" in *Journal of Marketing*, January 1960, pp. 563–78.

research. The audit study should have four distinct stages: (a) qualifying the company, (b) establishing benchmarks for analysis, (c) auditing of internal research operations, and (d) preparing an audit report.

In the first stage, auditors should develop a clear idea of the company's position in the industry, the organisation of its marketing activities and its emphasis on sales or production. The second step involves the setting up of standards to which the marketing research staff should conform. The third stage involves the audit of marketing research operations against the standards set earlier. Finally, the audit report covering (1) a critical evaluation of the existing research programmes, (2) an appraisal of the research needs, and (3) the programme and organisation recommended for installation, should be prepared and submitted. The management audit of marketing research could be done either by the company's own personnel under the direction of top management or by an outside consulting firm.

Budget Control

Another important control device is the budget. It may be emphasised that budget is an important constraint not only for individual research projects but also for the research activity as a whole.

There are various ways by which budget allocations to the marketing research function can be decided. A rough and ready measure is to spend a certain specified percentage of the total sales on marketing research. This percentage may be based on the prevailing average for firms of the same size in the same industry. Another method is that each department or functional area decides its budget on the basis of its own marketing research requirements. Yet another approach is that budget allocation is made on an ad hoc basis, keeping in mind the requirements of a particular task. An approach of this type is based on specific tasks and as such it becomes difficult to arrive at an overall budget allocation. Thus, the latter approach is in a way fragmentary and does not enable the management to have an overall long-term perspective of the marketing research function.

Whatever may be the approach adopted for budget allocation, one thing must be made clear. A certain minimum budget must be available and there should not be any uncertainty and misunderstanding among researchers in this regard. This is very necessary if marketing research is to be both effective and efficient. The budget should invariably provide for some exploratory research so that specific research, if necessary, can be undertaken later. In view of financial constraints, it may be necessary to lay down priorities among research projects.

At this stage, it will be interesting to know the results of a survey undertaken by Twedt[8] who wanted to analyse the current practices in the areas of authorisation, control and evaluation of marketing research projects. A 7-question open-ended questionnaire was addressed to 593 marketing research department heads in the United States. Of these, 265 usable replies were received. The data revealed that there was relatively less reliance on systematic methods of internal communication, control and information retrieval. Another finding was that a majority of the department heads had no formal system for evaluating the marketing research projects. Needless to say, if the productivity of marketing research projects is to be increased, it is necessary to establish a systematic and formal evaluation and control system within the company.

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[8] Twedt, Dik, "Authorisation, Control and Evaluation of Marketing Research Projects" in *Journal of Marketing Research*, Vol. 12, February 1975, pp. 86–92.

MARKETING RESEARCH AND MARKETING MANAGEMENT

A point that needs to be emphasised is that management of marketing research can be effective and successful only when there is coordination between research and management. Both of them should have a good understanding and appreciation of each other's role. However, in practice one finds that on many occasions there are differences of opinion and discord between the research department and the management. In this context, it will be worthwhile to study some of the major areas of conflict between them.

Keane, John G[9] has spelt out the conflicting points of view of the top management and marketing researchers in the areas of research responsibility, research personnel, budget, assignments, problem definition, research reporting and use of research. These viewpoints are given in Table 2.1.

Table 2.1 Probable Areas of Top Management—Marketing Research Conflict

Top management position	Area	Marketing research position
• MR lacks sense of accountability	Research	• Responsibility should be explicitly defined and consistently followed
• Sole MR function is an information provider	Responsibility	• Desire decision-making involvement with TM
• Generally poor communicators	Research	• TM is anti-intellectual
• Lacks enthusiasm, salesmanship and imagination	Personnel	• Researchers should be hired, judged and compensated on research capabilities
• Research costs too much	Budget	• "You get what you pay for" defence
• Since MR's contribution is difficult to measure, budget cuts are relatively defensible		• Needs to be continuing, long-range TM commitment
• Tend to be over-engineered	Assignments	• Too many non-researchable requests
• Not executed with the proper sense of urgency		• Too many "fire-fighting" requests
• Exhibit ritualized, staid approach		• Insufficient time and money allocated
• MR best equipped to do this	Problem	• TM generally unsympathetic to this widespread problem
• General direction sufficient… MR must appreciate and respond	Definition	• Not given all the relevant facts
• Can't help changing circumstances		• Changed after research is under way
• Characterised as dull with too much researchers and qualifiers	Research	• TM treats superficially

Contd.

[9] Keane, John G., "Some Observations on Marketing Research in Top Management Decision-Making" in *Journal of Marketing*, Vol. 33, October 1969, pp. 10–15.

Top management position	Area	Marketing research position
• Not decision-oriented	Reporting	• Good research demands through reporting and documentation
• Too often reported after the fact		• Insufficient lead-time given
• Free to use as it pleases… MR should't question	Use of Research	• TM use to support a pre-determined position
• Changes in need and timing of research are sometimes unavoidable		• Isn't used after requested and conducted… wasteful
• MR deceived by not knowing all the facts		• Uses to confirm or excuse past actions

Source: *Ibid.*, p. 13. Reprinted with permission from the American Marketing Association.

In order to improve the inter-relationship between top management and marketing researchers, Keane[10] offers very useful suggestions which are briefly as follows:

Suggestions for Top Management

1. Top management should define research responsibilities. It should clearly specify the overall function of the research department, its limitations and its priorities. Also, the role of the research director should be spelt out.
2. Realistic research budgets should be established as well as periodically reviewed by the top management. It is necessary to associate the marketing research director in setting.
3. Top management should be objective while appraising the efforts of research. It should not allow itself to be led by its own notions and biases in this regard.
4. It is necessary to undertake a detailed periodical review of research in all its ramifications. Such a review should cover budgets, priorities in research projects, personnel, goals and policies, with a view to improving the marketing research function.
5. Management should emphasise high yielding research projects so that profitability through marketing research can be increased. Each research project should be questioned as to its current benefit and cost.
6. Management should ensure that none of its activities is against the ethical principles.
7. Finally, management should ensure that there are not too many layers between the top management and research. Too many layers would delay the flow of research findings to top management.

Suggestions for Marketing Research

1. Marketing researchers should make every effort to understand the thinking of top management. They should have a clear understanding of the plans and priorities of the company so that their own efforts may fit into the overall framework.

[10] *Ibid.*, pp. 10–15.

2. Marketing researchers should be decision-oriented and attach a sense of urgency to the preparation of their reports.
3. There should be a continuous effort on the part of marketing researchers to improve research methodology. They should combine communication skills, research skills and stimulate innovation in research methodology.
4. Often, there is a tendency to repeat the familiar approach as it is convenient, rather than to explore the best possible approach. This does not allow marketing researchers to be as imaginative as they should be. Obviously there is a need for more imagination in marketing research.
5. Marketing researchers should be on the look our for relevant research opportunities which may be highly beneficial to their company. They should keep themselves up-to-date in economic, demographic and other related fields.
6. Marketing researchers should ensure that their research at every stage is in conformity with the ethical principles.
7. Finally, marketing researchers should make every effort to achieve persuasive communication. Many a time, top management ignores research findings because of inadequate and poor communication. The research report should have a proper format, the methodology should be clearly explained and the findings well documented in a precise and a convincing manner.

If these suggestions are followed by the top management and marketing researchers, it will lead to an improved relationship between them, though genuine differences on certain issues may occasionally crop up. What is important is a broad and a positive outlook and a sincere effort on their part to understand and appreciate each other's viewpoint.

Summary

The chapter has first pointed out two major advantages of marketing research management: (1) its utility to marketing management in decision-making and (2) its contribution towards making marketing research cheaper as well as more effective. It has then identified the qualities of a marketing research manager. This is followed by a discussion on organizing the marketing research function. The different options available to a firm in this regard have been discussed. When a firm does not undertake marketing research itself but prefers to entrust it to an outside agency, then several considerations become relevant while choosing an agency. While inviting research proposal from an agency, it would be good for the firm if it gives some thought to the contents of the research proposal. The chapter then discusses some methods of evaluation and control of marketing research—an area which has remained rather neglected.

Towards the end of the chapter, the need for coordination between research and management is emphasised and the probable areas of conflict between them are indicated. The chapter concludes with suggestions both for the top management and the marketing researchers for achieving a better understanding between them.

Key Terms and Concepts

Questions

1. What is meant by "research management"?
2. Why is research management regarded as useful to marketing management?
3. What qualities should a good marketing research manager possess?
4. What are the different alternatives open to a firm for organising its marketing research function?
5. "The organisation structure for the marketing research function depends on the type of agency that has to handle it." Comment.
6. "The setting-up of a marketing research department alone is not sufficient for ensuring qualitative marketing research." Explain this statement, pointing out other factors that are also relevant.
7. What are the key elements of a marketing research plan?
8. What should be the main contents of a research proposal?
9. Having received a research proposal from an outside consultancy firm, you are now called upon to examine it. How would you go about this task?
10. What tools are available for evaluating and controlling individual research projects?
11. What tools are available for controlling the overall research activity of a firm?
12. What is marketing research audit?
13. What are the different ways by which the budget allocations to the marketing research function can be decided?
14. "Management of marketing research can be effective and successful only when there is a coordination between research and management." Comment.
15. Briefly discuss some major conflicting viewpoints of the top management and the marketing researchers.
16. What suggestions would you like to make to the (a) top management, and (b) marketing researchers to ensure a better understanding between them?

APPENDIX

A List of Marketing Research Agencies

AC Nielsen ORG MARG Pvt. Ltd.

Dr Ambedkar Road, Voltas House A,
2nd Floor, Chinchpokli East,
Mumbai-400033
Tel: 022-66632800
Fax: 022-6663 2701
Website: www.nielsen.com

Bare International

2nd Floor, Roopmangal Building,
Corner of Main Avenue and 16th Road,
Santacruz – West, Mumbai - 400 054
Tel: 022-66897017
Fax: 022-022-66897043
Website: www.bareinternational.com

Better Marketing Services

15 Trade Field, 3rd Floor,
Sanghvi Nagar Aundh, Pune - 411007
Tel: 020-25893662
E-mail: info@betterlabs.net

Centre for Research and Consultancy

Khadi Federation Building, NH Bypass,
Padivattom, Kochi - 682024
Tel/Fax: 0484-2808108
E-mail: crckochi@vsnal.com

Cross Tab

No. 468, 80 Feet Road, 6th Block,
Koramangala,
Bangalore -95
Tel: 080-4178 5800, Fax: 080-4178 5808
Mumbai: 022-28443031
Wabsite: www.cross-tab.com

Data Search

187 Santoshpur Avenue, Kolkata,
West Bengal-700 075
Tel: 033-2416 6891/4434
Fax: 033-2416 6460
E-mail: datasearch@vsnl.com

Hansa Research Group Pvt. Ltd.

105-106 Anand Coplex,
189-A Sane Guruji Marg, Mahalaxmi,
Mumbai- 400 011
Tel: 022-2301 5122/44
Fax: 022-2309 6862
New Delhi: 011-4165 6207
Website: www.hansaresearch.com

IMAS Research

IMAS Research (Information Marketing & Social Research)
2nd Floor, Nanda Bhawan,
5 - Ashok Avenue, Sapru Marg,
Lucknow- 226 001
Tel: 0522-4015880, Fax: 0522-2231597
E-mail: imaresearch@gmail.com

Icon Added India Value Pvt. Ltd

305, 306,
Samarpan Complex New Link Road, Chakala,
Andheri (E), Mumbai - 400 099
Tel: 022-2838 0975/76
Fax: 022-2838 0978

IMRB International

"A" Wing, Mhatre Pen Building,
Senapati Bapat Road, Dadar (W),
Mumbai – 400 028
Tel: 022-2432 3500/3700
Fax: 022-2432 3600
Kolkata:- 033-4400 6200
Website: www.imrbint.com

Kaybase Consulting Solutions

14 Ananda Road, Alwarpet,
Chennai - 600 018

Tel: 044-4203 0989
Fax: 044-4203 0990
Website: www.kaybase.com

Market Pulse

Market Pulse, C-11, Sector-6
Noida-201301
Tel: 0120-4078500
Fax: 0120-4541157
Website: www.marketpulseindia.com

ML Infomap

124 - A Katwaria Sarai,
New Delhi - 110 016
Tel: 011 - 4168 8592, Fax: 011 - 4168 8593
Website: post@mlinfomap.com

Opinion and Market Research Company

398, 7 Cross, Mico Layout, BTM 2 Stage,
Bangalore-560 076
Tel: 080-4120 1441
E-mail: sriram@opinionresearch.in

Prognosyse Services Pvt. Ltd.

B - 44, Sector 63, Noida-201301
Tel: 0120 - 4623300
E-mail: contract@prognosyse.com

Positive Communications

B-1/6 Hauz Khas, New Delhi - 110 016
Tel: 011-4344 0044, Fax: 011-4344 0099
E-mail: info@positiveindia.biz

Synovate India

Synovate India, 2nd Floor, AML Centre 1,
8 Mahal Industrial Estate,
Off. Mahakali Caves Road, Andheri (East),
Mumbai - 400 093
Tel: 022-4091 8000/8100
Fax: 022-4091 8001
New Delhi: 011-461 83000
Website: www.synnovate.com

Vive Communications

57, Ist Floor, Kalu Sarai, New Delhi-16
Tel: 011-41018591/85
Fax: 011-46525613
E-mail: delhi@groupvive.com

Source: Businessworld Marketing Whitebook, 2010–2011

3 Value of Information

Learning Objectives

After reading this chapter, you should be able to understand:

- Need for, and characteristics of, useful information
- Expected Value Criterion
- Concept of Decision Tree
- Advantages and Limitations of Decision Trees
- Concept of Bayesian Analysis
- Reasons for infrequent use of Bayesian Analysis
- Advantages of Bayesian Analysis

Before undertaking marketing research, the management has to be convinced of its utility. If it feels that marketing research will not be helpful in decision-making, it will not be undertaken. Even when a decision to undertake research has been taken by the management, there are several alternative research designs from which one is to be chosen. Besides, the management may have to decide whether to expand or curtail research programmes of the firm. It may decide on such issues arbitrarily, using its intuitive sense of judgement. Such a subjective approach makes the research susceptible to the whims and fancies of the top management. The question then is—*Are there any rational methods by which the management can take decisions on such issues more objectively*? This chapter is devoted to answering this basic question.

NEED FOR INFORMATION

There may be certain situations where management is sufficiently clear that no additional information is likely to change its decision. In such cases, it should be obvious that the value of information is negligible. In contrast, there may be certain situations where the decisions cry out for information which is not available at any price. Between these two extremes, there are a large number of situations where the availability of additional information will improve the odds of making a good decision.

Unless the information collected does not lead the manager to change or modify his decision, the information has no value. In other words, if a manager has already made up his mind that regardless of what is revealed by the information, he will adhere to a particular line of action, there is no point in collecting information. Generally, information is most useful in cases (i) where one is unsure of what is to be done, and (ii) where extreme values, say, huge profits or losses, are involved. By collecting information, the management is simply reducing the odds of making a wrong decision.

However, it is not that any type of information available can serve the purpose. In order that information is really useful to the researcher, it must be

Relevant

This is the most important characteristic. It means that the information has relevance to the subject of enquiry.

Available

When a decision is being made, information must be available.

Accurate

The information, which is going to be used for decision-making, must be accurate. Obviously, the use of wrong information will lead to a wrong decision.

Current

Information must be current. This implies that it is not an obsolete one and is applicable to the time period of the study.

Adequate

In addition to the foregoing four characteristics, information must be adequate. Scanty or piecemeal information will not serve the purpose.

It may be mentioned that the available information may not have all the characteristics. As such, tradeoffs are usually made among these characteristics, depending on their relative importance to the research problem. However, as the most important characteristic is relevance, it must not be compromised in such a tradeoff.

A pertinent question is—*How much information should be collected in a given situation*? Since the collection of information involves a cost, it is necessary to ensure that the benefit from information is more than the cost involved in its collection. In the following paragraphs, an attempt is made to show how information can be evaluated for setting up a payment limit.

The Concept of Probability[1]

The concept of probability is the basis of decision-making under conditions of uncertainty. When we say that probability of certain event is 0.8, we mean that the likelihood of its occurrence is 8

[1] Some concepts and rules for calculating probabilities are given in the appendix to this chapter.

times out of 10 or 80 per cent. The more we think that a particular event is expected to occur, the greater will be its probability and vice versa.

There are three basic sources of assigning probabilities.

Logic/Deduction

It is quite simple to assign probabilities in some situations. *For example*, when a coin is tossed, the probability of getting a head or a tail is one-half or 0.5. Likewise, when a dice is rolled, the probability of getting any one of the six numbers (1 to 6) is 1/6. However, most of the marketing research situations are not as simple.

Past Experience/Empirical Evidence

Another source of estimating probabilities is the past experience or empirical evidence. A firm might have faced similar problems in the past. The experience gained in the process of resolving these problems may be helpful in the estimation of probability. Take an example of a firm which has introduced several new products in the past. It is now considering the introduction of yet another product. On the basis of its past experience, it may be in a better position to estimate the probability of the new product's success. Similarly, a firm may undertake an analysis of such data as are available, say, the level of national income, per capita income, rate of growth of the economy, etc., and attempt to forecast the sales. Though such analysis by itself will not give any probability estimate, it can serve as a basis for a subjective estimate of probability.

Subjective Estimate

This is another method of estimating probability and is perhaps the most frequently used basis of probability estimates. When probability is to be estimated by a manager, the main consideration is that who should be asked to do so. Obviously, a well informed and knowledgeable executive should be entrusted with this responsibility. There is considerable criticism of the theory of decision analysis, on account of the subjective method of estimating probability. As such, one should use as much data as possible even for assigning probability on a subjective basis.

THE EXPECTED VALUE CRITERION

This criterion requires the decision maker to calculate the expected value for each alternative decision. This is done by (i) multiplying each decision alternative by the probability value assigned to the state of nature that can occur; and (ii) aggregating the values thus arrived at. This is best illustrated by the following example.

Example

ABC Co. is a leading firm of dry cleaners with branches in Delhi and the large towns in Western U.P. The company has been thinking of setting up a new shop in Agra which already has four other dry cleaning shops, one of which is a branch of a national company at par with the ABC. ABC is concerned about the reaction of customer and potential customers to the opening of its branch in Agra, and is of the opinion that one of the three possibilities can take place: (i) increased market share, (ii) no change in the present operations, and (iii) a reduced market share. The company assigns a value to each of these outcomes (as given in Table 3.1).

Table 3.1

Outcome	Value in Rs (lakhs)
Increased share	3
No change	1
Reduced share	– 2

The next step is to assign probabilities to the outcomes. After discussion and consultations amongst several managers, the company assigns the probabilities (as given in Table 3.2).

Table 3.2

Outcome	Probability
Increased share	0.2
No change	0.5
Reduced share	0.3

On the basis of the information given in Tables 3.1 and 3.2, the expected monetary value (EMV) can be calculated.

$$\begin{aligned} \text{EMV} &= (\text{Rs } 3{,}00{,}000 \times 0.2) \\ &\quad + (\text{Rs } 1{,}00{,}000 \times 0.5) + (\text{Rs } -2{,}00{,}000 \times 0.3) \\ &= \text{Rs } 60{,}000 + \text{Rs } 50{,}000 - \text{Rs } 60{,}000 \\ &= \text{Rs } 50{,}000 \end{aligned}$$

Thus, the expected monetary value of the decision to open the branch is Rs 50,000. It may be noted that a little change in these probabilities would change the EMV considerably. A more pessimistic view of the venture might reverse a profitable venture into one resulting in loss. In other words, much depends on the probabilities that are assigned for decision-making.

Expected Monetary Value of Perfect Information

Sometimes management needs additional information so that it can make the right decision. In such cases it has to first decide how much it can pay for this information to an outside consultancy firm. There always is a maximum limit beyond which management is not prepared to spend for information. This brings us to the concept of 'expected monetary value of perfect information' (EMVPI). The following example shows how EMVPI can be calculated.

Example

ABC Co., whose major competitor is XYZ Co., has to decide whether or not to introduce a new product. Although completely reliable information regarding XYZ's plans is not available, the marketing manager of ABC has assumed certain probabilities on the basis of past experience. He has prepared the following conditional pay-off table.

Table 3.3 XYZ Company's Strategy

Probability	C_1 **0.6**	C_2 **0.4**
	Rs (million)	Rs (million)
Strategy S_1	6	10
S_2	4	15

C_1 Indicates that XYZ Co. introduces the new product.
C_2 Indicates that XYZ Co. does not introduce the new product.
S_1 Indicates that ABC Co. decides to introduce the new product.
S_2 Indicates that ABC Co. decides not to introduce the new product
The question is—*What is the expected value of perfect information*?
We first calculate the EMV of the two strategies:

$$\text{EMV of } S_1 = (6 \times 0.6) + (10 \times 0.4)$$
$$= 3.6 + 4$$
$$= \text{Rs } 7.6 \text{ million}$$
$$\text{EMV of } S_2 = (4 \times 0.6) + (15 \times 0.4)$$
$$= 2.4 + 6$$
$$= \text{Rs } 8.4 \text{ million}$$

On the basis of these calculations, ABC should choose strategy S_2 which is the optimal strategy.

From the pay-off matrix given above, it is possible to calculate a tentative value for perfect information. Assume that ABC Co. is considering approaching a consultancy firm to provide additional information relating to XYZ's plans. It should be noted that ABC cannot pay any arbitrary amount demanded by this consultancy firm. It should, therefore, fix up an upper limit beyond which it would not like to pay. *How is this limit determined*?

Assume that ABC Co. is fully acquainted with the plans of its competitor XYZ Co. In such a case, ABC will choose S_1 and gain a pay-off of Rs 6 million when XYZ introduces a new product. This is because S_2 will yield only Rs 4 million. Likewise, ABC will choose S_2 and gain a pay-off of Rs 15 million when it is certain that XYZ will not introduce the new product. This is because S_1 will yield only Rs 10 million.

Now, from the information given above, it is known that XYZ will choose C_1 during 60 per cent of the time and C_2 during 40 per cent of the time. In view of this, the expected monetary value under certainty will be as follows:

$$\text{EMV(C)} = (6 \times 0.6) + (15 \times 0.4)$$

$= 3.6 + 6$

$= \text{Rs } 9.6 \text{ million}$

Now, the expected monetary value of perfect information is to be determined. This is the difference between the expected monetary value under certainty and expected monetary value of the optimal strategy calculated under conditions of uncertainty, i.e. EMV(UC). In the example, S_2 is the optimal strategy, i.e. EMV(UC). Thus, the expected monetary value of perfect information is:

$$\text{EMVPI} = \text{EMV (C)} - \text{EMV (UC)}$$

$$= \text{Rs } (9.6 - 8.4) \text{ million}$$

$$= \text{Rs } 1.2 \text{ million}$$

Example

The following pay-off table gives the most accurate estimates of pay-offs for three alternative courses of action and four possible states of nature under conditions of uncertainty.

Table 3.4

Rs (million)

Courses of action	States of Nature			
	S_1	S_2	S_3	S_4
A_1	125	100	70	20
A_2	70	90	100	50
A_3	150	120	60	– 10

The probabilities are — S_1 : 0.4, S_2 : 0.25, S_3 : 0.2 and S_4 : 0.15. Two questions arise:

1. *What course of action would be recommended in this situation?*
2. *What is the expected monetary value of perfect information?*

Expected monetary value of each course of action is as follows:

EMV : $A_1 = (125 \times 0.4) + (100 \times 0.25) + (70 \times 0.2) + (20 \times 0.15)$

$= 50 + 25 + 14 + 3$

$= \text{Rs } 92 \text{ million}$

EMV : $A_2 = (70 \times 0.4) + (90 \times 0.25) + (100 \times 0.2) + (50 \times 0.15)$

$= 28 + 22.5 + 20 + 7.5$

$= \text{Rs } 78 \text{ million}$

EMV : $A_3 = (150 \times 0.4) + (120 \times 0.25) + (60 \times 0.2) + (-10 \times 0.15)$

$= 60 + 30 + 12 - 1.5$

$= \text{Rs } 100.5$ million

Since the EMV of A_3 is the highest, A_3 should be recommended in this case. *Calculation of the Expected Monetary Value of Perfect Information*

EMV(C) $= (150 \times 0.4) + (120 \times 0.25) + (100 \times 0.2) + (50 \times 0.15)$

$= 60 + 30 + 20 + 7.5$

$= \text{Rs } 117.5$ million

EMVPI $= \text{EMV (C)} - \text{EMV (UC)}$

$= \text{Rs } 117.5 \text{ million} - \text{Rs } 100.5$ million

$= \text{Rs } 17$ million

DECISION TREES

So far the discussion was confined to single stage problems wherein the decision maker is required to select the best course of action on the basis of information available at a point of time. However, there are problems with multiple stages wherein a sequence of decisions is involved. Each decision leads to a chance event which in turn influences the next decision.

A decision tree is a graphical device depicting the sequences of action-event combinations. All possible sequences of action–event combinations are shown in a systematic manner in a decision tree.

The decision tree in *Fig. 3.1* shows a simple decision of making a choice between two alternatives, viz, *whether or not to open a new branch of a particular dry cleaning company*. The square node shows a decision point and a circular node from which branches on the tree represent each possible outcome or state of nature. In *Fig. 3.1* there are three branches emanating from the circular node which represent the three possible outcomes or states of nature that can result. These are: increased market share, no change in market share and reduced market share.

The typical method of constructing such a tree is as follows:

1. Identify all the possible courses of action.
2. List the possible results, i.e. 'states of nature' of each course of action specified in (1) above.
3. Calculate the pay-off of each possible combination of courses of action and results. The pay-off is normally in monetary terms.
4. Assign probabilities to the different possible results for each given course of action.The probability indicates the likelihood of occurrence of a particular result or event.
5. Finally, select the course of action that gives the maximum pay off.

An augmented decision tree is given in Fig. 3.2

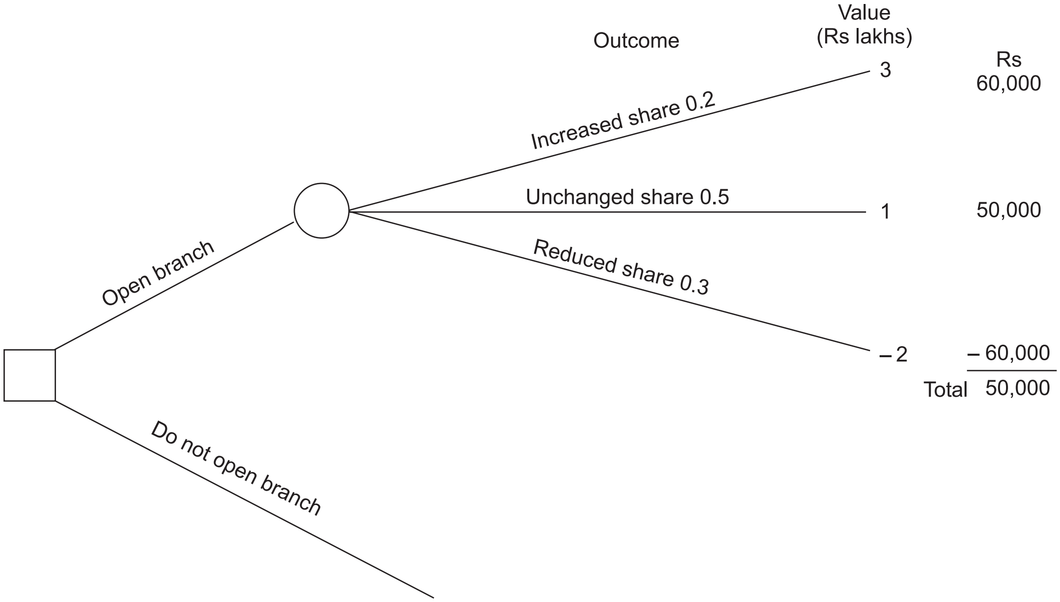

Fig. 3.1 Decision Tree for ABC Company

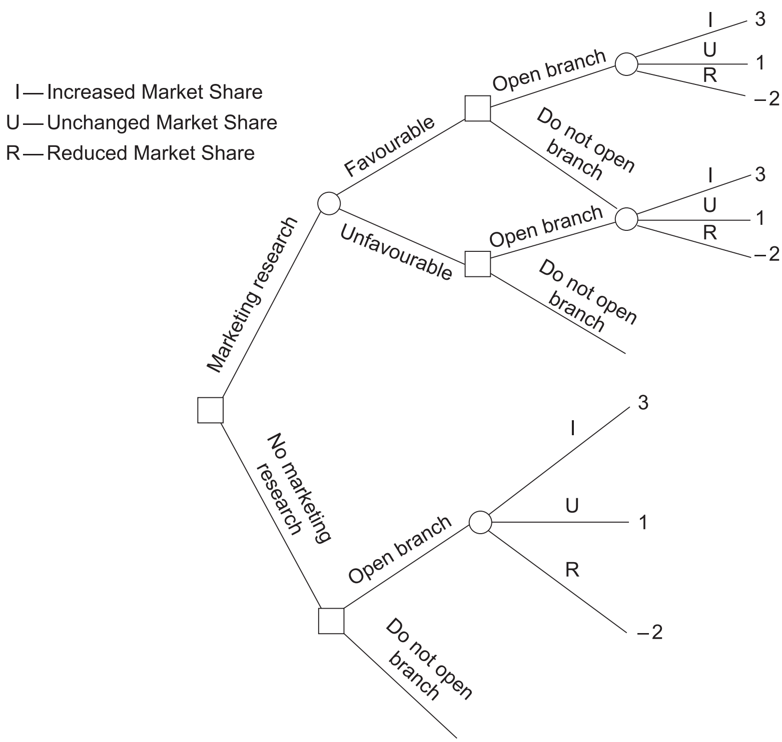

Fig. 3.2 Augmented Decision Tree, ABC Company

Advantages of the Decision Tree Approach[2]

Certain advantages may be attributed to the decision tree approach. **Firstly**, the decision tree approach structures the decision process and thus helps one in making a decision in a systematic manner. **Secondly**, the approach necessitates that the decision maker considers all possible outcomes regardless of whether they are desirable or undesirable. Thus, no possible outcome is likely to be left out in decision making. **Thirdly**, the decision tree approach is helpful in communicating the decision-making process to others in a very succinct manner, clearly indicating the assumptions used. **Fourthly**, attention can be focused on each individual financial figure, probability, as also the underlying assumption, one at a time. **Finally**, the decision tree can be used with a computer which means that different sets of assumptions can be used to ascertain their influence on the final outcome.

Limitations[3]

There are certain limitations of the decision tree approach. **Firstly**, decision trees need time and money to complete. As such, they are unsuitable for minor decisions where their cost may exceed the benefit to be derived from them. **Secondly**, as the information is presented in a quantitative form, there is a risk that it may be taken as exact. It is necessary to ensure that the information used in the decision tree is reliable. **Thirdly**, the information required for this approach may not be available because a particular decision was not taken before and hence there is no evidence on which the probability can be assumed. **Fourthly**, non-quantifiable factors such as people's attitudes, government policy, etc., may be more important but these do not enter into a decision tree.

BAYESIAN ANALYSIS

If the analysis based on the decision tree is not helpful to the management in its decision-making, a more sophisticated technique known as the Bayesian analysis can be tried out. Sometimes managers find that prior probabilities regarding certain states of nature are no longer applicable. *For example*, a firm manufacturing readymade garments finds that certain garments are not selling in the market on account of their colour. It, therefore, has to use a different colour combination. In the meanwhile, it has to revise its prior probabilities. It may be noted that prior probabilities are changed after getting some additional information. As probabilities can be revised on account of the availability of new information, probability theory is of considerable importance in decision making.

There can be three **types of analysis** while using the Bayesian approach. These are: **prior analysis, posterior analysis** and **pre-posterior analysis.**

Prior Analysis

While deciding which course of action should be chosen, the decision maker uses prior probabilities only. These probabilities are prior to the receipt of any new information.

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[2] Based on Levin, Richard, David S. Rubin, Joel P. Stinson and Everette S. Gardner, Jr., *Quantitative Approaches to Management*, Singapore, McGraw-Hill Book Company, 1989 (7th edition), p. 222.

[3] Based on Powell, John and John Harris, *Quantitative Decision Making*, Essex, Longman Group Ltd., 1982, p. 78.

Posterior Analysis

This involves the use of posterior or revised probabilities while deciding on the course of action. Prior probabilities are revised by the decision maker on receiving new information on the states of nature.

Pre-posterior Analysis

This analysis deals with the strategic question of whether new information should be obtained and, if so, how much before deciding the course of action.

If the decision maker is willing to make certain probability assessments, pre-posterior analysis will enable him to ascertain the value of alternative research studies prior to undertaking the research. This value is known as the expected monetary value of imperfect information (EMVII). From this if cost of information (*CI*) is subtracted, the expected monetary gain of imperfect information (*EMGII*) can be obtained. This can be shown as

$$EMGII = EMVII - CI$$

The following steps are involved in a pre-posterior analysis:

1. Identify the possible research outcomes and calculate their unconditional or marginal probabilities.
2. Assume that each research outcome, in turn, has been obtained. Now, for each research outcome: (i) calculate posterior probabilities, (ii) calculate the expected monetary value of each course of action under consideration, (iii) select that course of action which yields the highest expected monetary value, and (iv) multiply the highest expected monetary value by the marginal probability of the research outcome.
3. Add the products of step 2 (iv) to obtain the expected monetary value of the strategy that includes commissioning of research before taking the final decision.
4. Calculate the expected monetary value of imperfect information (*EMVII*).
5. Calculate the expected monetary gain of imperfect information (*EMGII*).
6. Decide in favour of that strategy which yields the highest *EMGII* provided there is at least one strategy that gives a positive *EMGII*. In case there is no strategy with a positive *EMGII*, decide in favour of the strategy that gives that highest *EMV*.

An example will make these steps clear. It covers all the three analyses—prior, posterior and pre-posterior.

Example

Suppose a marketing manager of a soft drink manufacturing company is seriously considering whether to undertake a special promotion or not. The two options before him are: (i) run a special promotion, and (ii) do not run a special promotion. The following table gives the probabilities assigned by the marketing manager to the three possible outcomes, viz, very favourable consumers' reaction, favourable consumers' reaction and unfavourable consumers' reaction.

Table 3.5

Possible consumer reactions	Alternative courses of action		Probabilities of consumer reactions
	A_1 (Rs)	A_2 (Rs)	
Very favourable	1,00,00,000	0	0.7
Favourable	10,00,000	0	0.1
Unfavourable	–50,00,000	0	0.2

Prior Analysis

On the basis of this information, prior analysis will give the expected monetary value. This will be

$$\begin{aligned} \text{EMV}(A_1) &= (\text{Rs } 1{,}00{,}00{,}000 \times 0.7) + \text{Rs } 10{,}00{,}000 \times 0.1) + (-\text{ Rs } 50{,}00{,}000 \times 0.2) \\ &= \text{Rs } 70{,}00{,}000 + \text{Rs } 1{,}00{,}000 - \text{Rs } 10{,}00{,}000 \\ &= \text{Rs } 61{,}00{,}000 \\ EMV(A_2) &= \text{Rs } 0 \\ EMVPI &= \text{EMV(C)} - \text{EMV(UC)} \\ &= \text{Rs } 71{,}00{,}000 - \text{Rs } 61{,}00{,}000 \\ &= \text{Rs } 10{,}00{,}000 \end{aligned}$$

This indicates that the marketing manager should decide to run the special promotion. This is known as prior analysis as the expected monetary value is based on the assignment of probabilities by the marketing manager without any additional information.

Posterior Analysis

Suppose in the foregoing example the marketing manager wishes to revise his prior probabilities on the basis of additional information received by him. Posterior analysis uses both present and additional information. In this analysis, posterior or revised probabilities are used to ascertain the expected monetary value.

The following Table 3.6 gives the posterior probabilities on the basis of additional information.

Table 3.6 An Example of Posterior Analysis

Outcome S_i	Probabilities			
	Prior $P(S_i)$	Conditional $P(R/S_i)$	Joint $P(R \text{ and } S_i)$	Posterior $P(S_i/R)$
(1)	(2)	(3)	(4)	(5)
S_1: Very favourable	0.7	0.6	0.42	0.894
S_2: Favourable	0.1	0.3	0.03	0.064
S_3: Unfavourable	0.2	0.1	0.02	0.042
Total	1.0	1.0	0.47	1.000

R shows very favourable pre-test result.

In the first column of the table, three possible outcomes have been identified. The second column gives prior probability of each of the three possible outcomes. Now suppose a pre-test result on this promotion was favourable. In view of this, the manager must assess the conditional probability of getting a favourable pre-test given the various possible outcomes. Column 3 of the table gives such probabilities. The joint probability of R and S_i, i.e. P (R and S_i) is obtained by multiplying the probabilities in columns 2 and 3. The joint probabilities for all the three possible outcomes are shown in column 4. The last column gives the posterior probabilities. These have been calculated by applying Bayes' rule. Symbolically,

$$P(S_i/R) = \frac{P\,(R \text{ and } S_i)}{P\,(R)}$$

These are the probabilities of various outcomes given the test results. Thus, the posterior probability of very favourable outcome (S_1) given favourable test result (R) = 0.42/0.47 = 0.894. Similarly, the posterior probabilities of S_2 and S_3 can be calculated.
The posterior $EMV(A_1)$ is calculated as follows:

$$\begin{aligned}
\text{Posterior } EMV(A_1) &= (\text{Rs } 1{,}00{,}00{,}000)\ (0.894) + (\text{Rs } 10{,}00{,}000 \times 0.064) \\
&\quad + (\text{Rs} - 50{,}00{,}000 \times 0.042) \\
&= \text{Rs } 89{,}40{,}000 + \text{Rs } 64{,}000 - \text{Rs } 2{,}10{,}000 \\
&= \text{Rs } 90{,}04{,}000 - \text{Rs } 2{,}10{,}000 \\
&= \text{Rs } 87{,}94{,}000 \\
\text{Posterior EMVPI} &= EMV(\text{C}) - EMV(\text{UC}) \\
&= \text{Rs } 90{,}04{,}000 + \text{Rs } 87{,}94{,}000 \\
&= \text{Rs } 2{,}10{,}000 \\
\text{Prior EMVPI} &= \text{Rs } 10{,}00{,}000
\end{aligned}$$

It will be seen that prior EMVPI was higher (Rs 10,00,000) than posterior EMVPI (Rs 2,10,000). This makes sense as it shows that on account of the new information, the degree of uncertainty has declined. Consequently, the value of additional information has reduced.

Pre-posterior Analysis

Having discussed posterior analysis, we now turn to pre-posterior analysis which is helpful in evaluating the worth of research before it is undertaken.

Suppose that in our earlier example the marketing manager was conducting a test market for a special soft drink promotion. The test would cost Rs 80,000. Figure 3.3 presents the structure of the problem in the form of a decision tree. It may be noted that the tree diagram shows the decision problems in proper sequence. The first problem is whether to have a test market or not. This is followed by the market test (if it is undertaken); then the decision alternatives about the promotion and finally the possible outcomes of these decision alternatives. What follows is a step-by-step procedure with pre-posterior analysis.

Step 1

The marketing manager thinks that there are likely to be three test market outcomes: (i) a 15 per cent increase in sales (T_1), (ii) a 5 per cent increase in sales (T_2), and (iii) no increase in sales (T_3). He has now to obtain conditional probabilities of test market results as shown in Table 3.7.

Table 3.7 Conditional Probabilities of Test Market Results

States of nature	Test results		
	T_1 (+ 15%)	T_2 (+ 5%)	T_3 (± 0%)
S_1 Very favourable	0.6	0.3	0.1
S_2 Favourable	0.3	0.6	0.1
S_3 Unfavourable	0.1	0.1	0.8

The conditional probability indicates that if the test market is run as proposed and receives a favourable reaction from consumers, there will be certain probability of occurrence of T_1, T_2 and T_3. Thus the probability of having a + 15 per cent test result given a very favourable test market $P(T_1/S_1)$ is 0.6.

These conditional probabilities $P(T_i/S_{is})$ are multiplied by the prior probabilities $P(S_i)$, to give joint probabilities. *For example*, $P(S_1$ and $T_1) = P(S_1) \times P(T_1/S_1) = 0.6 \times 0.7 = 0.42$. All these joint probabilities are shown in Table 3.8. The marginal probability of each T_i can be obtained by adding the joint probabilities where T_i occurs. Thus the marginal probability of T_i, $P(T_1)$ is 0.47; of T_2, $P(T_2)$ is 0.29; and of T_3, $P(T_3)$ is 0.24. These probabilities are also shown in Table 3.8.

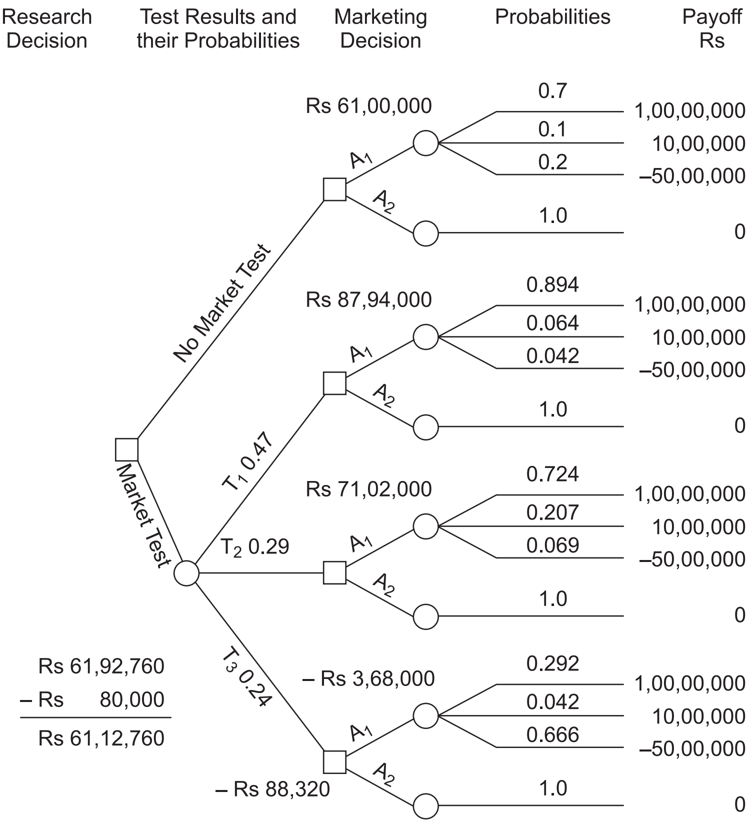

Fig. 3.3 Decision Tree: No Market Test *versus* Market Test

Table 3.8 Joint Probabilities of States and Test Market Results

States of nature	Test results T_1 (+ 15%)	T_2 (+ 5%)	T_3 (± 0%)	Marginal probabilities
S_1 Very favourable	0.42	0.21	0.07	0.7
S_2 Favourable	0.03	0.06	0.01	0.1
S_3 Unfavourable	0.02	0.02	0.16	0.2
Marginal probabilities	0.47	0.29	0.24	1.0

Step 2

The prior probabilities of the possible outcomes can now be revised. These probabilities are revised by using Bayes' rule. *For example*,

$$P(S_1T_1) = \frac{P(S_1 \text{ and } T_1)}{P(T_1)} = \frac{0.42}{0.47} = 0.894$$

$$P(S_2T_1) = \frac{P(S_2 \text{ and } T_1)}{P(T_1)} = \frac{0.03}{0.47} = 0.064$$

$$P(S_3T_1) = \frac{P(S_3 \text{ and } T_1)}{P(T_1)} = \frac{0.02}{0.47} = 0.042$$

Similar calculations can be easily made for S is given T_2 and T_3. These results are shown on the decision tree. The expected pay-off of each alternative is calculated again using the posterior or revised probabilities. On the basis of these calculations, the best courses of action and pay-offs are T_1 = Rs 87,94,000; T_2 = Rs 71,02,000; and T_3 = Rs 0. These three best pay-offs are then multiplied by their associated $P(T_i)$.

Step 3

The sum of the best outcomes, each multiplied by its respective $P(T_i)$, comes to T_1 = Rs 41,33,180; T_2 = Rs 20,59,580 and T_3 = Rs 0.

Step 4

Now, it is possible to calculate the expected monetary value of imperfect information (EMVII). This is shown below:

$$\begin{aligned} \text{EMVII} &= \text{EMV (with test)} - \text{EMV (without test)} \\ &= \text{Rs } 61{,}92{,}760 - \text{Rs } 61{,}00{,}000 \\ &= \text{Rs } 92{,}760 \end{aligned}$$

This is the maximum amount that can be paid for this research.

Step 5

The expected monetary gain can also be calculated as shown below:

$$\text{EMGII} = \text{EMVII} - \text{CI}$$

= Rs 92,760 – Rs 80,000

= Rs 12,760

Step 6

Since the expected monetary gain is positive, it is advisable to undertake the test market.

It may be pointed out that one may consider alternative designs for test market, each having different costs and conditional probabilities. In view of these factors, the EMGII will also be different for each alternative design. In the same manner (as in the preceding example), we have to calculate EMGII for each research design or test market. Obviously our choice will be in favour of that design which gives the highest EMGII.

Some reasons responsible for such a situation are:

1. There may be a shortage of people who are sufficiently familiar with the technique.
2. There may be hesitation on the part of the decision maker in acknowledging and quantifying uncertainty.
3. There may arise problems in quantifying prior probabilities and conditional probabilities.
4. There may arise problems when the assumptions inherent in the Bayesian analysis do not hold good in a particular decision situation.

Conclusion

It is felt in some quarters that the Bayesian analysis is an abstruse method and is more an academic exercise than a realistic decision method. It is true that such a decision method is seldom used. At the same time, the Bayesian analysis covers more information than traditional methods and, as such, it should enable one to arrive at correct decisions more frequently than would otherwise be possible. This apart, a major advantage of the Bayesian analysis is that it enables to carry out the analysis in a sequential fashion. Data obtained from one sample survey can be used as the prior information when new information becomes available. Then by using Bayes' theorem, the two sources can be combined. Again, this being posterior distribution, it can be used as prior information when further new data become available. Thus the sequence continues. There is yet another benefit of this method. Many a time, the marketing researcher is given the direction by the management and is not associated with the structuring of a problem. However, as the requirement of data for the application of the Bayesian analysis can be best fulfilled through the interaction of manager and researcher, it facilitates communication between them.

Summary

Often, the management has to decide whether or not research should be undertaken or whether to expand or curtail its research programmes. This chapter discussed some rational methods by which management could take decisions on such issues as objectively as possible.

The chapter first emphasised the need for information in decision making. It then introduced the concept of probability and indicated three basic sources of assigning probabilities. This was followed by a discussion on the expected value criterion for decision making illustrated by examples. The chapter then discussed the tree diagram with the help of examples, specifying its advantages and limitations.

Finally, a more sophisticated technique, known as the Bayesian Analysis, was discussed. A numerical example was given to explain the various steps involved in its use. Certain reasons responsible for seldom use of the Bayesian analysis have also been given. At the same time, it was pointed out that on account of the additional information obtained through the Bayesian analysis, the management would be in a position to take correct decisions more frequently than in case of traditional statistical methods. Another benefit of the Bayesian analysis is that it facilitates communication between the management and the marketing researchers.

Key Terms and Concepts

Questions

1. What is wrong with the subjective method of taking a decision as to whether or not to undertake a research project?
2. Why is it necessary to estimate the value and cost of information before conducting research?
3. Do you think that research can generate all the information required by the management?
4. What is the 'expected value' approach to decision making?
5. What is meant by a 'tree diagram'? How is it used in estimating the expected value of information?
6. What are the advantages and limitations of the 'tree diagram' approach for decision making?
7. How is the concept of probability relevant in decision making on research projects?
8. How would you use the Bayesian Analysis for deciding whether or not research should be done? Illustrate its use by a suitable example.
9. What are the advantages of Bayesian Analysis over the other methods?
10. On what grounds has the Bayesian Analysis been criticised? Do you agree with these criticisms?

APPENDIX

Conditional Probability, Joint Probability and Unconditional Probability

Conditional Probability

It is the probability assigned to an event when another event is known or assumed to have occurred. In symbols we can write $P(A/B)$, which reads "the probability of A given B". *For example*, given a favourable market (B), the probability that a proposed new product will be successful (A), is given by $P(A/B) = 0.8$.

Joint Probability

It is the probability that two or more events will occur. In symbols we can write $P(A \text{ and } B)$, which reads "the probability of A and B."

For example, one might assign a Probability of 0.3 on the basis of likely performance of both the existing product and the new product in the market:

Addition Rule: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

If the two events are mutually exclusive, then

$$P(A \text{ or } B) = P(A) + P(B)$$

Multiplication Rule: $P(A \text{ and } B) = P(A/B) \cdot P(B)$

If the two events are independent, then

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

Bayes' Rule

$$P(A/B) = \frac{P\,(A \text{ and } B)}{P(B)}$$

or

$$P(A/B) = \frac{P(A) \cdot P(B/A)}{P(A) \cdot P(B/A) + P(A') \cdot P(B/A')}$$

A' = Events other than A.

Unconditional Probability

It is the probability assigned to an event that is independent of other events. It is also called marginal probability. It can be calculated by subtracting from 1 the sum of the probabilities of all the joint probabilities of which it is a part. For example, if $P\,(A \text{ and } B) = 0.3$ and $P(A \text{ and } C) = 0.2$, then $P\,(A) = 1 - (0.3 + 0.2) = 0.5$.

4 The Research Process

Learning Objectives

After reading this chapter, you should be able to understand :

- What are the different stages of the research process
- How to formulate the research problem
- Types of research design
- How to determine sources of data
- How to design data collection forms
- How to determine sampling design and sampling size
- How to organise and conduct the field survey
- How to process and analyse the collected data
- How to prepare the research report
- Questions to be addressed at the various stages of the research process
- Errors in the research process

The marketing research process involves a number of inter-related activities which overlap and do not rigidly follow a particular sequence. A researcher is often required to think a few steps ahead. *For example*, if a researcher has formulated a research problem and is considering the sampling plan, he is supposed to consider the type of data to be collected as also the detailed tabulation. This is because the various steps are inter-woven into each other and each step will have some influence over the following step.

In marketing research, even though our focus is on one particular step, other inter-related steps or operations are also being looked into simultaneously. As we complete one activity or operation, our focus naturally shifts from it to the subsequent one, i.e. the focus is not concentrated exclusively on one single activity or operation at any particular point of time.

Let us now describe the major steps involved in a marketing research project. Figure 4.1 shows these steps.

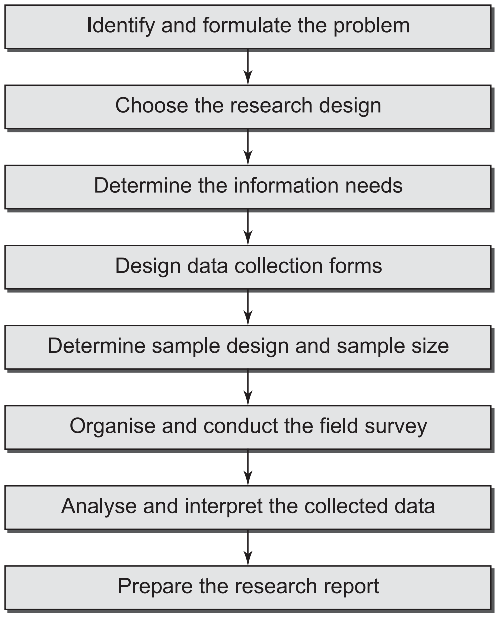

Fig. 4.1 The Research Process

FORMULATING THE RESEARCH PROBLEM

The first step in research is formulating a research problem. It is the most important stage in applied research as poorly defined problems will not yield useful results. It is rightly said that "a problem well defined is half-solved." Poorly defined problems create confusion and do not allow the researcher to develop a good research design.

It may be mentioned that the problem formulation from the researcher's point of view represents translating the management problem into a research problem. Table 4.1 gives some examples of management and research problems. In order to formulate an appropriate research problem on the basis of a management problem, it is necessary to have a meaningful dialogue between the researcher and the manager. As was emphasized in Chapter 2 on Marketing Research Management, the conflicting viewpoints between the top management and marketing researchers must be reconciled if research has to be effective and useful. Without a meaningful dialogue, the problem is likely to be defined poorly. The research carried out on that basis will hardly have any value for the management.

Table 4.1 Some Examples of Management and Research Problems

Management Problems	Research Problems
1. Allocation of advertising budget among different media types.	1. Undertaking research to ascertain awareness generated by each media type.
2. Declining sales during the past two years.	2. Causal research to be undertaken for determining the reasons for declining sales.

Contd.

Management Problems	Research Problems
3. Should the launch of the new product at the national level be restricted to some States?	3. Test market to be organized.
4. How much bonus is to be given to factory workers?	4. Research study on productivity to be conducted.
5. Whether a training programme launched last year is to be continued this year?	5. Ascertain the effectiveness of training by analyzing the output of randomly selected sample of workers both for pre-training and post-training periods.
6. Which one copy is to be used?	6. Undertake research by taking a suitable experimental design.
7. Whether to set up a Shopping Mall in a city?	7. Conduct an exploratory research to determine viability of the proposed Shoppingf Mall
8. Which of the three packaging should be adopted?	8. A consumer research study is called for.

In order to identify the research problem, three categories of symptomatic situations, namely, **overt difficulties, latent difficulties and unnoticed opportunities** should be studied. Overt difficulties are those which are quite apparent and which manifest themselves. *For example*, if a firm has been witnessing a decline in its sales for some time, this could be called an overt difficulty. Latent difficulties, on the other hand, are those which are not so apparent and which, if not checked, would soon become evident. *For example*, declining sales may, in due course, demoralise the sales staff. Unnoticed opportunities indicate the potential for growth in a certain area of marketing. Such opportunities are not clearly seen and some effort is required to explore them.

It is difficult to lay down any concise prescription for recognising problems. A person with an inquisitive nature and the necessary background would recognise a problem or an opportunity in less time than another who lacks these qualities. Once the researcher has identified two or more problems or opportunities, the next question he should be concerned with is—which of the problems is to be selected? This is necessary as he will not be in a position to take up all the problems on account of limited finances and time constraints. In such a case he has to determine priorities, carefully examining their importance to his organisation. Choosing a relatively less important problem would amount to wasting limited resources. He should look into the value and cost aspects as explained in the preceding chapter. He should then select that problem which gives the maximum net value of research.

After a problem has been chosen, the next task is to formulate it precisely. This too needs a good deal of care on the part of marketing researchers. Formulation implies a clear statement or definition of the problem.

A complete problem definition must specify each of the following:

(i) Sample and sampling units
(ii) Time and space boundaries
(iii) Product features, and consumer preferences
(iv) Specific environmental conditions

Taken together these four aspects identify the who, when, where, and what of the research. These are briefly explained.

Sampling Units

The individuals or objects whose characteristics are to be measured are called sampling units. The sampling units always identify the objects to be studied. It is necessary that the universe is well defined. Consider, for example, the statement—‘“Women's dress buyers in Delhi stores on January 30, 1990”. This specifies a particular universe, provided that clear definitions are given for ‘Women's dress buyers’, and ‘Delhi stores’. Consider another universe—”Women living in the Delhi metropolitan area who are shopping for one or more dresses in January 1990.” The difference in the two statements is that whereas the sampling units of the universe are ‘buyers’ in the former, in the latter they are ‘shoppers’. Also, note another difference between the two universes. In the first case, the universe indicates ‘Buyers of women dresses’, implying that the buyer may be either male or female. But in the second case, only women comprise the universe.

Time and Space Boundaries

As regards time and space boundaries, we find that the two universes are again different. In the first instance, a precise date, viz. 30th January, 1990 is given while in the second instance the entire month of January is given. Similarly, the two universes are different in terms of space—the ‘buyers’ universe specifies stores located in Delhi while the ‘shoppers’ universe specifies the Delhi metropolitan area which should be a larger territory than the former. A more subtle difference between the two universes can also be seen. The ‘buyers’ universe specifies that buying takes place in stores located in Delhi. The ‘shoppers’ universe does not specify as to where shopping takes place. It says that women shoppers living in the Delhi Metropolitan area in January 1990 are shopping. They may be shopping outside Delhi as well. Thus, in the second case the area in which shopping occurs is unlimited.

As has been mentioned by F.E. Brown[1]:

> Marketing managers continually run the risk of making the right decision at the wrong time. Opportunities are transient, the marketing executive who assumes a static environment is doomed to failure.

In view of this, it is vitally important that the marketing manager and researcher decide upon the suitable time reference for the decision.

Characteristics of Interest

This aspect identifies the focus of the problem. In our earlier example, the characteristics of interest can be style and colour preferences, buying behaviour, personality traits, etc. Again, the researcher may be interested in only one characteristic. It is necessary that the problem definition specify one or more characteristics to be measured and the fact that the nature of relationships amongst them is to be determined. Thus, we may like to know more specifically as to what dresses are liked by educated women or those who are employed. Is there any preference for store location amongst the members of the universe on account of their income? This and similar other questions will lead us to focus attention on the nature of relationships amongst the various characteristics.

[1] Brown, F.E., *Marketing Research*, Addison Wesley, Chapter 2, p. 35.

Environmental Conditions

This aspect indicates the uniqueness or generality of the problem. *For example*, if the management is interested in knowing how the units respond to price changes, then the problem definition should specify the prices to be researched. The management is sometimes interested in knowing the behaviour of certain types of firms under specific economic conditions. In such cases, the problem definition must spell out those conditions precisely. In other words, the problem definition must specify the environment for which the company wants research results. It may also spell out the possibilities of changes as well as the direction of change in the environment so that the results of the research study do not become irrelevant.

It may be emphasised that the problem definition in marketing research is a step towards identification and structuring of the management's question. The most important objective of problem definition, however, should be to answer the right question.

Hypothesis Development

Before we pass on to the next stage, it is worthwhile to briefly mention the development of hypotheses. A hypothesis is a proposition which the researcher wants to verify. Often there may be several competing hypotheses, either specified or implied. If, before undertaking the research, the researcher finds that all hypotheses are true, then there is no need whatsoever to undertake research. One objective of research is to select among the possible hypotheses and to test them empirically with the help of statistical tools in order to ascertain whether they are true or false.

While the formulation and testing of hypotheses are important in research, it is not necessary that every marketing research study must have a hypothesis. In some studies we are only interested in knowing factual information and hence there is no need for formulating a hypothesis. *Chapter 15 deals with the testing of hypotheses*.

To sum up, a careful formulation of the research problem would be helpful in providing a sense of direction to the research staff. As it specifies the precise scope of the problem, it makes research both meaningful and economical. Further, problem formulation, by setting out assumptions, would avoid any confusion to the reader. This also gives an idea of the environment in which the research is to be done, so that focus on the problem is not lost. Finally, problem formulation would also indicate the limitations of research itself so that one can see it in a proper perspective.

CHOICE OF RESEARCH DESIGN

A research design specifies the methods and procedures for conducting a particular study. Broadly speaking, research designs can be grouped into three categories—exploratory studies, descriptive research and causal research.

The choice of research design will depend essentially on the nature of the problem on which the research is to be undertaken. Another factor that is also relevant in this respect is the scope of the proposed study. If the scope is wide enough covering a number of aspects, then the research design will be very different from a study having an extremely limited scope.

An exploratory research focuses on the discovery of ideas and is generally based on secondary data. A descriptive study is undertaken when the researcher wants to know the characteristics of certain groups such as age, sex, educational level, income, occupations, etc. A causal research is undertaken when the researcher wants to know the cause and effect relationship between two or more variables. Such studies are based on reasoning along well tested lines.

Figure 4.2 gives these three types of research designs along with their sub-classifications. Detailed discussion on these research designs is given later in the next two chapters. As our purpose here is to discuss the steps involved in the research process, we move on to the next step, which relates to determination of sources of data.

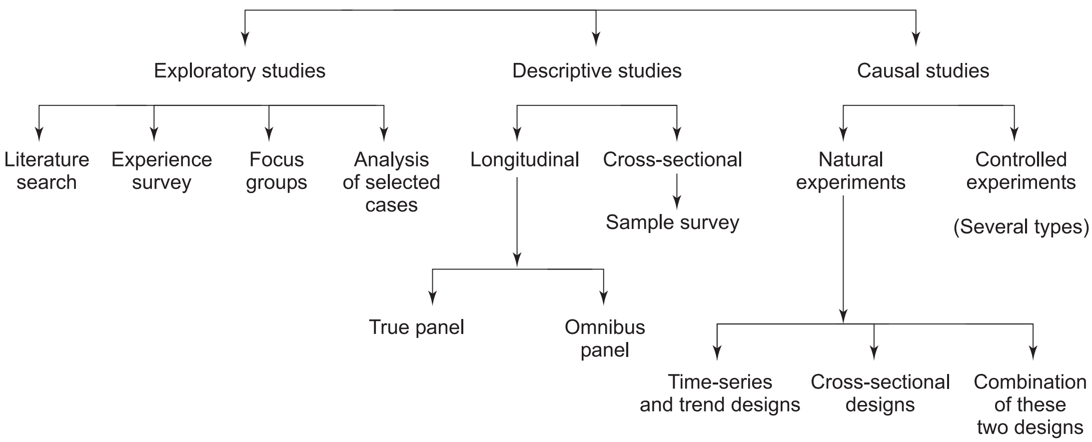

Fig. 4.2 Types of Research Design

DETERMINING SOURCES OF DATA

The next step is to determine the sources of data to be used. The marketing researcher has to decide whether he has to collect primary data or depend exclusively on secondary data. Sometimes, the research study is based on both secondary and primary data.

When a study is to be based on secondary data, whether partly or fully, it is necessary to satisfy oneself that the data are quite suitable for the objectives spelt out by the study. It is also advisable to evaluate secondary data in detail to avoid possible sources of error. To begin with, one should be familiar with the authentic sources of relevant data, their periodicity, the agency publishing or having such data, the concepts used in compilation and their limitations, if any. A sincere effort must be made to look into the existing data with a view to examining their suitability for the research. It is only when such secondary data are unavailable, inadequate, or unreliable, that a researcher should decide on collecting fresh data. *Chapter 7 deals with the secondary data in detail.*

DESIGNING DATA COLLECTION FORMS

Once the decision in favour of collection of primary data is taken, one has to decide the mode of collection. The two methods available are **observational method**, and **survey method**.

Observation

This method suggests that data are collected through one's observation. If the researcher is a keen observer, with integrity he would be in a position to observe and record data faithfully and accurately. While the observational method may be suitable in case of some studies, several things of interest such as attitudes, opinions, motivations and other intangible states of mind cannot be observed. Another aspect of this method is that it is nonreactive as data are collected unobtrusively without the direct participation of the respondent. This is a major advantage as the behaviour can be recorded without relying on reports from the respondents. *The observational method is discussed in more detail in Chapter 8.*

Surveys

In marketing research, field surveys are commonly used to collect primary data from the respondents. Surveys can be **(i) personal (ii) telephonic (iii) by mail** and **(iv) by diary.** Of these, personal and mail surveys are more frequently used in India. A choice has to be made regarding the type of survey for collecting data. There are certain advantages and limitations of each type of survey. Broadly speaking, telephonic survey is suitable when very limited information is sought in a short period of time. Moreover, such information should be readily available with the respondents. In contrast, surveys based on personal interviews are suitable when detailed information is to be collected. Sometimes a combination of two or more methods could also be used.

It is a common practice to use structured questionnaires prepared in advance, to elicit the necessary information from the respondents. In case the enumerators are to fill up the questionnaires, the survey is a personal one. It is a mail survey if the information is sought by sending the questionnaire by post. Whether it is a personal or a mail survey, it is necessary to design a suitable questionnaire, conduct a pilot survey and undertake a pre-testing of the questionnaire. The pre-testing will enable the researcher to realise the shortcomings of his questionnaire. In the light of this 'reaction' of the respondents, coupled with the personal observation of the researcher, the questionnaire should be modified. *The process of designing questionnaires and scaling techniques are discussed in Chapters 8 and 9.*

DETERMINING SAMPLING DESIGN AND SAMPLING SIZE

Another aspect which forms a part of research process is the sampling plan. When the marketing researcher has decided to carry out a field survey, he has to decide whether it is to be a census or sample survey. In almost all cases, a sample survey is undertaken on account of its overwhelming advantages over a census survey.

When a decision in favour of a sample survey has been taken, it is necessary to have a clear definition of the population from which the sample is to be drawn, before deciding on the type of sample design to be used. First, a broad choice is to be made between probability sampling and non-probability sampling. The researcher then selects a specific type of sample design from a number of sample designs. The type of sample design chosen will depend on its suitability and also the availability of the requisite sample frame.

As regards sample size there are two basic approaches—the ad hoc or practical approach and the statistical approach. Although the former is widely used in marketing research, it should be the endeavour of the researcher to follow the statistical approach which is based on well-defined principles. The size of sample will depend on the degree of precision required as also on the cost considerations.

The object of sampling is to choose a sample which will faithfully reproduce the characteristics of the population or universe. In practice, however, this objective is never completely attained on account of the occurrence of two types of errors—errors due to bias in the selection and sampling errors. It is desirable to minimise these errors and to consult an experienced statistician on sampling. *Chapters 11 and 12 are devoted to sampling designs and sample size decisions, respectively.*

ORGANISING AND CONDUCTING THE FIELD SURVEY

Having prepared the questionnaires and selected the sample design and size of sample, the next step is to organise and conduct the field survey. Two important aspects should be looked into—**interviewing** and **the supervision of field work.** The task of interviewing seems to be simple but, in reality, it is one of the most difficult tasks in marketing research. This is because respondents are generally hesitant in giving information unless approached with tact, initiative and intelligence. Supervision of field work is equally important to ensure timely and proper completion of the field survey. Neglecting these aspects would result in interviewing errors, which, in turn, would undermine the utility of the survey. *Chapter 13 deals with interviewing and the supervision of field work.*

PROCESSING AND ANALYSING THE COLLECTED DATA

Once the field survey is over and questionnaires have been received, the next task is to aggregate the data in a meaningful manner. A number of tables are prepared to bring out the main characteristics of the data. The researcher should have a well thought out framework for processing and analysing data, and this should be done prior to the collection. It is advisable to prepare dummy tables, as such an exercise would indicate the nature and extent of tabulation as also the comparisons of data that can be undertaken. *This aspect is discussed in Chapter 14.*

In order to derive meaningful results from the statistical tables, the researcher may use one or more of the following four steps. The first step is to calculate relevant measures of central tendency as also of dispersion, highlighting the major aspects of the data. The second is to cross-tabulate the data to ascertain some useful relationships. The third is to calculate the correlation coefficient and undertake a regression analysis between variables. The fourth is to undertake a multivariate analysis. Such an analysis uses a variety of techniques to determine important relationships amongst several variables.

While designing a research study, the researcher should give adequate thought to the use of particular analytical techniques. In the recent years, many such analytical techniques have proliferated due to the emergence of the computer. The researcher now has access to an increasing assortment of techniques and it is desirable to know well in advance as to what analytical techniques are going to be used, so that the data can be collected accordingly.

It is necessary that the researcher gives as much importance to the analysis and interpretation of data as he has given to their collection. In the absence of proper analysis, data may be rendered useless resulting in a waste of time and money. *Chapters 14 to 20 deal with the data processing, analysis and reporting.*

PREPARING THE RESEARCH REPORT

Once the data have been tabulated, interpreted and analysed, the marketing researcher is required to prepare his report embodying the findings of the research study and his recommendations. As a poor report on an otherwise good research will considerably undermine its utility, it is necessary that the researcher gives sufficient thought and care to its preparation.

Although report writing needs some skill which can be developed with practice, the researcher should follow the main principles of writing a report. Some of these principles are objectivity, coherence, clarity in the presentation of ideas and use of charts and diagrams. The essence of a good research report is that it effectively communicates its research findings. As management is generally not interested in details of the research design and statistical findings, the research report should not be loaded with such details, otherwise, there is a strong likelihood of its remaining unattended on the manager's desk. In view of this, the researcher has to exercise extra care to make the report a useful and a worthwhile document for the management.

Sometimes, a detailed marketing research study throws up one or more areas where further investigation is needed. Since research on those areas or aspects could not have been fitted into the original project, a separate follow-up study has to be attempted. *Chapter 20 deals with the types of reports, the format of a research report and its preparation.*

To sum up, the marketing research process, as described above, involves various steps, though strict adherence to each of these steps may not be necessary. A researcher may deviate from the above sequence and steps depending on his specific needs. It should be remembered that as research proceeds from the selection of the theme through the collection and analysis of data to the preparation of a report, the focus of attention will move from one activity to the other. This implies that the researcher does not always concentrate exclusively on one particular phase of research until its completion.

Further, while it is beneficial to draw a detailed plan and sequence of various activities in marketing research, it is hardly so if it requires such financial backing as the firm cannot afford. There is no point in attempting something which cannot be completed on account of financial constraints or limitations of time.

Another point worth emphasising is that howsoever elaborate a research design may be, its successful implementation depends in no small measure on its management. In fact, management of research, whether in marketing or in any other field, is of great importance. *This aspect has been discussed at length in Chapter 2.*

The foregoing discussion provides some understanding of the steps involved in the research process. At the same time, the researcher must know that each step involves several issues that should be addressed. If those issues are not taken care of, there would be further complications in the subsequent steps. This will affect the quality of research. It is, therefore, necessary to understand specific issues in each step of the research process. Table 4.2 lists some of the typical questions that need to be resolved at each stage of the research process.

Table 4.2 Questions to be Addressed at the Various Stages of the Research Process

Formulate the Research Problem
What is the purpose of the study? Is it to solve a problem or to identify an opportunity ?
Is any background information available?
What is likely to be the cost of information that may have to be collected?
Is research economically viable? Should it be undertaken?

Contd.

Types of Research Design

What is the nature of the problem?

What is the scope of the proposed study?

What type of study will it be,—Exploratory, Descriptive or Causal? Will it be a combination of these ?

Determining Sources of Data

Is it possible to use secondary data? To what extent ? Whether government publications or private?

What is the source of primary data? Is it relevant to our research? Is it reliable? How to design data collection forms ? Who will be respondents? Are they competent to answer questions? Is it possible to obtain objective answers from the respondents?

Designing Data Collection Forms

What should be the mode of collection?

Whether to use observational method or the survey method?

Should electronic or mechanical means to be used in observation method?

Should the questionnaire be administered in person or through mail or over the phone? Should measurement scales be used in the questionnaire? What specific scale/s to be used?

Determining Sample Design and Sample Size

Is a sample necessary?

If so, from which population sample is to be drawn ?

Is a list of population elements available?

What type of sample should it be — Probability or Non-probability ?

Within the Probability sample, what specific design is to be used ?

How large should the sample be ?

How should the sample be chosen ?

Organising and Conducting the Field Survey

Who will collect the data?

Has training been given to those who have to collect the data?

How long will the collection of data take?

Has provision of supervision in field survey been made?

Has any special effort been made to ensure the quality of data collected?

Processing and Analysing the Collected Data

Who will be responsible for editing of the data?

How will the data be coded?

What method of tabulation will be used — Manual tabulation or Computer tabulation?

Which methods will be used in analysing data?

Will computer be used for detailed analysis?

Contd.

Preparing the Research Report

Who will prepare the report?

What is the competence of the person preparing the report?

How far will statistical tables and charts be used?

Is it necessary to have an oral report? If so, who will present the report?

Will the report make recommendations?

Should the report indicate limitations?

Is it necessary to invite feedback on the report?

In the light of feedback, what improvements in the report are necessary?

ERRORS IN THE RESEARCH PROCESS[2]

The foregoing discussion provides some idea of the steps involved in the research process. It also gives a list of questions that need to be addressed at the various stages of the research process. This apart, an additional aspect needs to be discussed here. The researcher should ensure that the research does not have a high degree of error. If no care is exercised in minimising errors that are likely to crop up at every stage then they are bound to assume phenomenal proportions.

Broadly speaking, the errors are of two types—**sampling errors** and **non-sampling errors**. These two together constitute the total error.

Sampling Errors

Quite frequently, marketing research studies are based on samples of people or products or stores. The results emerging from such studies are then generalised, i.e., applied to the entire population. *For example*, if a study is done amongst *Maruti car owners* in a city to know their average monthly expenditure on the maintenance of their car, it can be done either by covering all *Maruti car owners* residing in that city or by choosing a sample, say 10%, of the total *Maruti car owners*. In the latter case, the study may give a different average than the actual average if the entire population is covered. This difference between the sample value and the corresponding population value is known as the **sampling error.** *This is discussed in Chapter 12.*

Non-sampling Errors

Non-sampling errors, as the name implies, are all those errors which occur in different stages of research except in the selection of sampling. Obviously, these errors are many and varied. A non-sampling error can arise right at the beginning when the problem is defined wrongly. It can also occur in any of the subsequent stages such as in designing a questionnaire, non-response of the questionnaire, in the analysis and interpretation of data, etc.

An important point to note is that sampling error is measurable while it is not easy to measure a non-sampling error. Another point to note is that sampling error decreases as the sample size in-

[2] Kinnear, Thomas C. and James R. Taylor: *Marketing Research—An Applied Approach*, New York, McGraw-Hill Book Company, 1987, pp. 22–26; and Tull, Donald S. and Del I. Hawkins: *Marketing Research—Measurement & Method*, New Delhi, Prentice-Hall of India Private Limited, 1998, pp. 67–72.

creases. This is not necessarily so in the case of non-sampling error. As the chances of non-sampling errors are several during the course of a study, the marketing researcher has to be very particular to ensure an effective control over them. Different types of non–sampling errors are briefly explained below.

Types of Non-sampling Errors

Defective Problem Definition Problem on which research is to be undertaken should be precisely defined. For example, a study on unemployment must be clear as to the concept of unemployment, the reference period, the geographic area to be covered, and so on. If any of these basic concepts has wrong connotation, the results of the study would turn out to be wrong.

Defective Population Definition If the population is not well-defined and does not fit to the objects of research study then an error occurs. In other words, selection of an appropriate population causes this error. Suppose a study is undertaken to know the views of industrial workers on incentives offered by a company. The study defines its population as male employees and interviews are held amongst them. The exclusion of female employees would be a source of error.

Frame Error The sampling frame is the list of all units comprising the population from which a sample is to be drawn. If the sampling frame is incomplete or inaccurate, its use will give rise to this type of error. For example, consider the voters' list as a sampling frame. If a survey is to be undertaken to collect information from different sections of the society, then the use of voters' list will be inappropriate. This is because young people below 18 years of age will be left out from the survey. Likewise, inadvertent exclusion of a part of population or geographic area will result into an error.

Surrogate Information Error This type of error occurs when the information sought by the researcher is different from the information needed to solve the problem. A simple example of this error is when price of brand is taken to represent its quality. In such a case, it is presumed that higher the price of the brand, the better is its quality. This may or may not be true.

Non-Response Error It is almost impossible to obtain data from each and every respondent covered in the sample. There are always some respondents who refuse to give any information. Thus, non-response error occurs when respondents refuse to cooperate with the interviewer by not answering his questions. This error also occurs when respondents are away from home when the interviewer calls on them. In case of mail survey particularly, the extent of non-response is usually high. For example, if a survey is conducted to ascertain the consumption pattern of people in a town, the error may occur when there is considerable difference between the consumption pattern of non-respondents and respondents.

Measurement Error This is caused when the information gathered is different from the information sought. For example, respondents are asked to indicate whether they own a colour television set. Some of them may respond in the affirmative just to boost their image before an interviewer, even though they may not be owning a colour television set. Such responses will result in measurement error. This type of error occurs frequently in research studies. Moreover, it is difficult to control it as it can arise from several sources.

Experimental Error An experiment aims at measuring the impact of one or more independent variables on a dependent variable. For example, take the case of the impact of training on the performance of salesmen. During the period when the training is given, there may be a decline in competition and as a result sales performance may improve. The results of such an experimental study will be misleading. Experimental error, like measurement error, may occur from several sources, which are discussed in Chapter 6.

Poor Questionnaire Design A questionnaire is an instrument to collect data from respondents in a survey. If the questionnaire is defective, the data collected on that basis will be misleading. For example, if one or more questions are wrongly worded conveying a different meaning than what was sought to be conveyed, wrong data will be collected through responses to such questions. This and related issues are discussed in Chapters 8 and 9.

Interviewer Bias This error occurs on account of interviewer's influence in conducting an interview or wrong recording by him. By putting emphasis on a certain word or phrase in a questionnaire, interviewers can influence respondents to answer in particular way. Interviewers sometimes even resort to filling up questionnaire without contacting the respondents. This error is discussed at length in Chapter 13.

Data Processing Error After the data have been collected, they are to be processed. This involves coding the responses, recording the codes, etc., so that data collection can be transformed into suitable tables. Mistakes can occur during the processing stage of data. This issue is discussed in Chapter 14.

Data Analysis Error As in the case of data processing, errors can occur on account of wrong analysis of data. Apart from simple mistakes in summation, division, etc., more complex errors can occur. For example, the application of a wrong statistical technique can cause such errors. This aspect is discussed in Chapters 15 to 19.

Interpretation Error Sometimes wrong interpretation of data can cause this type of error. In order to support a particular line of action, the researcher may deliberately mis-interpret data. Wrong interpretation of data may occur at time without one being aware of it. This aspect is discussed in Chapter 20.

CONCLUSION

The marketing researcher should not only be familiar with the foregoing potential errors but should also make an earnest effort to have an effective control over them. His effort should be to ensure that his research study is free from these errors to the extent possible. This means that he should be ever vigilant throughout the different stages of his research study. However, in practice, it is seldom possible to eliminate all potential errors. Efforts should be made to minimise individual errors. If two or more individual errors occur, he should minimise total error by error trade-offs. Finally, he should measure or estimate the extent of residual error that has still remained in the study.

Summary

Marketing research involves several interrelated steps, namely, formulating the research problem, research design, determining sources of data, designing data collection forms, determining sampling design and sampling size, organising and conducting the field survey, analysing the collected data and preparing the research report. When we talk of a particular step in research, our focus is mainly (though not exclusively) on it.

It is necessary that the problem chosen for research be comprehensively defined. A complete problem definition must specify (i) unit of analysis, (ii) time and space boundaries, (iii) characteristics of interest, and (iv) specific environmental conditions under which the problem is being studied. The chapter provides a list of typical questions that need to be resolved at each stage of the research process.

At every stage of the research process, there is likely to be some degree of error — sampling and non-sampling error. The researcher should exercise sufficient care to minimise these errors; otherwise these errors will undermine the utility of the research study.

Key Terms and Concepts

Research Problem 55
Exploratory studies 58
Descriptive studies 58
Causal studies 58
Data collection forms 59
Surveys 60
Research Report 61
Sampling Errors 64
Non-sampling Errors 64

Questions

1. "The marketing research process involves a number of interrelated activities which overlap and do not rigidly follow a particular sequence." Comment.
2. What is the sequence of steps involved in a marketing research project?
3. Why is the formulation of a research problem regarded as important?
4. What aspects must be specified in a problem definition if it is to be completed?
5. Do you think that every project must pass through each stage of the research process? Give reasons to support your answer.
6. What is a hypothesis? Should every research project have a hypothesis?
7. Distinguish between sampling and non-sampling errors.
8. What non-sampling errors are likely to arise during the course of a research study?
9. What questions need to be addressed at various stages of the research process? Mention at least two questions at each stage.

5 Exploratory and Descriptive Research Designs

Learning Objectives

After reading this chapter, you should be able to understand :

- The characteristics of scientific method
- The distinction between scientific and non-scientific methods
- The concept of research design
- Types of research design
- Exploratory research
- Descriptive research

SCIENTIFIC METHOD

As research should be based on scientific method, we should first know what the scientific method is. The scientific method encourages doubts and criticism so that what emerges is the real evidence which has stood the test of reasoning. It makes science progressive as it is never too sure about its results. A unique characteristic possessed by this method is self-correction. A scientist does not believe any proposition without testing it. He has a number of built-in checks all along the way to enable him to adhere to the right path and arrive at the 'truth'. Such checks are free from personal beliefs, attitudes and values.

Karl Pearson[1], in his famous book *The Grammar of Science* observes that there are **three distinct characteristics of the scientific method**—(a) careful and accurate classification of facts and observation of their correlation and sequence (b) the discovery of scientific laws with the aid of the creative imagination and (c) self-criticism and the final touchstone of equal validity for all normally constituted minds.

The first characteristic shows that the scientific method should enable us to classify facts accurately and carefully, free from the idiosyncracies of the individual mind. In other words, there must be objectivity in this task. The second characteristic relates to the discovery of scientific laws

[1] Pearson, Karl, *The Grammar of Science*, London, J.M. Dent and Sons Ltd., 1951 (Reprint), p. 37.

with the help of imagination. A mere collection of facts will not be sufficient to bring about scientific discoveries which will be the result of disciplined imagination and painstaking effort of the scientists. Finally, the third characteristic is that of self-criticism, i.e., the scientist should critically examine his own research in a detached manner.

Wolfe[2] expresses these characteristics in a different language. According to him, the common characteristics of the science are—(i) critical discrimination, (ii) generality and system, and (iii) empirical verification. Critical discrimination implies that one must not be influenced by mere appearance or prevalent notions but must try to get at the naked facts. Second, science is not interested in individuals but is concerned with generality or the system, i.e., groups or classes of objects. Finally, science aims at the testing and verification of facts empirically so that they can be confirmed or rejected.

Comparison of the scientific method and non-scientific method

Having looked into the different methods of knowing, we may now turn to a comparison of scientific and non-scientific methods. While there are several distinguishing features of the scientific method, the more important ones are briefly described below.

(i) The scientific method is more objective as compared to the non-scientific method. This is one of the strongest points in favour of the former. Over the years, a good deal of thought and experience has gone into the development of scientific procedures as a result of which far greater objectivity is found in the scientific method as compared to other methods. *For example*, hypotheses can be verified with the help of statistical principles, ensuring complete objectivity. Though there may sometimes be an element of subjectivity in the scientific method, that is more on account of the investigator than on account of the deficiencies of the method itself.

(ii) The scientific method is more precise than the non-scientific method. One great advantage of the former is that measurement and numerical analysis can be done, though measurement is not always attempted in every scientific investigation. Qualitative concepts are also defined precisely, which enables easier and more effective communication among researchers.

(iii) Finally, the scientific method takes cognizance of the existing knowledge in a particular field, carries out further investigations in it and compares the results with those obtained earlier. This leads to the expansion of knowledge. The process which is continuous and unending, systematises knowledge. Thus the scientific method contributes to the accumulation of systematic knowledge while the non-scientific method may not be able to do so.

Let us see whether marketing research satisfies these criteria. First, the marketing researcher is expected to be objective in his investigation. However, it is extremely difficult to remain completely objective during the entire research process, as one may be anxious at times to collect information to support and justify one's own position in regard to a certain issue.

Second, the marketing researcher is not so happily placed as the natural scientist in respect of the instruments of measurement. The latter can measure the minutest changes in his laboratory and is sure of the accuracy of his measurement. But the marketing researcher has to deal with such aspects as the attitudes of consumers, changes in their preferences and their impact on the consumption of a given product. The instrument of measurement that is often used in such problems is the question-

[2] Wolfe, A., *Essentials of Scientific Method*, New York, The Macmillian Company, 1925, pp. 10–15.

naire, which is relatively crude and cannot give a very high degree of precision. Added to this is the fact that it is used by several interviewers with varying backgrounds, training, experience and ability. As such, the information collected by them will have different degrees of accuracy.

Finally, the third criterion of the scientific method is that it is a continuous and unending process leading to the accumulation of systematic knowledge. Marketing research should ideally satisfy this criterion. However, as it is problem-solving and problem-oriented research, the focus of investigation is narrow. Because of the urgent nature of problems handled by marketing researchers, they seldom undertake exhaustive studies as is done by the natural scientists.

RESEARCH DESIGN

Having discussed the nature of the scientific method and the steps involved therein, we now turn to research design. According to Kerlinger[3]

> Research design is the plan, structure, and strategy of investigation conceived so as to obtain answers to research questions and to control variance.

The definition consists of three important terms—plan, structure and strategy. The plan is an outline of the research scheme on which the researcher is to work. The structure of the research is a more specific outline or the scheme and the strategy shows how the research will be carried out, specifying the methods to be used in the collection and analysis of data.

Let us look into a few other definitions of research design. Bernard S. Phillips[4] has defined the research design as:

> …the blueprint of the collection, measurement and analysis of data. It aids the scientist in the allocation of his limited resources by posing crucial choices—Is the blueprint to include experiments, interviews, observation, the analysis of records, stimulation, or some combination of these? Are the methods of data collection and the research situation to be highly structured? Is an intensive study of a small sample more effective than a less intensive study of a larger sample? Should the analysis be primarily quantitative or qualitative?

According to Green and Tull[5].

> A research design is the specification of methods and procedures for acquiring the information needed. It is the over-all operational pattern or framework of the project that stipulates what information is to be collected from which sources by what procedures.

From the foregoing definitions it is evident that research design is more or less a blueprint of research. It can be compared with the plan of house, which lays down the method and procedure for the collection of requisite information and its measurement and analysis with a view to arriving at certain meaningful conclusions at the end of the proposed study.

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[3] Kerlinger, Fred N., *Foundations of Behavioural Research*, Delhi, Surjeet Publications, 1983 (Second Indian Reprint), p. 300.

[4] Phillips, Bernard S., *Social Research Strategy and Tactics*, Macmillan Publishing Co., Inc., p. 93.

[5] Green, Paul E. and Donald S. Tull, *Research for Marketing Decisions*, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1970, p. 73.

TYPES OF RESEARCH DESIGN

At the outset it may be noted that there are several ways of studying and tackling a problem. There is no single perfect design. As such, the researcher should not wait until he arrives at a unique and perfect research design. Research designs have been classified by various authors in different ways.[6] Different types of research designs have emerged on account of the different perspectives from which a research study can be viewed. However, a frequently used classification system is to group research designs under three broad categories—**exploratory, descriptive** and **causal** as was mentioned in chapter 4 while discussing the research process.

Figure 5.1 displays all the three research designs

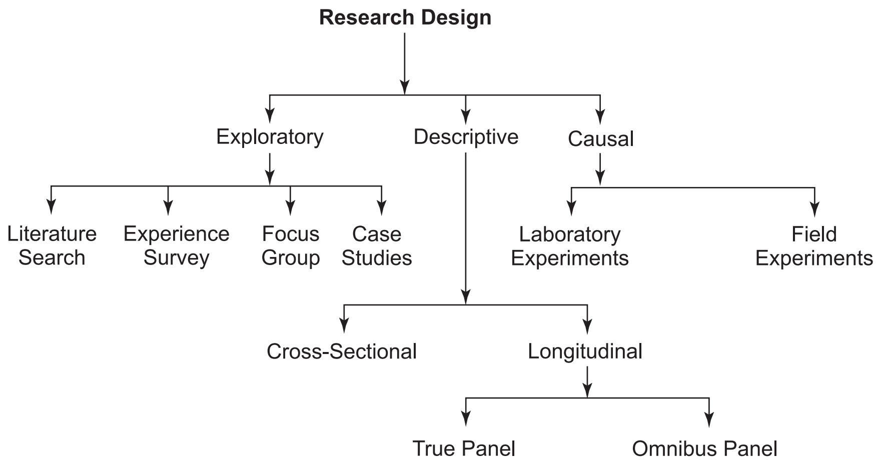

Fig. 5.1 Types of Research Design

Exploratory and descriptive research designs are discussed in this chapter while the causal research design forms the subject matter of the next chapter.

Exploratory Research

As its name implies, the researcher explores the nature of the problem and is free to proceed in whatever manner he wants to. Here, the focus is on the discovery of ideas as hardly anything is known about the problem to be studied. When the researcher embarks on an exploratory study, his approach is very flexible. In the beginning, he may be having vague ideas but as he goes on getting more and more information, he is more clear about the research problem. He may get new ideas to be examined to ascertain how far they are relevant to the problem.

With this brief introduction, we now turn to some methods that are generally used in exploratory studies. Following methods are generally used in exploratory studies:

- Literature Search
- Experience survey
- Focus group
- Case studies

These methods are discussed below.

[6] *See*, for example, Emory, C. William, *Business Research Methods*, Homewood, Illinois, Richard D. Irwin, Inc., 1976, p. 78.

Literature Search

Obviously, the literature search has to be relevant to the problem being studied. The search may involve conceptual literature, trade literature and published statistics. For example, take the case of a company whose sales have been declining. The researcher may look into the published statistics relating to the industry and compare it with his own. Such a comparison can be made easily and quickly. It will indicate whether the declining sales was an industry problem or the company's problem.

Sometimes, it may be necessary for the company to search conceptual literature if the problem so requires. Suppose the company finds that during the past couple of years, its sales have declined. The management discussed this problem with some salesmen who informed that there is much dissatisfaction among them. Having obtained this information, the management asked the researcher to look into psychological and sociological publications in addition to marketing journals.

It must be remembered that whenever an exploratory study is undertaken, due emphasis must be given on the discovery of ideas. If the researcher is able to come out with a couple of new ideas along with their possible explanations, this will be extremely useful in a subsequent stage when a descriptive study is conducted. This suggests that the research must be quite vigilant in his search for new ideas both from outside published material and the internal records of the company.

An exploratory study is in the nature of a preliminary investigation wherein the researcher himself is not sufficiently knowledgeable and is, therefore, unable to frame detailed research questions. To facilitate the generation of new ideas, the researcher along with his team should be given sufficient freedom to express themselves.

Experience Survey

As the name suggests, the experience survey attempts to tap the experiences of those who are quite qualified and sufficiently experienced in the overall area under which the problem being investigated is covered. Suppose there is a problem in respect of a consumer product. Here, any person who has worked in marketing area for sufficiently long time will be quite competent to share his experience. He may even provide some information that may turn out to be quite useful for the proposed study.

Senior executives of the company, product manager, sales manager and even sales representatives can be quite helpful while sharing their experience. It is advisable to contact people having different points of view. The researcher should have sufficient freedom in deciding the factors on which discussion is being sought.

At this stage, one may ask, when some information from knowledgeable and experienced people is being sought, what type of sample is to be used? It should be obvious here that the nature of this survey suggests that probability sample should not be chosen. The research has to use his judgement in choosing the respondents. At times, he has to depend on convenience sampling. This implies that respondents who are readily available and willing to share their knowledge and experience should be approached. Further, the interviews in the experience survey have to be unstructured and informal.

Focus Groups

In exploratory research, focus groups can be very useful in getting new ideas and insights. In the focus group interviewing method, the interviewer collects a small number of representative consumers for discussion on a particular subject. Generally, the group selected is a relatively homogeneous one so that a meaningful discussion can take place. On the other hand, it may be preferable to form a varied group so that diverse views on a particular topic are expressed. This will depend largely on the nature of the research problem.

To start a group interview in a reasonably sound manner, it is desirable that the moderator first explains the subject for discussion in his own words. Several groups are formed and the same procedure is followed in each case. Comparisons of discussions of these groups may enable the interviewer to get new 'insights' into the subject.

A detailed discussion on focus groups including their advantages and limitations is given in Chapter 13 on Interviewing.

Analysis of Selected Cases

Analysis of selected cases is yet another method that is frequently used in exploratory research. This method involves the detailed study of selected cases which are relevant to the problem under investigation. While using this approach, the researcher must be careful to record all relevant data. He should not be led away by such data that may support any initial hypothesis that he might have already formed. It is necessary to have an unbiased approach so that whenever any new information becomes available, it will be possible for him to make suitable changes, if necessary. To a large extent, the success of this approach depends on the researcher's ability to interpret a plethora of widely different information from one or more cases.

As requirements of data analysis where diversified data are involved are quite intense and challenging, the researcher must be proficient with various statistical techniques.

While using this approach, a relevant question is: which cases will be most valuable? Those cases which show either sharp contrast or have striking features are considered very useful.

At this stage, we may introduce a new term 'Benchmarking'. This involves identifying one or more organisations that excel in carrying out some function and using their practices as a source of ideas for improvement.

The practice of benchmarking would be quite useful for learning about existing products and business practices. It would also be helpful in providing better value to customers. However, benchmarked organisations would be most reluctant in revealing information about new products and in disclosing their strategies to competitors.

Descriptive Studies

Having looked into exploratory research, we now turn to descriptive studies. A good amount of research in marketing can be considered descriptive research or studies. Descriptive research is conducted when the purpose is as follows:

1. To determine the characteristics of a certain group. For example, when the researcher is interested in knowing the characteristics such as age, sex, educational level, occupation or income of certain groups, descriptive research is necessary.
2. To estimate the proportion of people in a given population who have behaved in a particular manner. For example, when the researcher is interested in knowing the proportion of people in a given population who are indifferent towards a new product launched in the market.

3. To make specific predictions. For example, the researcher is interested in knowing what will be the total sale of a specific product after two years, say, 2013.

There is a general belief that descriptive studies are factual and are very simple. This is not necessarily true. Descriptive studies can be complex, demanding a high degree of scientific skill on the part of the researcher. Unlike an exploratory study which is flexible, a descriptive study is considered rigid. The objective of such a study is to answer the "who, what, when, where, and how" of the subject under investigation.

Descriptive studies are well-structured. As was mentioned earlier, an exploratory study needs to be flexible in its approach, but a descriptive study, in contrast, tends to be rigid and its approach cannot be changed every now and then. It is, therefore, necessary that the researcher gives sufficient thought to framing research questions and deciding the type of data to be collected and the procedure to be used for this purpose. If he is not careful in the initial stages, he may find that either the data collected are inadequate or the procedure used is cumbersome and expensive.

Descriptive studies can be divided into two broad categories – cross-sectional and longitudinal. Of the two, the former type of study is more frequently used. Figure 5.2 gives the classification of descriptive studies.

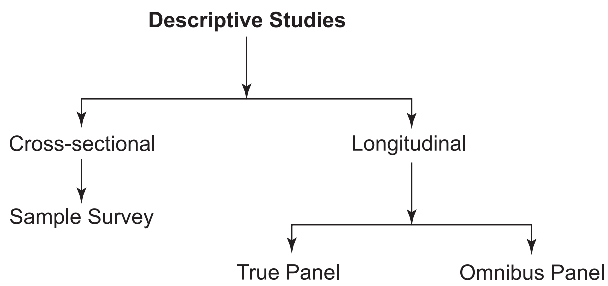

Fig. 5.2 Classification of Descriptive Studies

As regards the cross-sectional study, first a sample of elements from the population of interest is taken. Various characteristics of the sample members are measured once. A longitudinal study involves a panel, which is a fixed sample of elements. The sample remains relatively constant over time. The sample members in a panel are measured repeatedly.

Cross-sectional Studies

A cross-sectional study is concerned with a sample of elements from a given population. Thus, it may deal with households, dealers, retail stores, or other entities. Data on a number of characteristics from the sample elements are collected and analysed. Cross-sectional studies are of two types—**field studies** and **surveys**. Although the distinction between them is not clear-cut, there are some practical differences which need different techniques and skills.

Field studies are ex-post-facto scientific inquires that aim at finding the relations and inter-relations among variables in a real setting. Such studies *are done in life situations like communities, schools, factories, organisations, and institutions*.[7]

Field studies have their strengths and weaknesses.[8] One major strength is that they are close to real life, and they cannot be criticized on the ground that they are remote from real settings or are artificial. Field studies are more socially significant than other types of study. While investigating

[7] Kerlinger, Fred N., *op. cit*., p. 405.
[8] Ibid., pp. 406–408.

the behaviour and preferences of people, many other related issues, though not so obvious, also get answered. Thus, studies of this type have considerable social significance. Further, in real settings, variables exert their influence fully and, as such, the strength of variables is another advantage of field studies. Field studies are also strong in their heuristic quality. As an in-depth study of a few typical situations is made, many new questions crop up. Thus, additional hypotheses emerge during the course of investigation.

Field studies are also subject to certain weaknesses. Such studies are scientifically inferior to laboratory and field experiments. One of their major weaknesses is their ex-post facto character. As a result, interrelations among variables are weaker than they are in laboratory experiments. As there are several variables affecting the response of interest, such studies find it difficult to isolate their effects on account of there being almost no control on the variables. Another weakness is the lack of precision in the measurement of variables. This limitation arises on account of the greater complexity of field situations. Finally, such studies have practical problems in respect of feasibility, cost, sampling, and time. For instance, they are likely to take more time and involve a greater cost. The researcher has to look into these problems and satisfy himself that the proposed study is feasible and that sufficient time and money are available to him to undertake the study. In no case should he rush into a field study without examining these problems otherwise he may find himself in serious difficulties at a later stage.

Another type of cross-sectional study is survey research.[9] A major strength of survey research is its wide scope. Detailed information can be obtained from a sample of a large population. Besides, it is economical as more information can be collected per unit of cost. Also, it is obvious that a sample survey needs less time than a census inquiry.

Despite these advantages of survey research, it is subject to certain limitations. Generally, survey research does not penetrate below the surface as more emphasis is given to the extent of information sought rather than to an in-depth analysis. Another disadvantage is that survey research demands more time and more money, especially when it is conducted on a large scale.

Longitudinal studies

As mentioned earlier, longitudinal studies involve panels. There are two types of panels: true panels and omnibus panels. True panels involve repeated measurements of the same variables. It is important to know that each sample member is measured each time on the same characteristics over a period of time, such data will reflect changes in the buying behaviour of families. In an omnibus panel, a sample of elements is still selected and maintained, but the information collected from the sample members varies. At one time, it may be the evaluation of an advertising copy while at another time the attitude of panel members towards a new soft drink. This shows there is a clear difference between the true panel and the omnibus panel.

There are several advantages of using panel data. First, such data enable the researcher to undertake detailed analysis. Thus, one can determine the characteristics of individuals who have changed brands and those who have not. This may help the firm in identifying the segment of the population on which promotional effort should be focused. Another advantage of the panel is that more comprehensive data could be obtained as individuals or families included in the panel are those who have accepted to provide data periodically. As panel members are willing persons, more data can be collected. Yet another advantage is that panel data have been found to be more accurate

[9] Advantages and disadvantages of survey research are also based on Kerlinger, Fred N., op. cit., pp 422–23.

than data collected through surveys. Finally, costs of data collection through panels are generally lower than through personal interviews. A large proportion of the costs of the panel is fixed cost such as expenditure incurred on the recruitment, training and maintaining of panel members while the variable cost of collecting data from them may be moderate, particularly as the response rate will be extremely high.

There are certain limitations of panel data. A major criticism of panels is that they may not be representative samples. Since panel members are expected to put in some effort in furnishing data to the research organisation, some persons chosen in the original sample may refuse to serve on panels. This may distort the representative character of the original sample. To minimise refusals of this type, many organisations pay some money to panel members. This poses another issue: Does this payment attract a particular type of panel member? Another limitation is that panel members may report wrong data. Ordinarily, panel members are expected to act with a sense of responsibility and supply accurate information. However, this may not be the case when panels are not well maintained. Moreover, after the initial attraction of membership of a panel has faded, members may lose interest in this task and may not fully cooperate with the research organisation. This will affect the quality of information. Sometimes, panel members may deliberately give wrong information to show off their status, annoyance over periodical reporting or repeated interviews.

Comparison of Exploratory and Descriptive Research Design

Table 5.1 shows a comparison of exploratory and descriptive research designs. It brings out clearly the differences between the two research designs. However, there is always scope for combining the two designs though not at the beginning. As an exploratory research proceeds and some material is forthcoming, it prompts the researcher to extend its scope to undetake descriptive research.

Table 5.1 A Comparison of Exploratory and Descriptive Research Designs

Exploratory		Descriptive
Objective	Discovery of ideas and insights	Description of market characteristics or functions
Characteristics	Flexible design	Structured design, Formulation of specific hypotheses
Methods	Literature Search, Experience Survey Focus Groups, Case Studies	Sample Surveys, True Panels, Omnibus Panels

Summary

This chapter first explained what a scientific method is and how it differs from a non-scientific method. This is followed by a few definitions of research design and it is pointed out that there are three broad catagories of research design—exploratory, descriptive and causal. The chapter then discusses exploratory research design in detail. In this context, it discusses four methods, namely, literature search, experience survey, focus group and case studies that are commonly used in exploratory research.

As regards descriptive research design, it first points out that it has two broad categories; namely, cross-sectional and longitudinal which is of two types — true panel and omnibus panel. These are discussed in detail. The chapter ends by providing a comparison of exploratory and descriptive research designs.

Key Terms and Concepts

Questions

1. What is the scientific method? What are its characteristics?
2. How does a scientific method differ from a non-scientific method?
3. Do you think that marketing research satisfies all the characteristics of a scientific method? Give reasons for your answer.
4. What is a research design?
5. Is a research design necessary to conduct a study? Why or why not?
6. How do exploratory, descriptive and causal studies differ from each other?
7. What are the basic uses of exploratory research?
8. What is the basic characteristic of exploratory research?
9. Indicate whether the following are exploratory, descriptive or causal studies:
   (i) A study on the location of a new plant.
   (ii) A study to determine the reasons for the declining sales of a consumer product.
   (iii) A study to forecast the demand for scooters in India for the next 10 years.
   (iv) A study to advise on the sales volume quota for different territories.
10. What is the basic characteristics of descriptive research?
11. What are the main uses of descriptive research?
12. Distinguish between cross-sectional and longitudinal studies.
13. What are the relative advantages and disadvantages of cross-sectional and longitudinal studies?
14. What are the basic types of panels? Of what importance are the differences that exist in those panels ?
15. What are the basic types of cross-sectional studies?
    What are their relative advantages and limitations?
16. What is a cross-classification table ? What is the objective of cross-classification analysis?

6 Causal Research Design

Learning Objectives

After reading this chapter, you should be able to understand:

- The concept of causality
- The conditions of causality
- Natural experiments
- Controlled experiments
- The sources of experimental errors
- Experimentation in marketing research
- The criteria of research design

Having discussed two research designs—exploratory and descriptive in the preceding chapter, we now turn to causal research design. As the name implies, a causal research design investigates the cause and effect relationship between two or more variables. The chapter first describes the concept of causality, followed by the necessary conditions for causality to be inferred.

CONCEPT OF CAUSALITY

The concept of causality is complex. Let us take, for example, the statement "X causes Y". This implies that any change in Y is on account of X. This is how we commonly understand. However, a scientist will interpret this statement in a different way. He would say X is only one of the factors causing a change in Y. Further, while everyday interpretation implies a deterministic relationship, in contrast, the scientific interpretation implies a probabilistic relationship. Yet, another point of difference between scientific interpretation and everyday interpretation is that the former implies that it can never be proved that X causes Y. We can only *infer* on the basis of data that a relationship between X and Y exists. The inference is based on some observed data that might have been obtained in a very controlled experimental setting. Even so, the scientific notion recognizes the fallibility of such procedures.

CONDITIONS FOR CAUSALITY

This poses a major question: What kind of evidence is needed to support causal inferences? In this respect, it is necessary to satisfy three conditions, namely, concomitant variation, time order of occurence of variables, and elimination of other possible causal factors. It may be noted here that these conditions are necessary but not sufficient for causality. This means that even when all the three conditions are satisfied in a given case, it cannot be said decisively that there exists a causal relationship.

Concomitant Variation

Concomitant variation, or invariant association, is a common basis for ascribing cause. Concomitant variation is the extent to which a cause, X, and an effect, Y, occur together or vary together in the way predicted by the hypothesis under consideration. Suppose a company spends each year on advertising its products in different parts of the country. At the end of a year, the company finds that high sales have occurred in the areas with large advertising expenditures and meagre sales in the areas with limited advertising expenditures.

On the basis of this information, we can say that there is concomitant variation between advertising campaign and sales. Note that the implied hypothesis here is that advertising campaign causes sales to increase. It may be emphasised that we cannot decisively say that advertising is the cause of increased sales. At the most, we can say that the association between advertising expenditures and sales performance makes the hypothesis more tenable.

Time Order of Occurrence of Variables

A causal relationship between two variables on the basis of time order of their occurrence is conceptually simple. It implies that a variable cannot be considered the cause of another if it occurs after the other event. The occurrence of the causal factor must occur earlier or simultaneously with the occurrence of an event. Let us take an example pertaining to advertising expenditure and sales. Here, advertising expenditure (X) must precede the sales (Y). But there is another way of looking at the relationship between advertising expenditure and sales. Many companies allocate funds for advertising on the basis of part sales, for example, a 5 percent increase of the last year's sale. This indicates that higher sales lead to a higher allocation of funds for advertising. In the first example, X causes Y while in the second example, Y causes X. "It is possible for each term in the relationship to be both a cause and an effect of the other term."

On the basis of the above discussion, one can say that although this evidence is conceptually simple, its application is not that simple. The researcher must have a thorough understanding of the time sequence governing the phenomenon.

Elimination of Other Possible Causal Factors

The elimination of other possible causal factors indicates that when a causal relationship between two variables is being studied, then if there is one or more other possible factors that may effect that relationship, it should be eliminated. The relationship should be exclusively between the two factors.

Consider our earlier example of advertising expenditure and sales. How can we say that ad budget is a cause of improved sales performance? In fact, there are several factors such as pricing, quality of product, competition, magnitude of effort on the part of salesmen, and so on. If any one or more of these factors are relevant in a given relationship between ad budget and sales performance, one cannot decisively say that only ad budget is the cause of increased sales. Alternatively, a poor ad budget leads to decline in sales.

Thus, it is evident that we cannot rule out all other causal factors. However, in contrast, when we use experimental designs, it will be possible for the researcher to control some of the other causal factors. Further, the use of experimental designs enables the researcher to balance the effects of some of the uncontrolled variables so that only random variables resulting from these uncontrolled variables are measured.

It is worth noting that even when these three conditions, namely, evidence of concomitant variation, time order of occurrence of variables, and elimination of other possible causal factors are combined, it is not possible to say conclusively that a causal relationship exists. However, when more evidence pointing to the same conclusion becomes available from several investigations, our confidence on the causal relationship will increase. Again, if we have deep conceptual knowledge of the problem situation, confidence is further strengthened.

SOME DEFINITIONS AND CONCEPTS[1]

In order to understand experimentation properly, it is necessary for us to know some basic definitions and concepts.

Experiment

An experiment is executed when one or more independent variables are consciously manipulated or controlled by the person running the experiment, and their effect on the dependent variable or variables is measured. In surveys and observational studies, there is no manipulation of independent variables by the researchers. This is the fundamental difference between experimental and non-experimental research.

Treatments

Treatments are the alternatives or independent variables that are manipulated and whose effects are measured. Examples in marketing include product composition, advertising executions, price levels etc. In a measurement sense, treatments need only form a nominal scale.

Test Units

Test units are the entities to whom the treatments are presented and whose response to the treatments is measured. It is common in marketing for both people and physical entities, such as stores

[1] Kinnear, Thomas C, and James R. Taylor: *Marketing Research*, New York, McGraw-Hill Book Company, 1987, pp. 331–34.

or geographic areas, to be used as test units. For example, people may be asked to try a product and then have their attitudes toward it measured. Here people are the test units.

Dependent Variables

These are the measures taken on the test units. Typical marketing examples include sales, preference, awareness, etc. In a measurement sense, the dependent variables must form an internal scale.

Extraneous Variables

These are the variables other than the treatments that affect the response of the test units to the treatments. These variables can distort the dependent variable measures in such a way as to weaken or invalidate one's ability to make causal references.

Experimental Design

An experimental design involves the specification of (1) treatments that are to be manipulated, (2) test units to be used, (3) dependent variables to be measured, and (4) procedures for dealing with extraneous variables.

SYMBOLS DEFINED

To facilitate our discussion of specific experimental designs, we will make use of a set of symbols that are now almost universally used in marketing research.

- **X** represents the exposure of a test group to an empirical treatment, the effects of which are to be determined.
- **O** refers to the processes of observation or measurement of the dependent variable on the test units.
- **R** indicates that individuals have been assigned at random to separate treatment groups or that groups themselves have been allocated at random to separate treatments.
- Movement from left to right indicates movement through time.
- All symbols in any one row refer to a specific treatment group.
- Symbols that are vertical to one another refer to activities or events that occur simultaneously.

CAUSAL INFERENCE STUDIES

Having considered the meaning of causation and the types of evidence required to infer causal relationships in the preceding pages, we now turn to some specific designs of causal studies.

Causal inference studies can be divided into two broad categories—**natural experiments** and **controlled experiments**. The main point of distinction between the two is the degree of intervention or manipulation exercised by the investigator in a given study. Thus, a natural experiment will involve hardly any intervention of the investigator, except to the extent required for measurement. A controlled experiment, in contrast, will involve his intervention to control and manipulate variables.

Natural experiments[2]

There are three classes of designs for natural experiments—(i) **time-series and trend designs**, (ii) **cross-sectional designs**; and (iii) **a combination of the two.**

Time-series and trend designs

In a time-series design, data are obtained from the same sample or population at successive intervals. Generally, current data are obtained from a panel of individuals or households. Other panels such as wholesalers, retail stores or manufacturers can also be used. While time-series data relate to the same sample, trend data relate to matched samples drawn from the same population at successive intervals. Thus, there is no continuity in the sample in trend designs, as a result of which data can be analysed in the aggregated form. Since time-series data relate to the same sample over time, change in individual sample units can be analysed. An analysis of this type is also called longitudinal analysis.

There can be several variants of time series and trend designs. At one extreme they need at least one treatment and a subsequent measurement, at the other extreme, they may have several treatments and measurements. A few types of time-series and trend designs are briefly discussed below.

After-Only without Control Group The design is also known as the 'try out' or one-shot case study design. It is the simplest and can be shown symbolically as follows:

$$X \qquad\qquad O \tag{1}$$

where 'X' indicates the exposure of a subject or group to an experimental treatment whose effect is to be observed, and 'O' indicates the observation or measurement taken on the subject or group after an experimental treatment. Suppose that we provide training to a group of salesmen (X) for a certain period and then measure the sales effected by this group of salesmen (O). Since we do not have a prior measurement of sales made by each of the salesmen trained, it is not possible to measure the effect of training. On account of this major limitation, the design is used only in exploratory research. It should be avoided as far as possible.

Before–after without control group This design differs from the preceding one in one respect, i.e. it has a prior measurement as well. Symbolically, it can be shown as

$$O_1 \quad X \quad O_2 \tag{2}$$

and in an extended form as:

$$O_1 \quad O_2 \quad O_3 \quad X \quad O_4 \quad O_5 \quad O_6 \tag{3}$$

Taking our earlier example, the sales made by salesmen at period (1) are known to us. We now provide them training for a certain period, and then measure their sales. A comparison of sales after training is made with sales made during the corresponding period before training. Thus the effectiveness of training can be measured by O_2–O_1. The extended form of the design (3), is an improvement over design (2) as it shows that sales made by a group of salesmen X are measured for three successive periods prior to training and three successive periods after their training.

Although this design is widely used in marketing studies, it fails to provide effective conclusions. *For Example*, there may be several extraneous factors which affect the volume of sales. There may be a lack of competition or a spurt in income which may increase sales at a later period. There are other limitations as well such as the testing effect, which implies that measurement in a subsequent period may be affected by an earlier measurement.

[2] The discussion is on the lines of Green, Paul E. and Donal S. Tull, *op. cit.*, pp. 90–97

Multiple time-series Another time-series design involves the control group. Symbolically,

$$
\begin{array}{ccccccc}
O_1 & O_2 & O_3 & X & O_4 & O_5 & O_6 \\
O'_1 & O'_2 & O'_3 & & O'_4 & O'_5 & O'_6
\end{array} \tag{4}
$$

where the O's represent measurement of the control group. This design is an improvement over design (3) as it measures the effect of a specific treatment on the experimental group and compares it against the control group. Thus taking our earlier example of training salesmen, two comparable groups of salesmen are selected. Before the treatment, i.e. training, sales made by them for three successive time periods are measured for both the groups. Now the experimental group is given training. After the training, sales made by the experimental group as also those made by the control group (which was not given training) are measured. The difference between the average sales for the experimental group and the control group may then be attributed to training.

This design is generally used by selecting panels of individuals or households. Although this design is a substantial improvement over design (3), it suffers from some of the same limitations as were pointed out earlier. Thus, it fails to control history and there may be certain environmental changes in the later period, which may affect the effectiveness of the results. Also, results may be altered by the testing effect, i.e. respondents subjected to repeated testing show some peculiar reaction to the experimental stimulus.

Cross-sectional Designs

In cross-sectional designs, the effect of different levels of treatments are measured on several groups at the same time. Symbolically, a cross-sectional design may be shown as follows:

$$
\begin{array}{cc}
X_1 & O_1 \\
X_2 & O_2 \\
X_3 & O_3 \\
X_4 & O_4
\end{array} \tag{5}
$$

Thus, subscripts 1, 2, 3, 4 show different groups of X given differing treatments. The corresponding measures after the treatments are indicated by O_1, O_2, O_3 and O_4. Cross-sectional designs are used when varying levels of advertising is done for the same product but in different territories or when varying prices are fixed in different territories. The impact of varying levels of treatment is studied on the basis of the sales of the product in different territories.

The design also suffers from some of the limitations applicable to earlier designs. Thus, there may be extraneous factors that may affect the sale in a particular territory.

Combination of Cross-sectional and Time-series Designs

These designs, as the name implies, combine the time-series and cross-sectional designs. While there can be many variants, a more frequently used design is the ex-post-facto test-control group. The design can be s hown symbolically as follows:

$$
\begin{array}{ccc}
O_1 & X & O_3 \\
O_2 & & O_4
\end{array} \tag{6}
$$

Such a design is well suited to continuous panel data. A certain advertisement (*X*) is run and panel members are then asked if they had seen it earlier. Those who had may constitute a test or experimental group and those who had not form the control group. It may be noted here that the experimental and control groups would not be known until after the advertisement was run. The impact of the advertisement is measured by comparing the difference in purchases made by the experimental and control groups before and after the advertisement.

It will be seen that the experimental and control groups were formed on the basis of whether the panel members had seen the advertisement or not. This self-selection feature of the design may be a source of systematic error. Besides, the testing effect may contribute to inaccuracy. Despite these limitations, this design provides data both cheaply and promptly if the panel already exists.

Controlled Experiments

We have seen in the preceding pages that "*before–after*" experimental designs without control were subject to certain limitations, i.e. history, maturation, pre-testing and measurement variation. History may cause the 'before' and 'after' measurements to differ. There may be certain developments during the intervening period as a result of which the two measurements may not be comparable. The second factor is maturation which signifies biological and psychological changes in the subject which take place with the passage of time. *For example*, the subjects may react very differently '*before*' a television commercial is shown to them and *after* the programme. The third factor is the pre-testing which may affect the internal validity of the *before-after* design. If the consumers are asked about a particular product *before* the commercial on the television is shown, their responses to the *after* measurement could be influenced. Finally, variation in measurement may cause variations in the *before* and *after* measurements and these may be taken as the effect of the experimental variable. The foregoing limitations indicate the need for a control group against which the results in the experimental group can be compared.

In controlled experiments, two kinds of intervention on the part of the researcher are required. The first relates to the manipulation of at least one assumed independent or causal variable. In order to measure the effect of one or more treatments on the experimental variable, it is necessary that the researcher manipulates at least one variable. The second intervention relates to the assignment of subjects to experimental and control groups on a random basis. This is necessary so that the effect of extraneous factors can be controlled. As the size of the experimental and the control group increases, the effect of extraneous factors on these groups can be equalised or balanced by using a random selection procedure.

A few controlled experimental designs are as follows:

After-only with Control Group

This is the simplest of all the controlled experimental designs. In this design, only one treatment is given and then both the experimental and the control groups are measured. Symbolically, it can be shown as follows:

$$\begin{array}{ccc} R & X & O_1 \\ R & & O_2 \end{array} \qquad (7)$$

It has been criticised on the ground that it does not concern itself with the pre-test. However, by avoiding the pre-test, the design provides control over the testing and instrument effects. This design is particularly suitable in those cases where before measurement or pre-testing is not possible or where testing and instrument effects are likely to be serious.

Before-after with One Control Group

This design provides for pre-testing or before measurements. It can be shown symbolically as follows:

$$\begin{array}{llll} R & O_1 & X & O_2 \\ R & O_3 & & O_4 \end{array} \qquad (8)$$

Unlike design (6), this design provides for the selection of the experimental and control groups through the random method. The design is able to control most of the sources of systematic error. Both maturation and the testing effect may be taken as controlled in this design because of their presence in both the experimental and control groups. As the two before measurements, O_1 and O_3 and the two after measurements, O_2 and O_4 are made at the same points in time, the design is able to control history.

With the help of this design, one can measure the effect of treatments in three ways: $O_2–O_1$, $O_2–O_4$ and $(O_2–O_1) – (O_4–O_3)$. If these measures show similar results, the effect of experimental treatments can be inferred with greater confidence.

Four-group, Six-study Design

When the investigator has to obtain data from respondents in an undisguised manner, the 'before-after with control group' design, such as the preceding one, is not suitable. This is because both the experimental and control groups are likely to be influenced by the *before* measurement. To overcome this difficulty, a four-group, six-study design may be used. Such a design is extremely suitable in all those cases where some sort of an interaction between the respondent and the questioning process takes place. Symbolically, the design can be shown as follows:

$$\begin{array}{llll} R & O_1 & X & O_2 \\ R & O_3 & & O_4 \\ R & & X & O_5 \\ R & & & O_6 \end{array} \qquad (9)$$

This is a combination of designs (7) and (8). The effect of the treatment can be measured in several ways such as $O_2 –O_1$, $O_4–O_2$, $O_6–O_5$, $O_4–O_3$ and $(O_2–O_1) – (O_4–O_3)$. The after measurements can be shown in a 2 × 2 table as follows:

	No X	X
Before measurements taken	O_4	O_2
No *before* measurements taken	O_6	O_5

The difference between the '*No X*' and '*X*' column means shows the effect of the treatment. Similarly, the difference between the row means indicates the basis for estimating the testing effect. Further, the interaction of testing and treatment can be estimated from the differences in the individual cell means. Finally, the combined effect of history and maturation may be estimated by $O_6–O_1$, $O_6–O_3$ and $O_4–O_1$.

Our discussion of controlled experimental designs was confined to a single variable. At this stage, it may be necessary to make some observations on experimental research. It is decidedly better than descriptive research as it enables the researcher to ascertain cause and effect, provided a proper hypothesis is formulated. Experimental research is likely to be more useful to management in decision making and in recent years, it gained popularity which shows that it is a very promising area for researchers. While both laboratory and field experiments are useful in marketing, the latter are generally preferred as they are more helpful to management on account of their being more realistic.

SOURCES OF EXPERIMENTAL ERRORS

After having described the different types of experiments, we now turn to sources of potential errors in experiments. There are several errors which may distort the accuracy of an experiment. These are briefly described below.

History

History refers to the effect of extraneous variables as a result of an event that is external to an experiment occurring at the same time as the experiment. *For example*, consider the design $O_1 X O_2$ where O_1 and O_2 represent the sales effected by salesmen in an enterprise in the pre-training period and post-training period, respectively and X represents a sales training programme. This experiment is expected to indicate the effectiveness of the sales training programme by showing higher sales in the post-training period as compared to sales in the pre-training period. If the general business conditions have improved during the training period, then the sales could have risen even without the sales training programme. Thus, this factor would distort the accuracy of the experiment. In general, the longer the intervening time period between observations, the greater is the chance of history confounding an experiment.

Maturation

Although maturation is similar to history, it differs from it as the actual outcome is usually less evident. Maturation refers to a gradual change in the experimental units arising due to the passage of time. *In our earlier example* of training programme, salesmen have become more matured and more experienced due to the passage of time. As a result, the improvement in sales performance cannot be attributed to the training programme alone. Another example could be of consumer panels. The members of such panels forming test units may change their purchase behaviour during the period when an experiment is on. As the time between O_1 and O_2 becomes longer, the chance of maturation effects also increases.

Pre-measurement Effect

This error is caused on account of the changes in the dependent variable as a result of the effect of the initial measurement. *For example*, consider the case of respondents who were given a pretreatment questionnaire. After their exposure to the treatment, they were given another questionnaire, an alternative form of the questionnaire completed earlier. They may respond differently merely because they are now familiar with the questionnaire. In such a case, respondents' familiarity with the earlier questionnaire is likely to influence their responses in the subsequent period.

Interactive Testing Effect

This error arises on account of change in the independent variable as a result of sensitising effect of the initial measurement. In other words, the first observation affects the reaction to the treatment. *For example*, consider the case that respondents have been given a pretreatment questionnaire that asks questions about various brands of hair oil. The pretreatment questionnaire may sensitise them to the hair oil market and distort the awareness level of new introduction, i.e. the treatment. In such a case, the measurement effect cannot be generalised to non-sensitised persons.

Instrumentation

Instrumentation refers to the changes in the measuring instrument over time. *For example*, consider the case when the interviewer uses a different format of a questionnaire in O_2 as compared to that used in O_1. This would cause an instrumentation effect. A similar example could be of an interviewer who in his enthusiasm and interest in the survey in O_1, explained to the respondents whenever there was any difficulty. But the same interviewer gradually loses his interest in the survey and does not explain properly to the respondents in the post-measurement period – O_2. Yet another example could be when sales are measured in terms of revenue and the company has increased the prices of its products in the intervening period. In such a situation, the difference between sales in O_1 and O_2 will be on account of instrumentation as well.

Selection Bias

Selection bias refers to assigning of experimental units in such a way that the groups differ on the dependent variable even before the treatment. Such a situation arises when test units may choose their own groups or when the researcher assigns them to groups on the basis of his judgement. To overcome this bias, it is necessary that test units are assigned to treatment groups on a random basis.

Statistical Regression

Statistical regression effect occurs when test units have been selected for exposure to the treatment on the basis of an extreme pretreatment measure. *For example*, a training programme may be devised only for salesmen whose performance have been very poor. Sales increases in the post-treatment period may then be attributed to the regression effect. This is because random occurrences such as weather, health or luck may contribute to the better performance of salesmen in the subsequent period. Thus the effect of training programme may get distorted on account of this factor.

Mortality

Mortality refers to the loss of one or more test units while the experiment is in progress. It may be emphasised that mortality leads to the differential loss of respondents from the various groups. This means that respondents who left, say group A are different from those who left group B, thus making the groups incomparable. In case the experiment pertains to only one group, mortality effect occurs when responsiveness of the respondents who have remained in the experiment differs from responsiveness of those who have ceased to be in the experiment.

Table 6.1 shows in a summarised form sources of potential errors in experimental and quasi-experimental designs.

Table 6.1 Sources of Potential Errors in Experimental and Quasi-Experimental Designs

Experimental Designs		Potential Errors							
		History	**Maturation**	**Pre-measurement**	**Instrumentation**	**Regression**	**Selection**	**Mortality**	**Interaction Error**
1.	After-only (One-shot case study)	–	–				–	–	
2.	Before-after without control group	–	–	–	–	?	+	+	–
3.	After-only with control group	+	+	+	+	+	+	+	+
4.	Before-after with one control group	+	+	+	+	+	+	+	+
5.	Four-group, six study Quasi-experimental Designs	+	+	+	+	+	+	+	+
6.	Time Series	–	+	+	?	+	+	+	–
7.	Multiple time series	+	+	+	+	+	+	+	–

Notes: A plus (+) indicates that the design controls the error.
A minus (–) indicates that the design is unable to control the error.
A question mark (?) indicates a possible source of concern.
A blank indicates that the factor is not relevant.

EXPERIMENTAL VERSUS NON-EXPERIMENTAL DESIGNS

In the preceding chapter, our entire focus was on exploratory and descriptive research designs. Both of them are non-experimental designs. It may be noted that both these designs are unable to provide the control necessary to infer that a causal relationship exists.

As far as exploratory studies are concerned, there is hardly any problem because they are rarely used to make causal statements. But this is not the case in respect of descriptive studies.

Many a time, the descriptive study involves a cross sectional survey which comes to the conclusion that X causes Y. This apart, at times the time-series data are analysed using regression analysis to conclude X causes Y. Such studies, in fact, satisfy only one condition of causality, namely, concomitant variation. There is no control over the other two conditions of causality—the time order of the two variables, and the elimination of other possible causal factors. In view of these considerations, we cannot be sure about the causal relationship.

Descriptive studies are most frequently used in marketing research. Further, such studies will continue to ascribe causal relationships. While using such studies to establish causal relationships the researcher should know that he is taking the risk of being wrong.

EXPERIMENTATION IN MARKETING RESEARCH

Prior to 1960, experimentation in marketing research was very seldom. Thereafter, there has been a steady growth in this area. A major field where experimentation in marketing is performed happens to be test marketing or market test. A controlled experiment is planned carefully in a selected part of the market place. In most of the cases, the objective of such an experiment is to ascertain the probable sale of, say, a new product. If the result of the experiment is favourable, then the company may launch the product on a large market. Of course, there are some other areas where experimentation can be used in marketing research. For example, in advertising while choosing one of the two advertising copies, experiment can be used. Similarly, in the area of packaging too, experiment can be carried out.

While marketing experiments will continue to be used, there are three problems which need to be considered before undertaking any experiment. These are briefly discussed below.

Cost

Cost is a major consideration in marketing experiments. For example, when experiments relate to test marketing, designing questionnaires, choosing the sample and conducting survey and finally analysing the data and reaching the conclusion, all these activities will require funds. Further, if the test marketing shows unfavourable result, the company may have to suffer loss if it has already gone into production.

Time

Time is another consideration while deciding on experimentation. In the test marketing exercise, it is generally felt that sufficient time should be given to get reliable results. Experiments conducted over short periods do not allow for the cumulative effect of the marketing actions. In view of this, generally, a test marketing experiment is conducted for a year. Even longer time periods can be used, but this will turn out to be more costly. Again, this may pose some other problems, namely, control of experiment and reaction of competitors.

Control

A host of control problems arise when one thinks of conducting an experimentation, say, in test marketing. In which area/s test markets should be conducted? How should the distribution of the product be organised in the selected areas? Is it possible to get the necessary cooperation from wholesalers and retailers? What steps should be taken to protect the test marketing from the possible sabotage from the competitors? The company has to address itself to these issues, otherwise test marketing experiment may misfire. There have been several test marketing misfires which suggest that experiment should be carefully planned and conducted.

CRITERIA OF RESEARCH DESIGN[3]

Having discussed a number of research designs, and sources of potential experimental errors, we now turn to the criteria which a good research design should have.

The **main criterion** of a research design is that it must answer the research questions. To do this, it is necessary that proper hypotheses be formulated otherwise there may be a lack of congruence between the research questions and hypotheses.

The **second criterion** relates to control of independent variables—both the independent variables of the study as also extraneous independent variables. In order to achieve this, it is necessary to follow the random procedure of selection wherever possible. Thus, subjects should be selected at random, they should be assigned to groups at random and experimental treatments should also be assigned to groups at random. Research design will be good to the extent that randomisation is followed. It must be used wherever it can be. This will ensure confidence in the results as there will be adequate control over the independent variables. Wherever it is not possible to follow this criterion of randomisation, the intrinsic weakness of the research design must be recognised.

The **third criterion** is generalisability. To what extent can we generalise the results of the study? It is an extremely difficult question to answer. This criterion does indicate that generalisability is a desirable feature of good research for one would certainly like to apply the results to other situations. This is more true in the case of applied research.

Summary

This chapter first discusses the concept of causality. It then explains the conditions of causality, namely, concomitant variation, time order of occurrence of variables, and elimination of other possible causal factors. It emphasises that even if these three conditions are combined, one cannot say decisively that there is a causal relationship between the two variables. One can only make inference about the relationship.

[3] This discussion is based on Kerlinger, Fred N., *op. cit*., pp. 322–26.

This chapter also explains some of the terms commonly used in experiments. This is followed by a detailed discussion on a number of natural and controlled experiments. This chapter then identifies the potential errors that are likely to be committed in experiments. These errors have been given separately for each of the seven experimental designs covered in the chapter.

Towards the end, the chapter deals with experimentation in marketing research and suggests that experiments must be carefully planned and conducted. At the end, it mentions three criteria of good research design, which is applicable to all types of research studies.

Key Terms and Concepts

Questions

1. What is a causal research design? How does it differ from exploratory and descriptive research designs?
2. “Causal research is based on reasoning along well-tested lines.” Comment.
3. What types of evidence can be used to support an inference of causality?
4. What is an experiment?
5. Distinguish between natural experiments and controlled experiments.
6. “Experimental research is better than descriptive research.” Do you agree with this statement? Why or why not?
7. Describe the following experimental designs:
   (i) After-Only with control group
   (ii) Before-After with one control group
   (iii) Four-Group, six study design
8. Do you think that cross-sectional and time-series designs can be combined in a study?
9. What are the basic extraneous variables that can affect the outcome of a research study?
10. Briefly explain the sources of potential errors in experiment.
11. What factors should be considered while designing an experiment in marketing?
12. What are the criteria of a good research design?

CASE STUDY 1

TRAVEL AND LEISURE

A leading travel agency based in Delhi has been in travel business for almost two decades. When it started 20 years ago, there were only a couple of travel agencies and there was not much competition. However, now a large number of travel agencies are in the field resulting in stiff competition. This travel agency has faced setbacks, resuting in a marked decline in its income. Its main problem is, how to revive its business.

It has given some serious thought to this problem. After discussion with its staff as also some people who are in this line, it has zeroed in on the following issues.

1. How to increase awareness among people about its existence in travel business and its long experience in this field?
2. What should be its target population?
3. How to identify at least five places each within and outside the country, which will be of great interest to the common man?
4. Should it cater to specific groups of people such as teenagers, teachers, government employees, senior citizens, etc? Alternatively, should it have general category regardless of any specific group?
5. What type of information should be obtained from the prospective applicants?
6. What problems are likely to arise at the implementation satge?
   How these would be taken care of?

Question

You are asked to prepare a research proposal covering each of the above issues.

CASE STUDY 2

THE TOY INDUSTRY TO FIGHT BACK RED INVASION

After having been swamped by a virtual Chinese invasion, Indian toymakers have begun to realize that they must fight back to regain the domestic market they lost to the dragon kingdom. Even in the export market, India's toy exports at around Rs 1.3 billion ($29.2 million) were, however, a far cry from the Chinese dominance globally. They realize that on account of tough competition from China, complete recovery would take quite some time, say up to three years. This is because the Chinese challenge was so strong that at one time it led to panic and closure of Indian toy factories.

No doubt, there is an ambitious programme to promote the toy industry. There is a joint project amounting to $ 2.2 million by the National Programme of Development of Toy Industry, the Ministry of Small Scale Industries and the Toy Association of India. This, of course, has been helpful to some extent in improving the quality and design of toys. However, there is an increasing realization among the toy-manufacturers that while production is being taken care of by the above-mentioned joint project, some effective steps need to be taken in marketing the toys. For this it is necessary to have detailed information from consumers. Since the Indian toy manufacturers are scattered all over the country and are mostly operating on a small scale, they think that the best course is to approach the Toy Association of India to undertake a detailed survey to collect the desired information. The Toy Association of India has agreed with this suggestion and is now negotiating with a couple of marketing research agencies to submit a research proposal.

Question

Assuming yourself as a senior member of a marketing research agency, prepare a research proposal for consideration of the Toy Association of India. Your proposal should specify the type of information to be collected, sample design and sample size to be used and the extent of challenge from imported toys. The main emphasis should be to revive and enlarge the domestic market as also to capture a greater share in the overseas markets.

CASE STUDY 3

THE CENTRAL LIBRARY

In a metropolitan city, the Municipal Corporation is seriously considering to boost up the 'library movement' in the city. It is already having a Central Library with four branches in different locations of the city. It feels that the existing libraries are not fully utilized. Most of the people who visit the libraries spend their time in reading newspapers and magazines for which a separate room is allocated within the libraries. The Chief Librarian along with the four branch librarians recently discussed several issues relating to their libraries. They almost unanimously decided to know precisely who are the users of the library, what is their educational background, social status, job, etc. For this purpose, they want to sponsor a research study. A marketing research agency has been approached, which, in fact, suggested that an exploratory study is called for in this regard.

The agency felt that the scope of research should be widened. It would like the study to be conducted into three phases. According to it, Phase I will be an exploratory research but instead of confining to users of library, non-users should also be covered, for this purpose. It suggested that two focus groups—one for users and another for non-users be used. Each such group should have 8 to 10 persons. The user-group should have persons from different branches as well as from the Central Library. As regards non-users, it would be desirable to ensure that their group is broadly comparable with the user-group.

The exploratory phase of the study should be followed by Phase II which would be confined to employees working in libraries. The Agency felt that as the library staff is directly in touch with the users, they understand better the interests and problems, if any, of the users. They should also be encouraged to offer suggestions based on their experience in dealing with the public.

The Agency recommended Phase III of the study exclusively for the general public. The respondents can be split into two categories, viz. those having telephones and those who have no telephones. The questions will be on their attitudes towards libraries, how important and useful a library can be in improving their knowledge as well as the feeling that the time spent in reading books borrowed from libraries is well-spent. In addition, they will be asked to indicate the subjects in which they are interested and the timings that suit them most.

Questions

1. Evaluate each phase of the research proposal indicating how far it is feasible and appropriate.
2. Is it possible to improve the research design comprising all the three phases as given above? If so, what improvements would you recommend?
3. Identify the sources of potential errors likely to arise during the course of research. How does the research design attempt to control these errors?

CASE STUDY 4

RESEARCH AND MANAGEMENT

Given below are four episodes pertaining to two different companies. As you will notice, these episodes deal with the relationship between research and management. In respect of each episode, find out (i) What is happening? (ii) Is the relationship between research and management cordial and effective? (iii) Reasons for your answer in (ii). In case the relationship is not effective, suggest what steps should be taken to make it effective.

Episode A

Ram, a senior research analyst has been given the marketing plan for the promotion of microwave ovens. He has been asked to review it and offer his comments. On going through the marketing plan, Ram was surprised and commented that had the concerned people looked into my research report, they would not have proposed such a marketing plan. It ignores some basic concepts and does not seem to be possible within the manpower and financial resources available with the company.

On getting the comments from Ram, the planning manager was rather upset. He told a couple of his colleagues that Ram thinks too much of himself. We are quite competent to handle the problem without any assistance from Ram.

Episode B

Ashok Parikh is a Director of Research in a large company manufacturing a variety of leather products. He is particular about proper planning of research proposals. He has impressed upon his research staff to be quite clear when they prepare research proposals. They should ensure that the plan covers management objectives of the proposed study, data requirements, research design and the possible benefits of the research findings.

One morning when Ashok Parikh had just arrived in the office, he got a telephonic call from the marketing department, asking him to send a research staff member to attend a planning meeting to discuss the research needs for a proposed study. Parikh asked Mehra to attend this meeting, advising him to be sure in developing a proper specification of how the information sought would be used.

The meeting lasted very long. Later in the evening when Mehra returned from the meeting he seemed to be disappointed and sad. He told Parikh that they bluntly told him that it was none of his business to know how they were going to use the information. They said, “Your job is to get us the needed information. As regards its use, leave it to us. We will decide the manner and extent of its use.”

Episode C

Ramesh is a product manager and Suresh is a research analyst engaged in a large company that manufactures a variety of confectionery products. The company has recently introduced a new product.

In this connection, the following dialogue has taken place between them.

Suresh: I understand you are interested in a consumer test for the new product.

Ramesh: Certainly, I am interested to get some favorable results from the test market.

Suresh: In case the results are favorable from the test market, what will be your next move?

Ramesh: I would launch the product at the national level.

Suresh: In case the test market gives unfavorable results, what will be your decision?

Ramesh: I don't expect negative results if a proper test market exercise is planned and executed. I am quite confident about getting favorable results.

Episode D

Mr. Navin Joshi is a research analyst working in an industrial firm headed by Mr. R. K. Gupta.

While Gupta was considering the allocation of funds for an advertising campaign to be launched shortly, he asked Joshi what should be the proper amount. Joshi pleaded that a large sum is required for advertising as several areas need to be covered as well as different print media and visuals would be used. However, Gupta did not agree with his view. He said many times even large advertising expenditures have not resulted into increase in business. As such, Mr. Gupta scaled down the proposed allocation suggested by Joshi.

Joshi felt upset on this and thought that whatever he suggests, it is always turned down by Gupta. He is at a loss how to convince his boss that meagre advertising budget is no good. It is better to scrap it completely.

CASE STUDY 5

ENERGISING HERBAL TEA

A prominent Ayurvedic company, which is known for its medicines all over the country, has recently developed a herbal tea. It feels that normal tea is injurious to health, especially when taken in excessive quantity. Further, it is habit forming and gradually one gets addicted to it. It claims that its herbal tea is completely free from caffeine and its ingredients are genuine and their combined effect is very soothing to the nerves. A person, after taking a cup of herbal tea, feels relaxed.

Although the company has just developed this herbal tea, it has not introduced it in the market on a large scale. It is keen to place advertisements on television and newspapers but has delayed that. The company management wants to have solid evidence of the merits of its tea. It thinks an experiment is called for.

Question

Prepare an experimental design to ascertain the effectiveness of herbal tea over normal tea. Your experiment should identify clearly test units, dependent and independent variables, treatments, possible sources of extraneous variation on the dependent variable and methods of control of extraneous variables. Present your experimental design using R, O, X symbols.

CASE STUDY 6

THE HIGHER EDUCATION MARKET

The Indian Education industry has been growing strongly with major contribution from secondary and higher education segments. The education industry was valued at Rs 50 bn in 2008 and is expected to reach Rs 80 bn by 2012.

Although higher education segment is dominated by the public sector, in recent years, private sector participation has been taking place. As a result, several high quality private institutes have come up.

Of late, the owner of a large business organisation has been thinking of entering the education market. He has observed several companies of long standing have already entered in this field. He finds that it will give him great satisfaction if he can contribute in enhancing and improving the quality of education.

He has to decide on several issues. To begin with, what type of institution should be started. The education market comprises three segments, viz. schooling, higher education and skill development. Of these three segments, he seems to be interested in higher education. Further, what type of higher education should be provided in the proposed institution? For this, he would like to know the existing status of higher education, both in the public and private sectors.

He is now seized of these and other related issues. As a marketing researcher, you have been approached by this organisation.

Questions

1. While submitting your research proposal, what type of research would you recommend?
2. Since the field of higher education is vast, how would you ascertain a couple of areas where one should step in?
3. Will secondary sources of information data help you in your assigned task?

CASE STUDY* 7

HIMACHAL SOFT DRINKS COMPANY

Himachal Soft Drinks is a leading soft drinks manufacturing company which is based in Mumbai and has established a good image in the country for its products. It manufactures soft drinks in a variety of flavours such as orange, pineapple and mango. However, the company has noticed that during the past several months its competitive position has declined. To restore its 'supremacy', the company feels that perhaps a promotional campaign, especially during the summer season, may be helpful. Such a campaign would cost Rs 40 lakh and as it is a sizeable amount, the company is concerned about whether it should incur such a huge expenditure, particularly as it has limited experience to ascertain the success of such efforts.

Himachal Soft Drinks Company feels that if consumer reaction is extremely favourable (over a 10 per cent increase in market share), it stands to gain an additional profit of Rs 60 lakh; if it is favourable (5 to 10 per cent increase in market share), the additional profit is expected to be Rs 40 lakh, and if it is unfavourable (market share remains more or less unchanged), it stands to lose Rs 40 lakh, indicating the cost of the promotional campaign. The company's marketing manager gives the following estimates of the likelihood of these occurrences:

S_1 : probability of extremely favourable consumer reaction = 0.3
S_2 : probability of favourable consumer reaction = 0.4
S_3 : probability of unfavourable consumer reaction = 0.3

The company wants to assign a marketing research study to an outside agency. The study would cost Rs 150,000 and include field studies to gauge consumer attitudes toward the advertisements. In addition, some laboratory copy tests would be done to assess the attention-getting power.

The company has approached a marketing research firm, which has given the following associations between its assessments of an advertisement's effectiveness through research and its ultimate success:

Consumer Reaction

Past Experience	Extremely favourable	Favourable	Unfavourable
Strongly positive	0.6	0.3	0.1
Moderately positive	0.4	0.5	0.1
Slightly positive	0.0	0.2	0.8

Questions

Should the company launch a special promotional campaign without the research, or should the proposed research be conducted? You should construct a pay-off table of the promotion decision option without the research. Draw a suitable tree diagram showing the total decision, including the research options. Determine the value of perfect research information as also the value of research information.

*Adapted from Churchill Gilbert A., *Marketing Research:* Methodological Foundations, Hinsdale, Illinois, The Dryden Press, 1976, pp. 53–54.

CASE STUDY 8

SHOULD RESEARCH BE UNDERTAKEN?

(a) A marketing manager who has to decide on pricing a new product is in a dilemma. His company has just developed a new consumer product and it is to be introduced in the market. The manager has three options, viz. to adopt skim-pricing, penetration pricing, or fix the price of the new product somewhere in between the two extremes.

The marketing manager knows that the desirability of fixing any of these three prices ultimately depends on the extent of demand for the new product. After considerable thought and consultations with his senior colleagues, he has developed the following pay-off table.

Rs (Lakhs)

Alternatives	State of Nature		
	Light Demand S_1	Moderate Demand S_2	Heavy Demand S_3
Skimming Price A_1	40	20	–20
Intermediate Price A_2	20	40	–10
Penetration Price A_3	–20	0	30

Based on his past experience and knowledge of the possible substitutes for the new product, the marketing manager thinks that the probabilities of having (i) light demand, (ii) moderate demand, and (iii) heavy demand would be 0.6, 0.3 and 0.1, respectively.

Questions

1. What should be the choice of the marketing manager if his objective is to maximize the expected returns?
2. What is the expected value of perfect information?
3. In the foregoing problem, suppose the marketing manager is inclined to undertake research so that additional information would enable him to price the new product under conditions of certainty. For this purpose, he wants to test-market the product. He is able to assign probabilities of achieving different test-market results, given that the product would ultimately have a particular level of demand. These probabilities are given in the table given below:

Conditional Probabilities of Getting Different Test Market Results Given Each State of Nature

Test Market		Light Demand S_1	Moderate Demand S_2	Heavy Demand S_3
1.	Unsuccessful	0.6	0.2	0.2
2.	Moderately Successful	0.3	0.1	0.3
3.	Highly Successful	0.1	0.7	0.5

(a) What is the expected value of the proposed research?

(b) What is your advice to the marketing manager regarding the desirability or otherwise of undertaking marketing research?

CASE STUDY 9

A COMPUTER RETAIL OUTLET

Four students who have first passed their MBA examination from the University of Delhi are interested to set up their own enterprise. Some time back, they appeared at the campus interviews. All of them were able to get good offers from both Indian and foreign companies. For a few days, they were rather in confusion whether to accept the offers of lucrative jobs or to set up their own company. Eventually, they decided in favor of the latter. While several options were available to them, they all agreed upon starting a computer retail unit. This choice was mainly based on their knowledge of electronics which they acquired in the university before taking up an MBA course of study.

As the boys came from the N.C.R., they decided to set up a computer retail outlet in Gurgaon (Haryana), which has close proximity to the national capital, Delhi. But they wanted to enter this line very cautiously.

They would like to undertake research concerning all aspects of the retail computer market, as they feel that they themselves would not be able to look into all this objectively, not to mention that this is just the beginning. They have now approached you to provide them with the requisite information.

Questions

1. What decisions need to be taken before setting up the proposed computer retail outlet?
2. Identity the type of information required in respect of each of these decisions.
3. In order to have the requisite information, what marketing research would you use?

CASE STUDY 10

SUPERIOR PUBLISHING HOUSE

A young boy Ram had a flair for writing. Therefore, he opted for English literature in M.A. Within a couple of years of his coming out from the university, he wrote a short novel concerning the prevailing social and political conditions in the country.

Ram was very happy that at such a young age, he was able to write a novel. He was now keen to get it published as soon as possible. Ram approached a couple of publishers and showed his manuscript for their consideration. He was disappointed to find that the publishers were not inclined to publish his novel They thought it would have an extremely limited demand and they would not be reach even the break-even point.

After receiving rejections from the publishers, Ram was feeling depressed. During this time, one day, all of a sudden, he got an idea to publish his novel on his own. He talked to his close friend Shyam about it and sought his help. Shyam was convinced about the talent and creativity of his friend. Both decided to publish the novel by the Superior Publishing House owned by them. Both agreed on their contribution to ensure a modest fund to take care of the initial requirements. They worked hard and soon after the novel was available in the market. Within six months of its release, there appeared very favourable reviews of the novel. Although encouraged by favourable reviews of the novel, Ram was concerned about the next step. Both friends decided to explore the market for novels and other general books that may appeal to the youth. However, they lacked the necessary information about the reading preferences of the youth. This information was very vital for the Superior Publishing House. It was eager to get an insight into the following areas:

1. What are the specific areas in which the youth are interested?.
2. Do young boys and girls purchase books, or do their parents purchase books for them?
3. What type of promotional items do college students enjoy most?
4. What advertising media are most effective in reaching college and university students?

You have been approached by the Superior Publishing House to develop and implement a research project to investigate these ideas.

Questions:

1. Define the research problem.
2. What is the target population for your study?
3. Discuss your proposed research plan.
4. Discuss the implications in the implementation of the project.

2

Data Collection, Sampling and Interviewing

7 Secondary Data

Learning Objectives

After reading this chapter, you should be able to understand:

- The meaning of secondary data
- The advantages and disadvantages of secondary data
- The method of evaluating secondary data
- The internal and external sources of secondary data
- How to search for published external data
- Syndicated sources of secondary data

After the research problem in marketing has been identified and selected, the next step is to gather the requisite data. At this stage, there is much temptation among the researchers to organise a field survey to collect the data. While a field survey may be necessary for data collection, it should be resorted to only when all other sources of data collection have been exhausted. As some authors have rightly said: "A good operating rule is to consider a survey akin to a surgery to be used only after all other possibilities have been exhausted."[1]

Any data which have been gathered earlier for some other purpose are secondary data in the hands of the marketing researcher. In contrast, those data which are collected at first hand either by the researcher or by someone else especially for the purpose of the study are known as primary data. Thus, primary data collected by one person may become the secondary data for another. *For example*, the demographic statistics collected every ten years are the primary data with the Registrar General of India, but the same statistics used by anyone else would be secondary data with that individual. There are certain distinct advantages, as also the limitations, of using secondary data. As a researcher, one should be fully aware of both the advantages and limitations.

ADVANTAGES OF SECONDARY DATA

- A major advantage in the use of secondary data is that it is far more economical, as the cost of collecting original data is saved. In the collection of primary data, a good deal of effort is

[1] Ferber, Robert and P.J. Verdorn, *Research Methods in Economics and Business*, New York, Macmillan, 1962, p. 208.

required— data collection forms are to be designed and printed, field staff is to be appointed and maintained until all the data have been collected, their travelling expenses are to be incurred, the sample design is to be selected, data are to be collected and verified for their accuracy, and finally, all such data are to be tabulated. All these activities would need large funds, which can be utilised elsewhere if secondary data alone can serve the purpose.

- Another advantage is that the use of secondary data saves much of the time of the researcher. This leads to prompt completion of the research project.
- Search for secondary data is helpful, not only because secondary data may be useful but because familiarity with such data indicates the deficiencies and gaps. As a result, the researcher can make his primary data collection more specific and more relevant to his study.
- As the researcher explores the availability of secondary data relevant to his project, he finds, in the process, that his understanding of the problem has improved. He may even have to change some of his earlier ideas in the light of the secondary data.
- Finally, secondary data can be used as a basis for comparison with the primary data that the researcher has just collected.

DISADVANTAGES OF SECONDARY DATA

In practice, one finds that secondary data seldom fit perfectly into the framework of marketing research. This is on account of a number of factors.

- The unit in which secondary data are expressed may not be the same as is required in the research project. *For example*, the size of firm can be expressed as (i) number of employees, (ii) paid-up capital employed, (iii) gross sales, (iv) gross or net profit, etc. It is just possible that the unit of measurement used in secondary data is different from the one needed in the research project. In that case, secondary data cannot be used.
- Even if the units are the same as those required by the research project, it may just be the case that class boundaries are different from those desired. *For example*, the monthly income of households may have a break-up of (i) less than Rs 500, (ii) Rs 501–1000, (iii) Rs 1001–1500, (iv) Rs 1501–2000, and (v) Rs 2001+ so far as secondary data are concerned. If the researcher wants to find, for example, the number of households with a monthly income of Rs 1800 or some similar figure, he will be at a loss with such secondary data.
- One does not always know how accurate the secondary data are. In case the degree of inaccuracy is high, the use of such dubious data would undermine the utility of a research study. In most cases, it is difficult to know with what care secondary data have been collected and tabulated. All the same, in the case of well-established and reputed organisations, both official and non-official, secondary data would be far more accurate and reliable and they can be used without much reservation.
- A severe limitation in the use of secondary data is that they may be somewhat out of date. A good deal of time is spent in the collection, processing, tabulation and publishing of such data and by the time the data are available to the researcher, they are already two to three years old. As a result, the data are no longer up-to-date. It is a moot question as to how such data are relevant at the time of their use. Obviously, the utility of secondary data declines progressively as the time goes by, and they are finally useful only for historical purposes.

EVALUATING SECONDARY DATA

Since the use of secondary data is substantially cheaper than that of primary data, it is advisable to explore the possibility of using secondary data. In this connection, there are four requirements that must be met. These are—(i) Availability of secondary data, (ii) Relevance, (iii) Accuracy, and (iv) Sufficiency.

These requirements are briefly discussed here.

- The first and foremost requirement is that secondary data must be available for use. At times, one may find that secondary data are just not available on a problem at hand. In such cases there is no alternative but to take recourse to the collection of primary data.
- Another pre-condition for the use of secondary data is their relevance to the marketing problem. Relevance means that the data available must fit the requirements of that problem. This would cover several aspects. First, the unit of measurement should be the same as that in the marketing problem. Second, the concepts used should be the same as are envisaged in the problem. *For example*, social class, income, employment should have the same definitions. Another pertinent issue is that the data should not be obsolete. Generally, any secondary data would have been collected sometime in the past, but they should not be so remote as to make them useless.
- The third requirement is that the data should be accurate. In this connection, one should consult the original source. This would not only enable the researcher to get more comprehensive information but would also indicate the context in which data have been collected, the procedure followed and the extent of care exercised in their collection.
- Finally, the data should be sufficient. If the data are inadequate, then compliance with the preceding requirements will be in vain.

The foregoing requirements must be met to avoid an improper use of secondary data. One may go into more specific details. It may be emphasised that the use of secondary data by the marketing researcher imposes an implicit responsibility on him that he has satisfied himself as to their accuracy and reliability. In view of this, he has to be extremely careful when deciding to use any secondary data. To help him take a decision, he has to seek answers to such questions as—What sample design was used for collecting data? What questionnaire was used? What was the quality of the field staff which collected the data? What was the extent of non-responses and how was the problem handled by the organisation? These are some of the questions which are pertinent while deciding the reliability of secondary data. As information on some of these questions is not readily available, the researcher may have to spend quite some time to get it. In the final analysis, it is the reputation of the organisation collecting and publishing such data, and its regularity in their publication, that would carry more weight than anything else.

Robert W. Joselyn[2] suggests a detailed approach for evaluating secondary data and understanding their potential limitations. The approach comprises eight steps as shown in Fig. 7.1.

The eight steps are grouped into three categories, namely (i) applicability to the project objectives, (ii) cost of acquisition, and (iii) accuracy of the data. Under each of these categories, answers to specific questions are sought. Thus, some of the basic questions are—Do the data apply to the population of interest? Do they apply to the time period of interest? Can the units and classifications presented apply? If answers to these and similar other questions are in the affirmative, one

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[2] Joselyn, Robert W., *Designing the Markething Research Project*, New York, Petrocelli/Charter, 1977, pp. 53–57.

may proceed with the use of secondary data, otherwise one should drop the idea of using them. At the end, the author rightly cautions the researcher to exercise great care before using the secondary data "because of the natural tendency of many people to hide a shaky foundation beneath an elaborate superstructure."

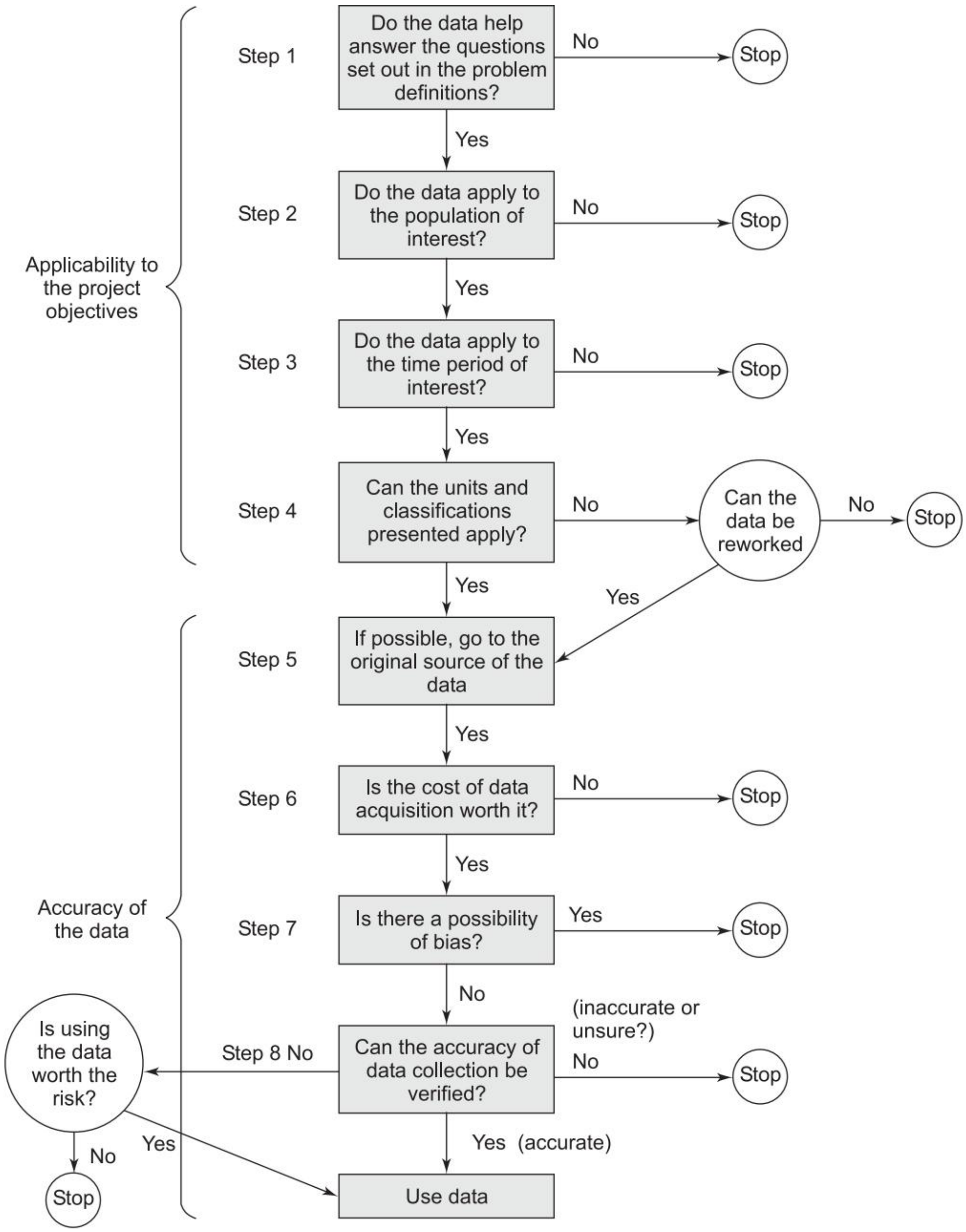

Fig. 7.1 Evaluation Procedure for Secondary Data

Source: Joselyn, Robert W., *Designing the Marketing Research Project*, New York, Petrocelli/Charter, 1977.

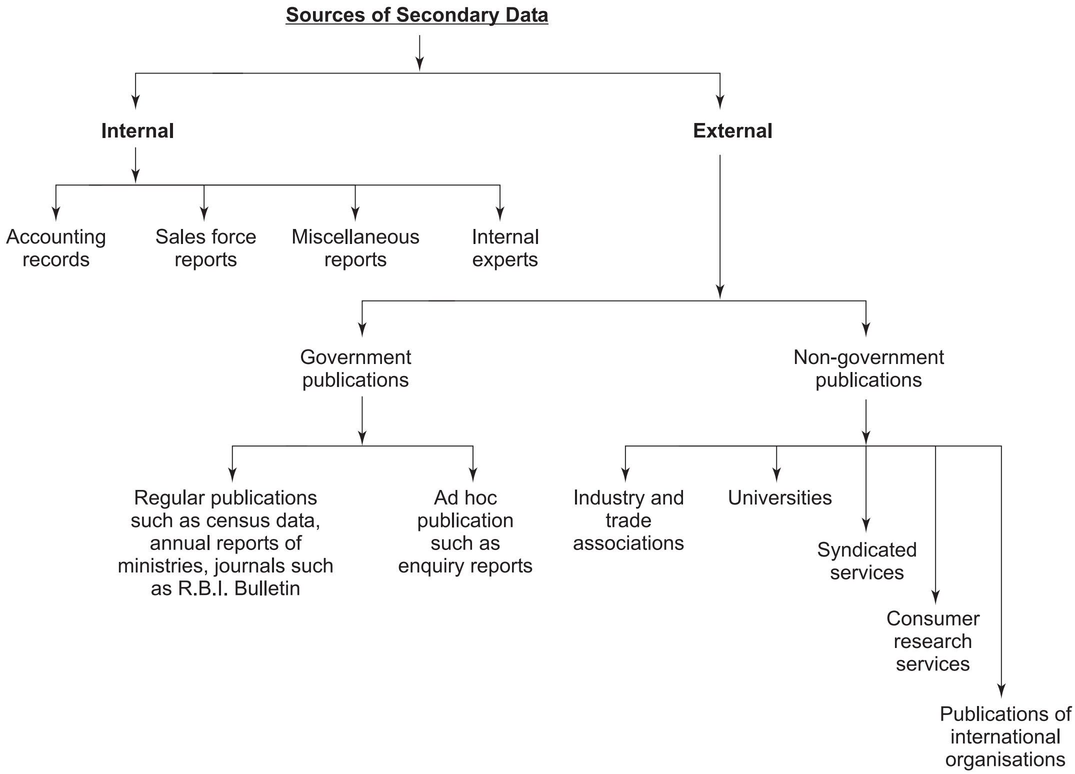

Fig. 7.2 Sources of Secondary Data

SOURCES OF SECONDARY DATA

Secondary data can be obtained internally, i.e. within the firm; or externally, i.e. from one or more outside agencies. Fig. 7.2 shows various sources of data. We first discuss internal sources.

Internal Sources of Secondary Data

Internal sources can be classified under four broad categories—**accounting records, sales force reports, miscellaneous reports and internal experts.**

- Accounting records generate a good deal of data. As profits are based on sales, sales invoice is a good source. Normally, a sales invoice includes name of the customer, address of the customer, items ordered, quantities ordered, quantities shipped, discounts allowed, price charged, total amount of sales and the date of sales. It often contains information on sales territory, sales representative and warehouse from which the product was despatched. Such information can be extremely useful in undertaking a detailed analysis of sales by product, customer, industry, geographic area, sales territory and sales representative. Compared with corresponding data on costs, it can indicate the level of profits (or loss) for each product. This apart, data on advertising expenditure along with the time period would also be available.

- Another internal source is in the form of sales force reports. This source can provide a very useful marketing information but somehow it has remained largely untapped. This is because sales persons may not be giving detailed reports. In order to ensure that this source is more useful, it is necessary to organise the system properly. It should be a simple process of reporting the information. Sales persons may be encouraged to provide accurate and comprehensive information. Some incentive may be given to those who report accurately and adequately.
- Another source of internal data is in the form of miscellaneous reports. Any studies done earlier on marketing problems of the company, special audit, etc. come in this category. Such reports on varying subjects should be properly maintained and easily accessible when required.
- Finally, experts working in the company can also be a good source of internal data. Executives working as product managers, marketing research managers, public relations personnel and advertising personnel have specialised knowledge relevant to marketing problems. However, this source is least tapped. A limitation of this source is that information is in the expert's mind and not on paper. The experts can provide useful information or ideas on a given marketing problem whenever a serious discussion is held in a meeting.

External Sources of Secondary Data

The external secondary data do not originate in the firm and are obtained from outside sources.
It may be noted that secondary data can be collected from the originating sources or from secondary sources. *For example*, the Office of the Economic Adviser, Government of India, is the originating source for the data on wholesale prices. In contrast, a publication such as the *Reserve Bank of India Bulletin* containing some parts of the series of wholesale prices, is a secondary source.

Generally, the originating source of external secondary data should be preferred on account of several reasons.[3] First, the originating source is more likely to explain the object and procedure of data collection. Second, the originating source is more likely to present all the data, whereas a secondary source may present a part of such data, depending on its requirement or convenience. Finally, the originating source would be more accurate as each additional repeating source of secondary data presents another possible source of error.

Despite these advantages of using the originating source of secondary data, many a time secondary sources of secondary data are used. There may be good reasons[4] for this. First, the secondary source may be readily available to the researcher and, as such, it is convenient to use it if the data are sufficiently reliable. At times, he may have to refer to different originating publications and search through numerous pages. The likely improvement in the quality of secondary data may not be commensurate with the time and effort required for using the originating source. Second, sometimes secondary sources provide secondary data on punched cards or magnetic tape for computer input. As a result of this facility, the researcher may prefer the secondary source.

As we are mainly interested in the external sources, the following discussion is confined to outside agencies which publish data.

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[3] Based on Uh1, Kenneth P. and Bertram Schoner, *Marketing Research-Information Systems and Decision-Making*, New York, Wiley and Sons, Inc., 1969, p. 361.

[4] Ibid., p. 391

Government Publications

A large bulk of secondary data useful to a marketing researcher is found in various government publications. To give an idea of the nature of data contained, periodicity and concepts used in respect of each of the government publications would be overstretching the scope of this textbook. Moreover, it is not necessary to be exhaustive as this work does not solely concern Indian statistics. As such, the following discussion provides only some general idea of the nature of data provided by the major government agencies.

To begin with, the Registrar General of India conducts a population census throughout the country every ten years and brings out demographic data in voluminous reports. These publications provide perhaps the most basic source of information useful to the marketing researcher. The data relate to various characteristics such as the break-up of population by sex, rural urban residence, age, education and occupation. While it is true that these statistics are available only decennially, they are the most authentic and are often used as the basis for projection for future years.

The Central Statistical Organisation (CSO) brings out statistics of national income. Its major publication, 'National Accounts Statistics', is brought out once a year and contains estimates of national income for several years. The figures are given separately for major economic activities such as agriculture, industry, trade, transport, etc. Besides this, the estimates of saving, capital formation and consumption expenditure, together with national and public sector accounts are given.

The CSO also brings out the Statistical Abstract, India, which is an annual publication. It contains all India statistics for various sectors of the economy for a number of years, usually five.

As regards industrial statistics, the CSO publishes detailed data on the performance of the industrial sector in its annual publication 'Annual Survey of Industries.' The data are given on a very comprehensive basis and relate to the number of units in a particular industry, workers and non-workers employed, productive capital employed and its break-up by major categories, number of man-hours worked, total production and its break-up by important product-types, both in physical units and values, expenditure incurred on materials, electricity consumed, and finally, the value-added by manufacture, shown separately as that part which is paid to workers as wages and that which returns to the industry.

The CSO also brings out the *Monthly Production of Selected Industries of India*. These statistics are on output, and index numbers.

The Director General of Commercial Intelligence, Government of India, brings out from Kolkata, monthly statistics of the foreign trade of India. The statistics are contained in two separate volumes— one for the export trade and the other for the import trade. These statistics are compiled on a very comprehensive basis, covering a very large number of products and are extremely useful in undertaking regionwise, countrywise or productwise studies on the prospects of foreign trade. They also provide historical data over a long period, thus enabling the researchers to study the changing composition of India's foreign trade over a chosen period.

As regards price statistics, there are some index numbers compiled and published by different government agencies. Thus, the Wholesale Price Index numbers are constructed by the Office of the Economic Adviser, Ministry of Commerce and Industry, Government of India. This is a weekly series and it is revised from time to time so as to make it representative of all the products. The products covered are food articles, foodgrains, non-foodgrains, minerals, fuel, power, light and lubricants, various manufactured products such as textiles, chemicals, metal, machinery and transport equipment. Apart from the wholesale price index, the Government of

India publishes the All-India Consumer Price Index numbers for (a) industrial workers, (b) urban non-manual employees, and (c) agricultural labourers.

Some other official publications include the (i) *Basic Statistics Relating to the Indian Economy*, which is an annual publication of the Planning Commission. It contains data on various aspects of the economy for several years, (ii) *Reserve Bank of India Bulletin*, which is a monthly journal dealing with all aspects of the economy in general, and currency and finance in particular, (iii) *Currency and Finance Report*, which is an annual publication brought out by the Reserve Bank of India. Although the main focus is on currency and finance, it contains statistics on almost all major aspects of the economy, (iv) *The Economic Survey*, which is an annual publication of the Department of Economic Affairs, Ministry of Finance, Government of India. It is published on the eve of the presentation of the national budget and contains a detailed review of the different sectors of the economy. Detailed statistics are also given in the publication, (v) *Agricultural Situation in India*, which is a monthly journal of the Directorate of Economics and Statistics of the Ministry of Agriculture, Government of India. It contains current statistics and articles on the assessment of the agricultural situation in the country and the states, (vi) *The Indian Labour Journal*, which is a monthly journal of the Labour Bureau, publishes statistics on price indices, employment, wages and earnings, absenteeism, etc. (vii) *The Indian Labour Year Book*, which is an annual publication, contains detailed statistics on wages and earnings, cost of living, industrial relations, labour welfare and industrial housing, (viii) *State Statistical Abstracts and District Statistical Handbooks*, which are published by various State Statistical Bureaux, publish statistical abstracts for their states on the lines of the *Statistical Abstract of India*, though the scope of the data covered varies from state to state.

Another important source is the National Sample Survey (NSS), which was set up by the Government of India in the Ministry of Planning in 1950. The objective of setting up this organisation was to obtain social, economic, demographic, industrial and agricultural statistics on a comprehensive and continuing basis. The NSS has been conducting multi-purpose socio-economic surveys in the form of rounds. A number of rounds have been completed by the NSS. The programme for each round is decided by the NSS in collaboration with the concerned ministries and state governments. A complete list of the nature of information collected in various rounds along with the code numbers is given at the end of each report to facilitate the reader in referring to a particular report in which he is interested. Apart from the regular rounds, the NSS has conducted ad hoc surveys in collaboration with the concerned central ministries.

Non-government Publications

Here, we give only a broad idea of non-government publications. We start with a major publication that provides a wide variety of marketing information.

Business World publishes every year the Marketing Whitebook. The first issue of this publication was out in 2004. The Marketing Whitebook covers a wide variety of data under seven different sections, each of which contains the latest data relating to that section. *For example*, data on spending patterns of urban consumers and rural consumers are given. Further, growth in the consumers markets covering certain industries / products has been highlighted with the data. Besides, the section on consumption patterns and trends in the service sector cover several services such as hospitality and tourism, health care and wellness, retail and domestic BPO services. These are just some examples of its contents. In view of its most recent and wide coverage, the publication has become extremely useful to marketers.

Another major source of marketing information is the National Council of Applied Economic Research (NCAER), which is a premier research institution in applied economics in India. It undertakes sponsored research, both from government and private sector organisations. NCAER's main strength lies in its capacity of conducting large national household studies, generating reliable data, its objective analysis and interpretation. One of its major studies is the Great Indian Middle Class (GIM) that was first conducted in 2004. GIM is based on an all-India survey of 300,000 households across 515 cities in 400 districts conducted annually since 2004 (excepting for three years).

The GIM gives information on consumer purchasing pattern and product preferences such as

Who owns what, where and why?

Which products consumers are buying?

What does the future hold for your market?

How are preferences likely to change in urban and rural areas?

Further, GIM gives some useful cross-matrix, a value-added feature that correlates household ownership of various goods with other interlinked products. Another feature is the detailed break-up on a wide range of products.

Another source of marketing information is the R.K Swamy BBDO Guide to Urban Markets. It provides a rigorous explanatory framework. It covers 784 towns with a population of over 50,000, which account for 77 per cent of India's urban population. It provides a simple way of indexing market potential across different towns, aggregated into states and regions. It has developed the market intensity index (MII), which is a good indicator of the character of the market.

Besides these three major sources of marketing information, there are a number of private organisations which bring out statistics in one form or another on a peridical basis. Of these, various industry and trade associations are important. *For example*, the Indian Cotton Mills Federation brings out statistics on the cotton textile industry. Likewise, the annual report of the Bombay Mill Owners' Association contains the latest statistics on the working of the member units. One major advantage of trade and industry publications is that they give an account of the main problems faced by those industries.

Another source of detailed information on the corporate sector is the stock exchange directories. The Bombay Stock Exchange Directory contains information on financial accounts, key profitability and other ratios of the listed joint stock companies. The Directory has been designed in such a manner that the latest possible write-up on the listed company can be inserted and the earlier one taken out. This ensures efficient updating of the various financial statistics of the companies.

A few more examples of non-governmental agencies bringing out periodical data may be given here. The Market Research and Statistical Bureau of the Coffee Board, Bangalore, publishes coffee statistics annually. The Coir Board, Cochin, brings out annually its publication titled '*India's Production, Exports and Internal Consumption of Coir and Coir Goods*'. The Rubber Board, Kottayam (Kerala), publishes the Indian Rubber Statistics annually. The Indian Sugar Mills Association, Delhi, annually issues the Indian Sugar Year Book, containing detailed statistics. The Steel Authority of India Ltd (SAIL) publishes statistics for the iron and steel industry in India on a quarterly basis. The Indian Woollen Mills Federation, Mumbai, brings out a quarterly publication '*Wool and Woollens of India*'.

It may be emphasised that the foregoing brief account of non-government publications is only illustrative. In view of the diversified industrialisation in India, it is not possible to refer to all major non-government organisations. This account should be sufficient to indicate that a good deal of secondary data is available in the country and that one should explore all such data and examine the possibility of their use before deciding to opt for primary data.

Besides the industry associations listed earlier, there are several chambers of commerce. Most of the states have them and there are also some at the national level such as the Federation of Indian Chambers of Commerce and Industry (FICCI), Associated Chamber of Commerce and Industry of India, Indo-American Chamber of Commerce, etc. These chambers or their federations occasionally bring out memoranda dealing with a specific industry and its problems. Such publications often contain useful statistics though such statistics may be 'biased'. Care must be exercised to see how far these statistics are appropriate and representative. In any case, the chambers of commerce (including their federations) are an additional source of secondary data which must be tapped.

There are a number of export promotion councils operating in India. Some of these bring out statistics at regular intervals. The publications of these councils, both statistical and otherwise, are quite authentic and, as such, useful for any studies pertaining to foreign trade. The marketing researcher who is concerned with any aspect of foreign trade would do well to look up relevant statistics in his chosen field with the concerned export promotion council.

Finally, a number of organisations (other than stock exchanges) have come up in India in recent years, which provide periodical data on a particular subject to the subscribing companies. These organisations have answered the need for such a paid service, and most of them collect data from secondary sources, arrange them in their own specified manner and present them to their clients. Of course, a few of them gather data themselves for the client companies.

Syndicated Services

Syndicated services[5] are provided by certain organisations, which collect and tabulate marketing information on a continuing basis. Reports based on the marketing information collected by such organisations are sent periodically (weekly, monthly, or quarterly) to clients who are subscribers. Syndicated services are normally designed to suit the requirements of many individuals or firms. Such services are particularly useful in the spheres of TV viewing, magazine readership, and the movement of consumer goods through retail outlets. Organisations providing syndicated services may also engage themselves in other types of research work for their clients. However, such organisations usually confine themselves to this activity alone.

Syndicated services may be regarded as an 'intermediate' source falling between the primary and secondary sources. This is because they possess the characteristics of both types of sources. As such services are based on data collected specifically by the organisation from original sources and since they are current in nature, the data may be called primary. On the other hand syndicated data may be regarded as secondary data as they are collected by an independent organisation for purposes of sale to a large number of firms. The data are not meant for use by a particular firm or in a specific research organisation. It should be obvious that as syndicated information is supplied to a large number of individuals or firms, its unit cost to the client is much less. If the client has to collect and tabulate the same information on his own, he will have to incur a considerably greater expenditure. Thus, though costwise it is a distinct advantage to the client, he does not enjoy any exclusive advantage as the same information is available to several clients also.

When syndicated information is collected from the same sample group of individuals, households or establishments over a period of time, it may be classified as a 'panel' type. The advantage of

[5] Based on Myers, James H. and Richard R. Mead, *The Management of Marketing Research*, Scranton, Pennsylvania, International Textbook Company, 1969, pp. 86–87.

panel type syndicated service is that it enables the client to measure changes over time. However, when a different sample is taken each time, the syndicated information is of limited use as over time comparisons are not possible.

Suppliers normally use one of the two methods of data collection, namely, consumer panels and store audits. As for as the first method is concerned, we have discussed it in an earlier Chapter 5 on Exploratory and Descriptive Research Designs. As such, reference may be made to the relevant part of that chapter. Hence, the discussion here is confined to store audits.

After proper seruting of collected data at the retail level, store audits indicate how much of a particular product or brand has been sold. This collected information at the retail level becomes a secondary data source. Clients can get all this information pertaining to industry, competition, product, or specific brand.

There are two major advantages of store audits, namely, precision and timeliness. They measure the product and brand movement directly at the point of sale.

After the data have been audited, these are readily available to the potential users. As against these advantages, store audits are subject to an inherent problem of representativeness. In most of the store audits, only 75 to 85 percent of retail stores are included. It means, 100 percent coverage of retail stores is a rare possibility. In view of this, the question is, how far the reported data are representative? Notwithstanding this limitation, the reported data emerging from store audits are, on the whole, quite valuable.

Apart from syndicated services, a number of research agencies offer customised research services to their clients. Unlike syndicated services, in customised services, the research agency undertakes ad hoc studies on behalf of its clients. An illustrative list of the customised research services offered by a leading research agency in India is as follows:

Consumer Research Services

Consumer Research

- Usage and attitude studies
- New product development research
- Brand tracking studies
- Simulated test marketing
- Market modelling
- Brand image and positioning research
- Advertising research
- Product testing
- Market estimation and forecasting
- Customised panel research

Qualitative Research

- Motivation research
- Life style research
- Concept evaluation
- Corporate image research
- Strategic research

The list is impressive as it shows a wide variety of research activities. Beside these two areas—consumer research and qualitative research, this research agency handles ad hoc research projects in other areas such as financial research, travel and tourism research, medical marketing research and social research. In a typical year it handles more than 400 widely diversified projects.

Another leading marketing research agency offers to undertake client-specific services in the following areas:

- Behavioural and attitude research
- Test marketing studies
- Campaign evaluation
- Opinion surveys
- Product and packaging studies
- Corporate image studies
- Media studies
- Industrial market research

It goes to the credit of these agencies that some of the studies conducted by them were of pioneering nature, involving the development of appropriate concepts as well as sampling and measurement techniques. They have a large field set-up supported by full-time investigators in different parts of the country having several years of professional experience.

Publications of International Organisations

So far the discussion was confined to national organisations. There are several international organisations that publish statistics in their respective areas. Some of these organisations publish data on India along with that of other countries. The main advantage of such data is that international comparisons can be drawn. As *Appendix I* to the chapter on International Marketing Research provides a list of major international sources of secondary data, they are not given here.

SEARCHING FOR PUBLISHED EXTERNAL DATA[6]

When a person starts on a research project and explores external published data, his first impression is that there are a very few sources of such data. However, it he continues his search for some time, more and more such data become available. In fact, the problem the researcher faces initially is not of non-availability of data, but of identifying and accessing data that already exist.

Churchill and Iacobueci provide some general guidelines that can be followed to get started on a search of secondary data on a particular topic. These are listed blow.

Step 1 The researcher should identify the information that he already possesses, followed by the need for additional information pertaining to his topic.

Step 2 He should now develop a list of key terms and names. A comprehensive list focusing on the chosen topic will be very helpful in providing access to secondary sources.

Step 3 Having completed the first two steps, the researcher is well-equipped to use the library or Internet. He can use several directories available keeping in mind that terms used are consistent with his own.

Step 4 With the data now available, he should compile the same. It is quite possible that he may get much more information than his expectation. All the same, a reverse situation cannot be ruled out. He may find that even with the plethora of information, its relevance from the viewpoint of his research topic is quite meager. In such a case, he needs to work again by expanding the list of key words and authors.

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[6] Based on Churchill, Gilbert A. Jr and Dawn Iacobueci:*Marketing Research*, Thomson Asia Pte. Ltd;Singapore, 2004, pp. 206–211.

Step 5 The researcher should also tap a specialised source, that is, a reference librarian, who is well informed and trained and can be quite helpful to the researcher in his search for the right information. But this is possible only when the researcher gives his requirement of information in specific details.

Step 6 In case, with the earlier steps, the researcher finds that his requirement is not fulfilled, he may use some directories that are available. In fact, there are directories of directories, but for this the researcher will have to first consult primary directories which will enable him to know other sources.

Step 7 As a last step to overcome deficiency or non-availability of required information, the researcher may have to contact experts and consultants who have good knowledge on the research topic. Professors in the universities, government officials and business executives may be in a position to help the researcher in his quest for information.

THE ROLE OF SECONDARY DATA IN MARKETING RESEARCH

Before we close this chapter, we would like to discuss briefly the role of secondary data in the marketing research process. Earlier, any research study based on secondary data was looked down upon as an inferior study—far away from an original contribution. People thought that the use of secondary data in a research study was to provide historical background. It was considered as an appendix to the main research report based on primary data.

In modern times, there has been considerable economic growth, coupled with intense competition in the corporate sector. In addition, on account of continuing technological developments, information of varying types are readily available. A good deal of data is stored in the form of database. Some of the useful databases for marketers are now available, Marketers everywhere are keen to tap such information to get an advantage over their competitors. All these factors have considerably enhanced the role of secondary data in the marketing research process,

Summary

This chapter has focused on secondary data. To start with, the advantages and limitations of secondary data have been discussed. Since the use of secondary data may be hazardous at times, the marketing researcher must satisfy himself regarding their suitability before use. For this purpose, a detailed evaluation covering aspects such as (1) applicability of the project objectives, (2) cost of acquisition, and (3) accuracy of the data should be conducted.

As the marketing researcher needs to be familiar with the different sources of secondary data, a brief account of such sources (both internal and external) with reference to India has been given. Some important official and non-official publications have been specified. The chapter has also given some idea of syndicated research services. This apart, customised services undertaken by research agencies as ad hoc studies on behalf of their clients have been discussed. The chapter then suggests the steps needed for searching published external data.

At the end, the chapter concludes that the role of secondary data in marketing research process has considerably enhanced in recent times.

Key Terms and Concepts

Questions

1. What are secondary data?
2. What are the advantages of secondary data?
3. What are the limitations of secondary data?
4. Why is it necessary to critically review the secondary data available?
5. How would you evaluate secondary data?
6. Mention some major official sources of secondary data in India that may be relevant for marketing research.
7. Examine the major sources of secondary data from the viewpoints of their relative costs and flexibility.
8. Distinguish between internal and external secondary data, giving a few examples of each.
9. Distinguish between a primary source and a secondary source of secondary data? Which one, in your opinion, is superior?
10. What is syndicated research? Give a brief account of such research done by any Indian agency.
11. What is a store audit? What are its major advantages?
12. Mention a major source/sources of the following types of secondary data in India:
    (i) Population by sex and age-groups.
    (ii) Consumer price indices.
    (iii) Export and import trade.
    (iv) Industrial production.
13. What are syndicated services? Mention a few organisations which provide such services.
14. Describe in some detail any two syndicated research studies that you know.
15. What are ‘market indices’? Name a few such indices.
16. Name some international publications that may be useful in marketing research.
17. Why is it important to search secondary data before collecting primary data for any research project?
18. List the various sources of internal secondary data.
19. What steps are needed while searching published external data?
20. What problems do the researchers face regarding the quality of secondary data? How should they address these?

8 Collection of Primary Data

Learning Objectives

After reading this chapter, you should be able to understand:

- The concept of observation
- Different methods of observation
- The concept of questionnaire
- How to design a questionnaire
- The additional considerations while designing a mail questionnaire
- The relative advantages and disadvantages of observation and communication methods

As was mentioned in the preceding chapter, the marketing researcher should, first of all, explore the secondary data from various sources and examine the possibility of their use for his study. In several cases, he may find the data inadequate or unusable and therefore, he may realize the need for collecting first-hand data. As in the case of everyday life, if we want to have first-hand information on any happening or event, we either ask someone who knows about it or we observe it ourselves, or we do both. The same is applicable to marketing research. Thus, the two main methods by which primary data can be collected are observation and communication. This chapter is devoted to these methods.

OBSERVATION

Observation is one of the methods of collecting data. It is used to get both past and current information. *For example*, instead of asking respondents about their current behaviour, we may observe it and record our observations. Although it is not possible to observe past behaviour, we may observe the results of such behaviour. In a way, secondary data reflect the results of the past behaviour of people as also of past occurrences.

In marketing research, the observational method is not used frequently. All the same, as it is used especially in marketing experimentation, a brief discussion is provided here.

At the outset, let us go through a few examples indicating how observation may be used in marketing research.

- One of the factors influencing the sale of a branded product is how readily it is kept in stock. An interested manufacturer may send some observers to a sample of stores to find out how frequently the product is out of stock. Likewise, sales are also influenced by its display position in a store. A prominently displayed product will receive greater attention of the people visiting the store as against another product displayed in an obscure corner. Here, too, a manufacturer can ascertain from observers what sort of display his product is getting in selected stores and with what results.
- In order to ascertain what prices are charged by competitors, a manufacturer may depute some observers to go round the stores.
- Today, certain mechanical devices are used for observation, for example, the eye-camera, the pupilometric camera and the motion-picture camera. A device known as the audiometer is attached to radio sets for recording automatically the station to which the radio-set is tuned. This is supposed to give an idea of the size of audience for a particular programme. Similarly, the size of audience watching a particular television programme can be ascertained through mechanical devices, which enable the manufacturer, who has sponsored that programme, analyse whether it has been viewed by a sizeable number or not. Furthermore, he can ascertain the reaction of those who actually viewed the programme by interviewing a sample of them. Thus, the observation method in conjunction with interviewing the respondents provides very useful information.

There are some **advantages** of observation as a method of collecting information. To begin with, the direct observational technique enables a researcher to record behaviour as it occurs. In contrast, other techniques record the data mostly retrospectively on the basis of the respondent's report after the event. Another merit of direct observation is that it can be used regardless of whether the respondent is willing to report or not. In a field survey, if an enumerator comes across an unwilling and hostile respondent, he cannot collect the desired information. But, this problem does not arise at all in the case of direct observation. Yet another advantage of observation is that it can be used even when it pertains to those who are unable to respond such as infants and animals.

There are, however, some **limitations** of this method. Firstly, only the current behaviour of a person or a group of persons can be observed. One is unable to observe the past behaviour nor can one observe a person's future behaviour because the act of observation takes place in the present. Secondly, observation does not help us in gauging a person's attitude or opinion on a certain subject nor his knowledge of the same. Thirdly, the observational method is very slow and as such, when a large number of persons are to be contacted, it becomes unsuitable because of the long time required for this purpose.

Apart from these inherent limitations of observation, there are certain difficulties too.

Difficulties in Observation[1]

Certain difficulties come in the way of accurate observation and cause it to become distorted. These difficulties arise on account of (i) inadequacies of our sense organs, (ii) interdependence of observation and inference, and (iii) effects of interaction between the observer and the observed.

[1] Based on Madge, John, *The Tools of Social Science*, London, Longman Group Ltd., 1978 (Ninth impression), pp. 117–131.

The first set of difficulties arises on account of inadequacies of our sense-organs, which "operate in a highly variable, erratic and selective manner." Several studies, conducted by psychologists, show that the perception of a man depends on several factors such as his freshness, interest, and freedom from interruption. The more favourable the conditions, the more receptive the person will be to outside impressions. Further, objects that are large or clear and sounds that are repetitive are likely to receive greater attention of the person.

Other difficulties arise on account of the interdependence of observation and inference.

All perception, after the first weeks of life, is compounded of the immediate experience and of the stored experience. Anything that impinges on our senses conveys a meaning to us largely to the extent that we relate it to what we already know. Observation and inference are inseparable.[2]

This means that whatever an observer sees he tries to explain or interpret it on the basis of his past experience. Thus, the observer inference problem is the main difficulty in as much as the observer can draw wrong inferences from observations.[3]

The third set of difficulties crops up because of the effects of interaction between the observer and observed. This may have two distinct dangers. First, persons being observed may become self-conscious of the observation and this may influence their normal behaviour. Second, observation may get distorted merely because one more person—the observer—is present and people are conscious of his presence. Figure 8.1 shows methods of collecting primary data.

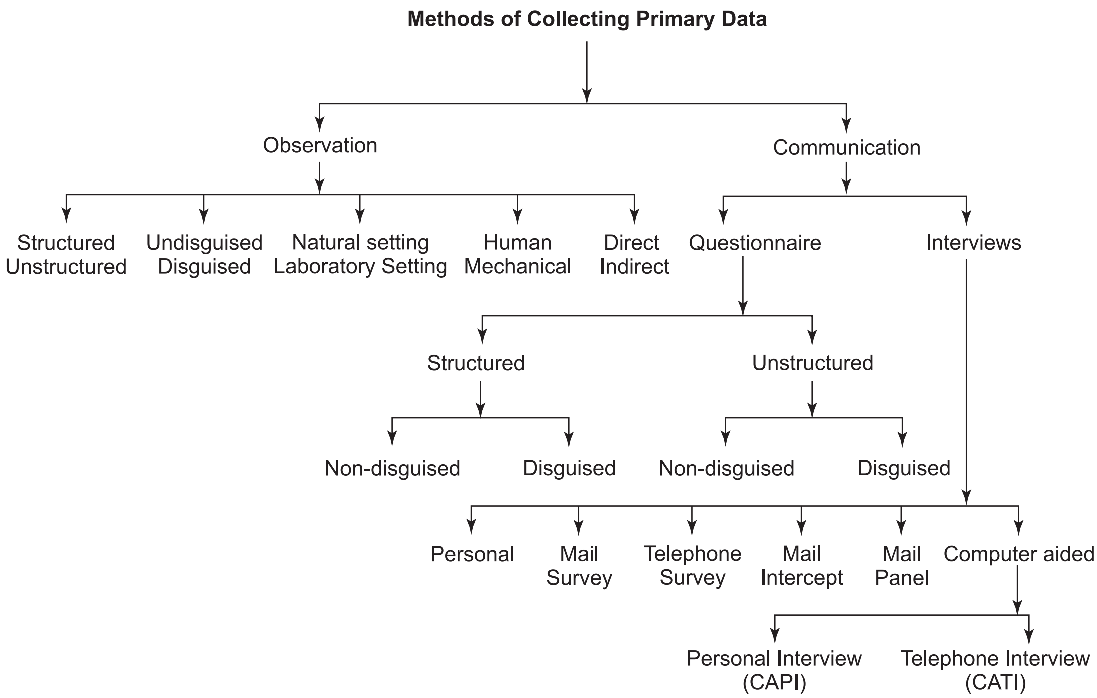

Fig. 8.1 Methods of Collecting Primary Data

[2] Ibid., p. 122.

[3] *See* Kerlinger, Fred N., *Foundations of Behavioural Research*, Delhi, Surjeet Publications, 1983, Second Indian Reprint, pp. 538–39.

METHODS OF OBSERVATION

There are several methods of observation of which any one or a combination of some of them can be used by the observer. Thus, there are structured or unstructured methods, disguised or undisguised methods, or observations made in a natural setting or laboratory setting, direct-indirect observation, or human-mechanical observation. These are briefly discussed below.

Structured-unstructured Observation

Structured observation is used when the research problem has been formulated precisely and the observers have been told specifically what is to be observed. They may be given a simple form to record their observations. Unstructured observation implies that observers are free to observe whatever they think is relevant and important. While structured observations are free from subjective bias, unstructured observations are subject to this limitation. The extent of the bias may vary to the extent an observation is unstructured.

Disguised-undisguised Observation

In the case of disguised observation, the subjects do not know that they are being observed. In some cases, disguised observation may be made by the observer by posing as one of the shoppers who are being observed. This type of observation is often preferred because it is feared that people may behave differently when they know they are being observed. It may be difficult to completely disguise an observation, though this apart, it poses an ethical question of its desirability when those who are being observed are kept in the dark.

Observation under Natural Setting–laboratory Setting

Another way to classify observations is on the basis of their setting, i.e. natural or laboratory. Observations in field studies are in their natural setting and are, therefore, undertaken in extremely realistic conditions. Sometimes, an experimental manipulation may be introduced in a field study. Observation in a laboratory setting, on the other hand, enables the observer to control extraneous variables which influence the behaviour of people. Observational studies in laboratory settings have certain advantages over field studies. They enable the collection of data promptly and economically and in addition, permit the use of more objective measurements.

Direct–indirect Observation

In the case of direct observation, the event or the behaviour of a person is observed as it occurs. In contrast, indirect observation implies that some record of past behaviour is observed. In other words, the behaviour itself is not observed, rather its effects are observed. An observer engaged in indirect observation generally looks for physical traces of behaviour or occurrence of an event. Suppose, he is interested in knowing about the liquor consumption of a household, he would look for empty liquor bottles in the garbage. Similarly, the observer may seek the permission of the housewife to see the pantry. He may carry out a pantry audit to ascertain the consumption of certain types of products. It may be noted that the success of an indirect observation largely depends on how best the observer is able to identify physical traces of the problem under study. Direct observation is far more common than indirect observation.

Human-mechanical Observation

Another way of classifying observations is whether they are made manually or by machines. Most of the studies in marketing research based on human observation wherein trained observers are required to observe and faithfully record their observations. In some cases, mechanical devices such as eye cameras and audiometers are used for observation. One of the major advantages of electrical/mechanical devices is that their recordings are free from subjective bias. As against this advantage, such observations may be less valid than human observations. This is because the observer's power of integration can lead to a more valid evaluation of the observation.

COMMUNICATION

The communication method, in effect, is the method of designing questionnaires with a view to collect the requisite information. The questionnaires can be classified into four main types—(i) structured-non-disguised, (ii) structured-disguised, (iii) non-structured-non-disguised, and (iv) non-structured-disguised.

It may be mentioned here that some authors prefer to call the 'non-disguised' as direct and the 'disguised' as indirect questionnaires.

A **structured questionnaire** is a formal list of questions framed so as to get the facts. The interviewer asks the questions strictly in accordance with a pre-arranged order. If, for example, the marketing researcher is interested in knowing the amount of expenditure incurred on different types of clothing, i.e. cotton, woollen or synthetic, by different households classified according to their income, he may frame a set of questions seeking this factual information. If the marketing researcher appoints some interviewers to collect information on his behalf, the interviewers are expected to adhere to the same order in asking questions as contained in the questionnaire.

A structured questionnaire can be of two types, namely, disguised and non-disguised. This classification is based on whether the object or purpose of the survey is revealed or undisclosed to the respondent. Thus, a **structured-non-disguised questionnaire** is one where the listing of questions is in a prearranged order and where the object of enquiry is revealed to the respondent. Most marketing research studies use this type of questionnaire. In the case of a **structured-disguised questionnaire,** the researcher does not disclose the object of the survey. He feels that if the respondent comes to know the object of the survey, he may not be objective in giving the necessary information and, as such, its purpose may be defeated. He is, therefore, very particular not to divulge the purpose of the investigation.

It may be mentioned that in a large majority of cases, it is felt that the respondent should be taken into confidence and clearly told why the survey is being undertaken, so that he would realise its relevance and give the desired information accurately. Questionnaires of this type are known as **structured and non-disguised questionnaires**. It may be pointed out that most of the surveys for marketing research use this type of questionnaire.

A **non-structured questionnaire** is one in which the questions are not structured and the order in which they are to be asked from the respondent is left entirely to the researcher. He asks the questions in the manner in which he deems fit in a particular situation. In fact, he may only have certain main points on which he may develop the questions at the time of the actual interview. As it will be seen, a non-structured questionnaire is devoid of rigidity and allows considerable freedom to the researcher in choosing the order as well as the specific content of questions. Normally, unstructured questionnaires are used in exploratory research when some respondents are contacted. It is only subsequently, on the basis of answers received, that a well-structured questionnaire is developed. This is because the interviewer has a better understanding of the problem on hand only after the exploratory research. Questionnaires of this type can be split into two sub-types. Where the purpose of the enquiry is disclosed to the respondents, the questionnaires are known as **non-structured and non-disguised** while in other cases, the questionnaires are classified as **non-structured and disguised questionnaires.**

Let us briefly discuss the relative **strengths and weaknesses of the different types of questionnaires. The structured-non-disguised questionnaire has several advantages.** *Firstly*, it facilitates the collection of information in a systematic and orderly manner as the questions have been formulated in advance. *Secondly*, since the questions asked by each interviewer happen to be identical and are asked in the same order, the information is generally not vitiated on account of the varying characteristics of the different interviewers. *Third*, a structured questionnaire calls for a straightforward and simple approach on the part of interviewers. As such, even less qualified interviewers can be deployed in canvassing such a questionnaire. *Fourth*, such a questionnaire makes it far easier to edit, tabulate and interpret the data it contains. *Finally*, a structured questionnaire can be conveniently pre-tested so that suitable modifications can be made in the phraseology of questions or in their sequence or both.

As against these advantages of a structured questionnaire, it suffers from a major limitation. This arises when the respondent is asked questions concerning personal or motivational aspects. Despite this weakness, the structured–non-disguised questionnaire is most frequently used in marketing research, as was mentioned earlier.

An unstructured questionnaire is most suitable when motivational factors are involved. The interviewer is free to ask probing questions to get at the key motivational factor or factors. Questionnaires of this type are normally used in depth interviews—a subject to which we shall revert later in the book. Such questionnaires facilitate the conducting of interviews in an informal manner. They also lend flexibility to the whole process of interviewing. A point worth emphasising is that in the case of unstructured questionnaires, the role of the interviewer becomes far more important as compared to the one when a structured questionnaire is used. In view of this, more capable interviewers are required to handle them, which raises the cost of the survey. Also, the interviewer needs more time per interview if it is unstructured. This also enhances the overall cost of the field survey. Finally, the researcher faces problems while editing and tabulating an unstructured questionnaire.

Having discussed the relative strengths and weaknesses of the structured and unstructured questionnaires, we now turn to the designing of structured questionnaires.

DESIGNING A QUESTIONNAIRE

Designing a questionnaire is not as simple a job as it looks at first sight. A marketing researcher intending to collect primary data has to be extremely careful in deciding what information is to be collected, how many questions are to be formulated, what should be their sequence, what should be the wording of each question, and what should be the layout of the questionnaire. All these aspects need considerable time and effort of the marketing researcher. If he is able to develop a questionnaire suitable for his field investigation, he will find that his task of collecting the data has become much easier than otherwise.

Type of Information to be Collected

While attempting to design a questionnaire, the marketing researcher has to first ask himself what type of information he needs from the survey. He should seriously consider this question as it will have considerable repercussion on the usefulness of the survey. For, if he omits to collect information on some relevant and vital aspects of his survey, his research study is unlikely to be useful. At the same time, if he collects information on some issues not directly relevant to his study, he not only raises the total cost of the survey but also increases the time factor. This being the case, the survey will take much more time than is really necessary. It will also lead to greater inaccuracy as the respondent will have to answer many more questions than are strictly necessary and he will, therefore, not be sufficiently careful in giving the exact answer. In either case, the marketing researcher will be the loser. To avoid this situation, he should give serious thought to the specific information to be sought. It will considerably facilitate him if he looks ahead to the analysis stage so that he could enlighten himself on the type of tabulation as also the statistical methods that are to be used.

Crisp[4] has very lucidly explained the different types of information which are generally sought in marketing research. The information could be one or more of the following types: (i) facts (ii) quasi facts (iii) awareness, or penetration of information (iv) opinions (v) attitudes (vi) future action plans and (vii) reasons.

Factual information is perhaps sought most frequently in marketing research. *For example*, the question—*Do you own a car*? is intended to seek such factual information. In addition, sometimes information collected belongs to the second category, namely, quasi facts. This implies that the information received from respondents is not factually corrected though it may appear to be so. Thus, a question in continuation of the earlier one about the ownership of a car, could be—*If yes, when did you buy the car*? Here, the respondent may not remember on the spur of the moment, the year when he bought the car. Apart from this, the inaccuracy may originate on account of the desire on the part of the respondent to leave a favourable impression on the interviewer. Thus, for example, if a respondent is asked—*Do you eat fruit everyday*?, he may say 'yes' even when he does not, simply because he wants to impress upon the interviewer that he belongs to a well-to-do family and can afford to spend money on fruit on a daily basis.

Regarding factual information, the interviewer has to ensure that the information sought is available with the respondent and that he is willing to part with it. Questioning respondents about the distant past is not good as they will not be able to give an accurate answer. Another point worth noting is that the interviewer should ensure that the respondent has understood his question correctly and that he in turn has understood the respondent's answer correctly. This will avoid miscommunication.

The third category of information sought relates to awareness. Sometimes, the marketing researcher is interested to know whether the respondent is aware of the existence of a certain product or brand. Such information is particularly sought by a firm soon after it has launched an advertising campaign, to enable it to know if advertising has contributed to the awareness of the respondent. Besides, information determining the increase in penetration could be sought through marketing research. *For example*, the firm may take up a second study subsequently, more or less on the same lines as its first study, to ascertain how much increase in the penetration has taken place between the two dates.

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[4] Crip, Richard D., "Organisation of the Marketing Research Function" in *Handbook of Marketing Research*, New York, McGraw-Hill Book Company, 1973.

Information is often sought on the opinion of the respondent. He is specifically asked, What view he holds on a particular subject? and he is free to opine. Similarly, information on the respondent's attitude on one or more subjects or things is sought. The distinction between 'attitude' and 'opinion' is not very clear "A commonly drawn distinction has been to view an 'attitude' as a predisposition to act in a certain way and an 'opinion' as a verbalisation of the attitude."[5] However, the distinction between the two terms gets blurred when the terms are used to predict what the respondent will do. In view of this, some authors have used the terms 'attitude' and 'opinion' interchangeably.

The question on opinion poses some difficulties for the researcher. To begin with, when an answer to an opinion question is received from the respondent, the researcher is not sure whether the respondent is well informed about the subject on which his opinion has been sought. A respondent can give any opinion without knowing the subject at all. This is obviously a great disadvantage and it is difficult for the researcher to verify. Another difficulty is to ascertain the intensity of an opinion, though this can be taken care of by suitably phrasing the specific question. We shall revert to this a little later. Another difficulty is that as opinions are many-sided, the same respondent will give different answers based on different aspects such as social, legal, moral, economic, etc. It will not be evident to the researcher which viewpoint the respondent has taken. Attitudes are very important as they give an indication of the past, or the likely future behaviour of the respondents. Studies on consumer behaviour are possible only when information on attitude is adequately available. Chapter 9 is devoted to Measurement and Scaling while chapter 10 is on Attitude Scales.

Occasionally, the marketing researcher wants to know what are the immediate plans of the respondent in regard to a certain thing. *For example*, he may be asked whether he plans to buy a car during the next six months. Such an information is normally a statement of intention of the respondent. One does not know whether it will be implemented or not. Any information collected under this category has to be used with great caution otherwise one is likely to arrive at wrong conclusions.

Finally, the marketing researcher at times wants to know the reason for a particular choice or action of the respondent. *For example*, the respondent owning a car, may be asked why he bought that particular make. He is expected to give one or more reasons in support of his choice. Here too, there is an apprehension that the respondent may not come out with genuine reasons.

It must be emphasised again that the marketing researcher should be clear about the nature of the information to be collected. The above classification of the requisite information will facilitate him in phrasing the questions in the right form.

Types of Questions

The second important aspect in the designing of a questionnaire is to decide which types of question are to be used. Questions can be classified in various ways. One way of classification is as follows:

- Open-ended questions
- Dichotomous questions
- Multiple-choice questions.

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[5] Green, Paul E. and Donald S. Tull, *Research for Marketing Decisions*, Englewood Cliffis N.J., Prentice-Hall, Inc., 1970, p. 118.

An **open-ended** or simply 'open' or 'free answer' question gives the respondent complete freedom to decide the form, length and detail of the answer. Open questions are preferred when the researcher is interested in knowing what is uppermost in the mind of the respondent. However, open questions pose certain problems. At the time of the actual interview, it becomes difficult for the interviewer to note down the respondent's answer verbatim. If the interviewer has to take down the answer all by himself without any mechanical aid, he is quite likely to miss some vital information contained in the respondent's answer. Further, if several interviewers are conducting interviews and each one is recording the answers to opinion questions according to his understanding, and in his own way, then there is likely to be an element of bias in the recorded answers. Another difficulty in respect of open questions is that it is extremely difficult to compress lengthy answers in a meaningful manner. Such answers may be good qualitatively but their quantification becomes extremely difficult, if not impossible. The dichotomous question has only two answers in the form 'yes' or 'no', 'true' or 'false', 'use' or 'do not use', etc. An example of a dichotomous question is:

Do you use tobacco in any way?

Yes ______________ *No* ______________

There cannot be a third answer. However, in some cases, there may be a third answer which may come from those who do not want to take a definite stand one way or the other. For example, take the following question:

Do you like to watch movies?

Yes ______________ *No* ______________

Neither like nor disike ______________________

The third alternative may be included so as to provide for those respondents who do not have a positive preference or aversion to movies.

It may be pointed out that dichotomous questions are most convenient or least bothersome to respondents, who have simply to indicate their choice from the two possible answers. As such, these questions require the minimum possible time of the respondents. Also, answers to such questions are easy to edit, tabulate and interpret.

In the case of multiple-choice questions, the respondent is offered two or more choices. The marketing researcher exhausts all the possible choices and the respondent has to indicate which one is applicable in his case. *For example*, the following is a multiple-choice question:

Which of the following brand/brands do you use for washing clothes? Rin ________, Det ________, 501 Blur Bar ________, Super 777 Bar________, Wheel________, Bonus ________, Swastic________, Any other (please specify________).

Obviously, the respondent is likely to take more time to answer a multiple-choice question as compared to a dichotomous one. Also, more time is required in the editing, tabulation and interpretation of data.

Phrasing of the Questions

The next issue in the preparation of a questionnaire is how to phrase the questions. The way in which a question is drafted is very important as a slightly suggestive wording would elicit a very different answer from the respondent. Consider, for example, the following question:

Don't you think that this is a sub-standard product?

A question of this type would prompt respondents to answer in the affirmative. Many of them, who do not have a definite opinion about the product, are likely to agree that it is of sub-standard quality. However, if the above question is worded a little differently, the answer is likely to be different. Suppose this question is put as follows:

Do you think that this is a sub-standard product?

A question of this type is not a suggestive question. It is a straight forward question and respondents are not likely to be prompted to say 'yes' as was the case in the earlier question.

It will be interesting to know that a little difference in wording makes a good deal of difference in the answers. Payne[6] cites an example in this regard. He gives the following three questions and the related affirmative responses:

Quesion	Percentage of respondents saying 'yes'
1 Do you think anything *should* be done to make it easier for people to pay doctor's or hospital bills?	82
2. Do you think anything *could* be done to make it easier for people to pay doctor's or hospital bills?	77
3. Do you think anything *might* be done to make it easier for people to pay doctor's or hospital bills?	63

These questions were put to three matched samples of respondents—one question to each type. The only difference was in the use of the words 'should', 'could', and 'might'. This change in one word changed the percentage of affirmative responses by as much as 19 per cent, which clearly proves that the phrasing of questions has to be done with great care so that there is no room for any ambiguity.

In order to ensure the appropriate phrasing questions, one should be particular about the following factors:

1. Difficult words should be avoided as far as possible. Likewise, technical or special terms which an average respondent may not understand, should be excluded.
2. Vague words such as 'many', 'often', 'generally', 'on the whole' and 'reasonably', should not be used.
3. Lengthy questions should be avoided. Too much verbosity makes questions lengthy, and is likely to confuse the respondent.
4. One should avoid combining two questions into one. *For example*, the question—Which of the following modes of transport is cheaper and more convenient? (i) Train (ii) Bus
   It is quite likely that according to the respondent both the attributes, namely cheapness and convenience may not be applicable to either of the two modes of transport. One may be cheaper while the other may be more convenient.
5. Questions lacking specificity should be avoided or modified suitably so that they become more precise. *For example*, the question—Are you satisfied with your job?—is not sufficiently specific because it does not provide the necessary frame of reference to the respondent. One may be satisfied, say, from the viewpoint of emoluments but one may not be satisfied with the type or nature of one's work. These are two distinct aspects which perhaps cannot be taken care of by one question.

[6] Panyne, Stanley L., *The Art of Asking Questions*, Princeton, N.J., Princeton University Press, 1951, pp. 8–9.

Order of Questions

Another aspect that should receive the attention of the researcher is the sequence or order of questions to be contained in a questionnaire. Since, in the beginning, the researcher has to establish some rapport with the respondent, it is necessary that questions asked at the beginning are simple and thereby helpful in establishing the rapport. Difficult questions or those on sensitive issues should be relegated to the end of the questionnaire. Further, questions of a general type should be asked in the beginning while those which are specialised, needing some in-depth information from the respondents, should be left to the end.

However, care should be taken to sustain the interest of the respondent until the last so that he is able to answer specialised questions in a normal manner without fatigue and indifference. If the questionnaire is very lengthy, two or three sets of the same can be printed where the order of questions can be changed by a scheme of rotation for the sampled units. In such a case, some respondents would answer the specialised questions towards the middle of the questionnaire instead of towards its end.

How Many Questions to be Asked?

The researcher has also to decide how many questions are to be asked. We may add that the number of questions is not so important as the actual length of the questionnaire. We have just mentioned above that the researcher has to sustain the interest of the respondent until the last moment so that the interview can be completed successfully and the requisite information obtained. Too lengthy a questionnaire would obviously be a disadvantage and the response to it may be quite poor.

While deciding on the number of questions or the length of the questionnaire, the researcher should put himself in the respondent's shoes and imagine how he would react to that questionnaire. He can calculate the probable time that might be required by the respondent in answering the entire questionnaire. He can also canvass the questionnaire amongst some of his friends and acquaintances. Their opinion and reaction will be very helpful to him in finally deciding how lengthy the questionnaire should be. This is, in a way, pre-testing of the questionnaire which will be discussed towards the close of this chapter.

Layout of the Questionnaire

Finally, the researcher or someone on his behalf has to decide about the layout of the questionnaire. This implies that the document should be set in such a way that it leaves a favourable impression on the respondent. It should be neatly printed and the individual pages should not have too many questions so as to appear crowded. Proper spacing between the questions and within a question should be provided for. The more important wordings to which the researcher would like to draw the attention of the respondent, should be set in bold types or underlined. If it is really a lengthy questionnaire, special care should be taken to reduce its size by providing two columns in a page and by using finer types. But, this can be done up to a certain point for too fine a print may cause inconvenience to the respondent. The questionnaire should have 'easy looks' which means that it should be short and printed on superior quality paper so that writing with pen or pencil is smooth.

Mail Questionnaire

So far the discussion was confined to the designing of questionnaires to be filled in by personal interviews. In fact, the type of questionnaire to be designed depends on the type of survey. Broadly, there are three types of survey namely, **personal, mail and telephone**. As far as the telephone survey is concerned, it is not commonly used in India. As such, the personal interview and mail survey are the only two methods. Since a mail survey needs a questionnaire which should have some additional characteristics, it is necessary to look into this aspect in some detail. First, we should know the advantages and limitations of a mail survey.

Advantages[7]

1. It is much easier to approach a large number of respondents spread all over the country through post.
2. A mail questionnaire will not have any distribution bias as it will not show any particular preference or dislike for a certain neighbourhood, household or individual. This, however, is not the case with the personal interview as it is likely to be affected by the personal preferences or dislikes of the individual interviewer.
3. Likewise, a mail questionnaire is free from any interviewer's bias and errors which may undermine the reliability and validity of the results emerging from the survey.
4. Where the question asked is such that it cannot be answered immediately and needs some thinking on the part of the respondent, it is the mail questionnaire which will be most appropriate. A respondent can think over the question leisurely at home before giving his answer. The quality of answers is, therefore, likely to be superior to that obtained in the personal interview.
5. Since a large number of respondents can be approached all over the country through mail in a short period, a mail questionnaire saves a lot of time in collecting the desired information.
6. There is a good deal of saving in the total cost of a mail survey as cost of travelling, boarding and lodging of interviewers is not to be incurred. This enables the organisers of the survey to complete the investigation within a limited budget.
7. In case of mail questionnaires, there is no difficulty in having central supervision and control over the survey operations over a large region. This, however, is not the case when a large number of interviewers are appointed to cover different territories. As they have to be instructed, supervised and checked, these tasks cannot be managed from one centre alone.
8. Mail questionnaires also avoid the bias arising from any inhibitions in answering questions. In particular, when questions are of a personal nature, the respondents may hesitate to answer them in the presence of an interviewer. This type of inhibition will not be there if the mail survey is undertaken.
9. Finally, mail questionnaires will not have the problem of non-contacts in the strict sense as might be the case in personal interviews when the interviewer finds that the respondent, being away from home, is not available.

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[7] These as also the limitations, are mostly based on Erdos, Paul L., "Data Collection Methods: Mail Surveys" in *Handbook of Marketing Research* (Ed. Robert Ferber), New York, McGraw-Hill Book Company, 1974, pp. 290–92.

Limitations

The mail questionnaire suffers from some major limitations which are mentioned below:

1. It is not suitable when questions are difficult and complicated. In such a case, the help of interviewers is required to offer some introductory explanation to the respondent. Further, in all such surveys where the main object is to get the respondent talking or to undertake deep probing, mail questionnaires are completely unsuitable.
2. When the researcher is interested in the spontaneous answers of the respondent or his own answers uninfluenced by others who may influence his thinking, the mail questionnaire is inappropriate.
3. In case of mail questionnaires, it is not possible to verify whether the respondent himself or herself has filled in the questionnaire. If a questionnaire is addressed to a housewife concerning the expenditure on durable items in the family, it is she who is supposed to answer it. However, she may ask her husband or someone else in the family to fill in the questionnaire on her behalf. It should be evident that such answers may not be correct. Further, they may not reflect the opinion of the particular respondent whose opinion was sought.
4. The researcher has to accept the answers as they are provided in the mail questionnaire. In case there is any inconsistency or ambiguity in the answers, it will be difficult for the researcher to make use of such a questionnaire. He cannot further probe into the same to get some additional information or to remove the inconsistency or ambiguity.
5. The respondent, in case of a mail questionnaire, may go through his answers after he has filled in the entire questionnaire and may make certain modification in his original answers as a result of which these answers cannot be regarded as independent.
6. A mail questionnaire does not allow the researcher to supplement the information by his personal observations. That will be possible only when the questionnaire is canvassed by him personally.
7. Finally, a mail questionnaire normally has a relatively poor response compared to a questionnaire canvassed personally. In the latter case, even if the respondent is initially reluctant to answer the questionnaire, the interviewer can explain the purpose of the survey and point out its relevance to the respondent who may then agree to answer the questionnaire.

Additional Considerations for the Preparation of a Mail Questionnaire

As the interviewer is just not available for any explanation or clarification that a respondent is likely to need, it becomes necessary to prepare a mail questionnaire with greater care and more thought. It would, therefore, be worthwhile to look into additional factors that can significantly improve the quality of a mail questionnaire.

1. Mail questionnaires should be shorter than the questionnaires to be used personally otherwise the response rate would be affected adversely.
2. The wording should be extremely simple so as to avoid any misunderstanding.
3. In case a lengthy mail questionnaire has to be used, it may be desirable to send an advance letter, seeking the cooperation of the respondent. This may be followed by the questionnaire. Such a practice will prepare the respondent mentally to receive a lengthy questionnaire and a reasonably high response rate can be maintained.

4. Wherever necessary, suitable explanations should be provided so that respondents understand the questions in the proper perspective and in the manner in which the researcher intended.
5. A covering letter must invariably be enclosed with the mail questionnaire. The covering letter should explain the purpose and importance of the survey and solicit the cooperation of the respondent. It should be emphasised in a covering letter that the information to be given by the respondent will be kept strictly confidential and that his identity will not be disclosed.
6. A mail questionnaire should also be accompanied by a pre-addressed and stamped envelope to facilitate the respondent to return the same as soon as it is filled in without incurring any expenditure himself.

Pre-testing the Questionnaire

Once the questionnaire is ready, it should be pre-tested. Pre-testing of the questionnaire implies that it is tried out on a few respondents and their reaction to the questionnaire is observed. It helps the researcher decide whether any changes in the question-content or the wording of questions are called for. If so, specific changes that are desirable can also be ascertained and incorporated in the questionnaire. This would improve it and if it is a mail questionnaire, it would perhaps increase the response rate as well.

The other benefit of pre-testing the questionnaire is that the researcher can know the suitability of the instructions given to the interviewers as also their capability. In case certain changes are required, the same can be introduced. Interviewers will also have an opportunity to familiarise themselves with the problems they might face in the collection of data. This apart, pre-testing may indicate whether a particular sample design is feasible or some other sample design, which may be more appropriate, should be selected. Sometimes, pre-testing of a questionnaire is undertaken to find out the suitability of data for particular needs. For this purpose, the researcher may have to tabulate the data collected in the pilot survey (or pre-testing) and prepare dummy tables. With the help of these tables, one can examine whether such data would be appropriate and adequate for the objectives of the survey. In the light of this investigation, the questionnaire can be revised to elicit additional information.

The foregoing discussion may be summarized as below:

Important Considerations While Designing a Questionnaire

1. Specify the information required for the problem under study.
2. Select the type of questionnaire and the method for its administration.
3. Determine the type and content of each question.
4. Be careful in phrasing each question.
5. Decide the sequence of questions.
6. Determine what form of response each question is likely to have and provide space accordingly.
7. Decide the number of questions/size of the questionnaire.
8. Determine the layout of the questionnaire.
9. Pre-test the questionnaire among a small number of respondents.
10. Finalise the questionnaire and use it for the proposed survey.

In the appendix to this chapter, a specimen questionnaire is given. It relates to the passenger survey conducted by the Quick Airlines Corporation.

The questionnaire was designed specifically to collect data from passengers who availed themselves of the services of the Quick Airlines Corporation during the two weeks when the survey was on. It will be seen that the first four questions give the passenger identification data. The next four questions relate to the flight details including the date and number of the flight. Subsequent questions aim at collecting information on the views of passengers on the quality of service provided by the Quick Airlines Corporation. Some of the questions are dichotomous, resulting in only two responses, yes or no, while others provide five options on a scale such as excellent (5) to very poor (1) in regard to a particular service. There are only three open-ended questions in the entire questionnaire. The last question invites suggestions from the passengers for improvement of the quality of service rendered by the Corporation. It will also be noticed that this questionnaire is extremely simple and it would not take much time of the respondents in providing the information sought.

SURVEY METHODS

Earlier in this chapter, we discussed four different types of questionnaires based on two attributes, namely, structure and disguise. After the questionnaire has been designed based on the objective of the research study, the researcher has to decide how it is to be administered. A number of survey methods are available from which one method is to be selected.

Since there are several survey methods by which data can be collected, it may be worthwhile to know their relative strengths and weaknesses. The methods in question are – personal survey, mail survey, telephone survey, mall intercept interviews mail panels computer aided personal interviews (CAPI) and computer aided telephone interviews (CATI). Table 8.1 gives a comparative idea of these methods on selected criteria. It is evident from this table that each method of data collection has its uses, but none is superior in all situations. A method may be good or excellent in case of a few criteria, but in respect of other criteria, its rating may be low. For example, when a large quantity of information needs to be collected through a survey, both telephone and mail survey methods will be inappropriate. The choice should obviously be in favour of personal survey. In contrast, if a short survey is to be conducted in a limited time, telephone survey or CATI should be preferred. If cost is the major criterion, personal survey is ruled out and the choice should go in favour of telephone survey or CATI.

From the foregoing discussion, it is clear that the researcher has to exercise great care in choosing the survey method on the bases of a couple of criteria or considerations which he thinks are important in the survey.

Table 8.1 Comparison of Survey Methods

Criteria	Personal survey	Mail survey	Telephone survey	Mail Intercept Interviews	Mail Panels	CAPI	CATI
1. Probable response rate	Fair	Poor	Good	High	High	High	Moderate
2. Time required	Slow	Slow	Fast	Moderate to high	Low to moderate	Moderate to high	Fast

Contd.

Criteria		Personal survey	Mail survey	Telephone survey	Mail Intercept Interviews	Mail Panels	CAPI	CATI
3.	Cost	High	Low	Low	Moderate to high	Low to moderate	Moderate to high	Moder-ate
4.	Control of sample	Good	Poor	Excellent	Moderate	Moderate to high	Moderate	Moder-ate to high
5.	Supervision of field work	Fair	None	Excellent	Moderate	High	Moderate	Moder-ate
6.	Quantity of information	Good	Lim-ited	Limited	Moderate	High	Moderate	Low
7.	Quality of information	Good	Fair	Excellent	High	High	Fair	Limited
8.	Versatility	Excel-lent	Fair	Good	High	Moderate	Moderate to high	Low to Moder-ate

COMPARISON OF OBSERVATION AND COMMUNICATION METHODS[8]

We have discussed in the preceding sections two methods of primary data collection—observation and communication. At this stage, it is worth while to know their relative advantages and limitations. This comparison can be more meaningful when we use some dimensions for the same. Our comparison is based on versatility, business logistics (for example: speed and cost), and data quality.

Versatility

Versatility means the ability of the method to collect various types of information or data in which the marketers are mainly interested. On the basis of versatility, the observation method has very limited scope to collect varied information about human behaviour as also their socio-economic characteristics. In contrast, we find that the common method is far better as it is capable of collecting information of a wide range.

Speed and cost

As regards both speed and cost considerations, communication method has a distinct advantage over observational method. The latter takes considerable time in getting required information. In view of time factor, cost mounts up. This apart, far more information can be collected using communication method.

[8] Based on Churchill, Gilbert A. Jr. and Dawn Iacobucci: *Marketing Research*, Thomson Asia Pte. Ltd, Singapore, 2004, pp. 207–209.

Objectivity and Accuracy

There is one advantage of observational method, particularly when the respondent is unwilling to give information. In such a situation, observational method can be used even without the respondent's knowledge that he is being observed. Again, it provides more objective data than does communication. In a survey when one wants to know the opinion of the respondent on an important issue, it is the communication method that alone is suitable. In observation method, as personal contact with the respondent or subject is ruled out, it cannot give opinion or perception of the subject.

As regards accuracy, observational method provides more accurate and reliable information than communication. But this is possible when sufficient care is taken in the selection, training and supervision of observers.

Summary

Observation and communication are the two methods of collecting primary data. The chapter first discusses observation method. Both the advantages and limitations of observation as a method of collecting information have been pointed out. This is followed by a discussion on major difficulties in observation method. Five methods of observation such as structured-unstructured, disguised-undisguised, have been discussed.

The communication method deals with the designing of questionnaires. The chapter first discusses different types of questionnaires along with their relative advantages and limitations. Subsequently, it has dealt with the various aspects that should be considered while designing a questionnaire. These are—type of information to be collected, types of questions, phrasing of questions, order of questions, number of questions and lay out of the questionnaire.

Since the mail questionnaire is frequently used, its advantages and limitations have been explained. Additional considerations relevant for the preparation of such a questionnaire have been specified. The need for pre-testing a questionnaire has been emphasised. Towards the end, the chapter provides a comparison of seven methods of survey on the basis of several criteria. The chapter ends with a comparison of observation and communication methods.

Key Terms and Concepts

Observation 121
Structured and unstructured observation 124
Disguised and undisguised observation 124
Direct and Indirect observation 124
Natural – Laboratory setting 124
Human-mechanical observation 125
Questionnaire 125
Mail questionnaire 132
Pre-testing the questionnaire 134
Survey methods 135

Questions

1. What is ‘observation’?
2. Give a few examples of the use of observation in marketing research.
3. What are the advantages and limitations of observation as a method of collecting information?
4. What difficulties are encountered in observation?
5. Distinguish between the following:
   (i) Structured-unstructured observation
   (ii) Disguised-undisguised observation
   (iii) Observation under normal setting-laboratory setting
   (iv) Direct-indirect observation
   (v) Human-mechanical observation
6. What is a questionnaire?
7. What are the different types of questionnaires?
8. Distinguish between structured-non-disguised and non-structured-disguised questionnaires. What are their relative advantages and limitations?
9. What are the characteristics of a good questionnaire?
10. What factors would you take into consideration while designing a questionnaire?
11. Explain the following types of questions, giving a suitable example in each case:
    (i) Open-ended (ii) Dichotomous
    (iii) Multiple-choice (iv) Opinion-oriented
    (v) Leading
12. What are the advantages and limitations of (i) open-ended questions, (ii) dichotomous questions, and (iii) multiple-choice questions?
13. How is the sequence of questions relevant in a questionnaire?
14. What are the advantages and limitations of a mail questionnaire?
15. What additional considerations should be borne in mind while designing a mail questionnaire?
16. What is a pre-test? How is it helpful?
17. Design a three-page questionnaire on a hypothetical field survey of your choice.
18. What are the strengths and weaknesses of the seven survey methods given in the text?
19. Compare communication and observation methods on the basis of the following criteria:
    (a) Versatility (b) Speed and cost (c) Objectivity and accuracy.

APPENDIX

THE QUICK AIRLINES CORPORATION

Passenger Survey

1. Name: Mr/Mrs/Miss……………………………………………………………
2. Address: ……………………………………………………………………...
3. Age: (1) 18—20 years ( )
   (2) 20—30 years ( )
   (3) 30—40 years ( )
   (4) 40—50 years ( )
   (5) 50—60 years ( )
   (6) 60 years or over ( )
4. What are your educational qualifications?
   Below High School
   High School/Higher Secondary
   Graduation
   Post graduation
5. Where did you board this flight? …………………………………………………
6. Where will you get off/ ………………………………………………………...
7. Flight Number ……………………………………………………………………
8. Date ………………………………………………………………………………
9. What is the purpose of your taking this flight?
   (1) ( ) Government work
   (2) ( ) Business
   (3) ( ) Personal work
   (4) ( ) Vacation
   (5) ( ) Any other (please specify)
10. How many airline trips have you made during the past one year?
    None before ( ) 1–3 ( )
    4–6 ( )
    7–9 ( )
    10 or over ( )

In connection with your present flight, we would like to know how you feel about it. Please give your ratings be marking only one "X" against each item given below:

		Excellent	Good	Fair	Poor	Very poor
11.	Arrangement regarding reservation	5( )	4 ( )	3 ( )	2 ( )	1 ( )
12.	Punctuality of the flight	5( )	4 ( )	3 ( )	2 ( )	1 ( )
13.	Arrangement at the airport lounge	5( )	4 ( )	3 ( )	2 ( )	1 ( )
14.	Quality of service at the airport	5( )	4 ( )	3 ( )	2 ( )	1 ( )
15.	Announcements during the flight	5( )	4 ( )	3 ( )	2 ( )	1 ( )

16. What meal were you served on this flight?
    (1) ( ) Breakast
    (2) ( ) Lunch
    (3) ( ) Dinner
    (4) ( ) No meal, or snack only
17. Were the dishes tasty?

Excellent	Good	Fair	Poor	very poor
5( )	4( )	3( )	2( )	1( )

18. Quality of service in respect of meal/s

Excellent	Good	Fair	Poor	very poor
5( )	4( )	3( )	2( )	1( )

19. Do you have any suggestion or suggestions to offer with respect to the meals?
    Yes No
20. If yes, please specify.
21. Did you have any difficulty on this flight?
    Yes No
22. If yes, please specify.
23. Did you ask the air hostess for help?
    Yes No
24. Were you satisfied with her help?
    Yes No
25. Taking all factors into consideration what is your overall rating in respect of this flight?

Excellent	Good	Fair	Poor	very poor
5( )	4( )	3( )	2( )	1( )

26. What suggestion/s would you like to offer for its improvement?..................................
    ……………………………………………………………………………………..............
    ……………………………………………………………………………………..............

9 Measurement and Scaling

Learning Objectives

After reading this chapter, you should be able to understand:

- Types of scales
- Difficulty of measurement
- Sources of error
- Criteria for a good scale
- Development of marketing measures

In our daily life, we involve ourselves in measurement though we may not be aware of it. For instance, when we see a movie, we may either like or dislike it. Here, we are using some form of measurement to indicate how that movie is, of course, this is not in quantitative terms. In reality, the term 'measurement' implies that we are using numbers to describe a specified feature of a given product or service.

In marketing decision-making, measurement has a crucial role. For example, a firm is interested to know what is the response in the market for its recently introduced ball-point pens. This means it must measure the response, which can be in terms of sales. If it finds that it has not been able to reach even the breakeven point in sales over a reasonable time period, it has to probe this situation in detail so that the reason(s) for poor sales performance can be identified. It can then take remedial measures to ensure higher sales of ball-point pens. For obtaining the desired quantitative information about its product, the management will address this problem to the marketing researcher. Thus, we find that in marketing research, the measurement process involves the use of data (i.e. numbers) to represent the marketing phenomenon under investigation. In short, our objective is to evolve some form of measurement scale.

DEFINITION OF MEASUREMENT

Measurement may be defined as the assignment of numbers to characteristics of objects or events according to rules. A point worth emphasising is that the definition of measurement does not suggest the measurement of objects or events but the characteristics of interest in the concerned objects or events. We do not measure a buyer or a product, but we measure a certain characteristic of a buyer or a product. For instance, a buyer's preference usage rate, income, or attitude can be measured. Likewise, in respect of a product, we can measure its size, colour or its suitability for a particular purpose.

TYPES OF SCALES

There are four types of measurement scales. Table 9.1 shows characteristics of such scales.

Table 9.1 Characteristics of Measurement Scales

Scale	Number System	Marketing Phenomena	Permissible Statistics
Nominal	Unique definition of numbers (0,1,2,…9)	Classification: Brands Male-female Store types Sale territories Rankings	Percentages Mode Binomial test Chi-square test
Ordinal	Order of numbers (0<1<2….<9)	Attitudes Preference Occupation Social Class	Percentiles Median Rank-order correlation Two-way ANOVA
Interval	Equality of differences (2-1=7-6)	Attitudes Opinions Index numbers	Range Mean Standard deviation Product-moment correlation
Ratio	Equality of ratios (5/10=3/6)	Sales (Units/Rupees) Units produced Cost Number of customers	Geometric mean Harmonic mean Coefficient of variation

Source: Kinnear, Thomas C. and James R. Taylor: *Marketing Research: An Applied Approach* (International Edition), Singapore, McGraw-Hill Book Company, 1987, p. 292.

Nominal Scales

Nominal scales are more widely used than any other scale for research in social sciences. In such a scale, the numbers serve as labels to identify persons, objects or events. Thus, numbers may be assigned to students in a class or patients in a hospital. We might further use the nominal scale by counting students with a certain characteristic or attribute such as those who reside in the university hostels and others. In a nominal scale, we split a set into subsets which are mutually exclusive and collectively exhaustive. Consider the following exampe:

	Number of Students		
	Undergraduates	**Postgraduates**	**Total**
Day scholars	800	200	1000
Hostellers	400	150	550
Total	1200	350	1550

In this example, students have been identified and counted by two characteristics, namely, whether they are pursuing an undergraduate or post-graduate course of study and their place of residence. The numbers given in each of the four cells are mutually exclusive and the total of these four cells gives the total number of students. In a nominal scale, the only operation involved is the counting of numbers in each group. It is, therefore, the simplest of the four scales and also the least powerful. The scale does not show any order or distance relationship nor does it have any arithmetical origin. In view of these limitations of a nominal scale, it is unsuitable in determining relationships but is very useful in preliminary or exploratory work, where it is sufficient to know the broad dimensions of a certain phenomenon.

Ordinal Scales

Ordinal scales, as the name implies, are ranking scales. Besides having the unique characteristics of the nominal scale, these scales also indicate the order. This is possible when one is able to distinguish elements on the basis of a single direction. *For example*, one may rank two or more households according to their annual income or expenditure. Suppose we have five households with annual incomes as shown below:

Household	A	B	C	D	E
Income (Rs)	6,000	10,000	4,800	12,000	11,000

If the household with the highest income is to be given No. 1 and the next to it as No. 2, and so on, then the following order will emerge:

Household	Order of households on the basis of annual income
A	D
B	E
C	B
D	A
E	C

This is the use of an ordinal scale, which involves the ordering of households on the basis of their annual income. The point to be emphasised is that it is a mere ordering and does not indicate the differences in annual income amongst the five households. On the basis of this scale one cannot say whether the difference in annual income, between two households D and E, is greater than, less than, or equal to the difference between any other two households, say, E and B.

The use of the ordinal scale is possible when one is able to distinguish a certain product on the basis of a particular attribute. The above example was numerical, dealing with the annual income of households. It was simple as it did not involve any difficulty in ordering. Consider another example where acceptability of a soft drink is involved. Here, one can ask the respondents questions on the basis of one or more attributes such as flavour, colour, etc. Respondents may be asked to indicate whether they like the soft drink or not. One can develop a five-point scale such as given below:

I strongly like it +2
I like it somewhat +1

I am indifferent	0
I dislike it somewhat	–1
I strongly dislike it	–2

In this manner, ranking can be obtained by asking respondents their level of acceptability. One can then combine the individual rankings and get a collective ranking of the group.

Interval Scales

The third type of scale is the interval scale. It possesses not only the power of the nominal and ordinal scales but also additional strength which is the determination of the equality of differences. The classic example of an interval scale is the measurement of the temperature. Both the Fahrenheit and Centigrade scales belong to this type. One can say, on the basis of this scale, that a temperature of 100 degrees is 20 degrees warmer than 80 degrees and 20 degrees cooler than 120 degrees. It may be noted that differences between two values, say, on a temperature scale are multiples of each other. Thus, the difference between 40°F and 20°F is half the difference between 60°F and 20°F. Using the conversion formula from Fahrenheit to Centigrade.

Degrees centigrade = 5/9 (Degrees Fahernheit – 32), we can find the corresponding temperatures in Centigrade.

$$
\begin{aligned}
40^\circ &= \frac{5}{9}(40-32)\\
&= \frac{5}{9}\times 8 = \frac{40}{9} = 4.44^\circ\text{C}\\
20^\circ &= \frac{5}{9}\,(20-32)\\
&= \frac{5}{9}\times(-12) = -\frac{60}{9} = -6.66^\circ\text{C}\\
40^\circ - 20^\circ &= 4.44-(-6.66)\\
&= 4.44+6.66 = 11.10^\circ\text{C}\\
60^\circ &= \frac{5}{9}\,(60-32) = \frac{5}{9}\times 28 = \frac{140}{9} = 15.55^\circ\text{C}\\
60^\circ - 20^\circ &= 15.55-(-6.66) = 15.55+6.66\\
&= 22.21^\circ\text{C which is approximately twice of } 11.10^\circ\text{C}
\end{aligned}
$$

The above example shows, that on a particular scale, equal differences indicate equal differences in value with regard to that scale only.

Interval scales are more powerful than the nominal and ordinal scales. Also, they are quicker to complete and researchers find them more convenient.

Ratio Scales

Ratio scales possess the powers of the preceding three scales as also the concept of absolute zero or origin. Thus, they have order, distance and unique origin and are the most superior amongst all the scales. Examples of ratio scales are the commonly used physical dimensions such as height, weight, distance, money value and population counts. Equal ratio on the ratio scale indicates the equal ratio among the elements being measured. *For example*, 9 lbs and 45 lbs are in the ratio of 1:5. If we convert pounds into ounces, the same ratio will be obtained. Thus, 144 ounces and 720 ounces have the same ratio of 1:5, as earlier. In other words, one can change over from one unit to another by using the relevant conversion factor. In the above example, a change from pounds to ounces involved the multiplication of the two figures by 16. This facility of conversion from one unit of measurement to another is available in the case of the ratio scale alone.

An example covering all the four types of scales is given below:

Assessing a Respondent's Liking of Soft Drinks

Nominal Scale

Which of these soft drinks do you like? Check all that apply

—Coke
—Pepsi
—Seven up
—Sprite

Ordinal Scale

Please rank the soft drinks on the following list according to your degree of liking each, assigning your most preferred drink rank = 1 and your least preferred drink = 4.

—Coke
—Pepsi
—Seven up
—Sprite

Interval Scale

Please indicate your degree of liking of each of the soft drinks on the following list by checking the appropriate position on the scale.

	Dislike a lot	Dislike	Like	Like a lot
—Coke				
—Pepsi				
—Seven up				
—Sprite				

Ratio Scale

Please divide 100 points among each of the following soft drinks according to your degree of liking for each.

—Coke
—Pepsi
—Seven up
—Sprite

100

From the foregoing account of the four types of scales, it should be clear that these scales are in increasing order of sophistication from the viewpoint of data analysis.

DIFFICULTY OF MEASUREMENT

Unlike physical sciences, measurement in social sciences (of which marketing is a part) is quite difficult. The measurement of length, height, weight is a simple task involving the use of ratio scale. But this type of situation is normally found in physical sciences. In contrast, measurement in marketing is more difficult as it involves lower scales of measurement as compared to those used in the physical sciences. This would be evident from Fig. 9.1.

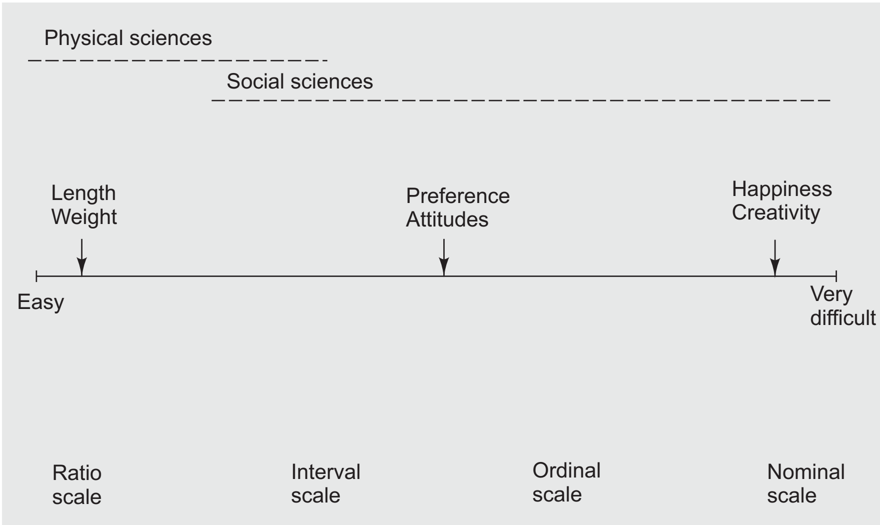

Fig. 9.1 Difficulty of the Measurement Process

Source: Kinnear, Thomas C. and James R. Taylor: *Marketing Research: An Applied Approach*, New York, McGraw-Hill Book Company, 1987 (3rd edition), p. 299.

The question that arises is: why measurement is more difficult in marketing compared to that in physical sciences? This can be explained by taking an example. Suppose we have to conduct a survey on the existence of medical facilities in certain localities in a city. Here, we have to first design a questionnaire to collect the information. We will then interview sample respondents for the information sought in the questionnaire. The point to note is that the attitude towards medical facilities would vary from respondent to respondent. Even the questionnaire design may not be a perfect instrument in eliciting the desired information. Thus, we see that measurement of attitude poses a major problem. At this stage, it is worthwhile to know as to what could be the possible sources of error.

SOURCES OF ERROR[1]

There are four major sources of error in measurement. These are:

(i) The respondent
(ii) The situation

[1] Based on Cooper, Donald R. and Pamela S. Schindler. *Marketing Research*: *Concepts and Cases*, New Delhi, Tata McGraw-Hill Publishing Company Limited, 2006, pp. 355–56.

(iii) The measurer
(iv) The instrument for data collection

Each of these sources of error is briefly discussed here.

The Respondent

Measurement may get distorted on account of different opinions of the respondent on a given issue. These differences arise on account of status of the respondent, level of education, social class, nature of job, etc. Further, some respondents may be reluctant to express their negative opinion on some issue while some others may express their attitude deliberately different from others. Again, there may be respondents who may not know the topic on which their response is being sought. In such cases, they may answer the question in a vague manner as they may not openly confess their ignorance on that issue.

The Situation

The situation in which an interview is being held also influences measurement. For example, an investigator approaches a respondent who is discussing some matter with his friends. Naturally, he may not provide answers by refusing to cooperate with the investigator. Alternatively, he may give answers in a casual manner to cut short the interview time. Again, when the respondent finds that his identity may not remain undisclosed, he may not express his actual feelings.

The Measurer

The measurer is no one else but the interviewer who is conducting interviews on the basis of a questionnaire. Measurement errors may crop up on account of the method used by the interviewer. It is possible that he may not be very careful while recording responses. He may change the wordings or may not be able to record the complete response. This partial, careless mechanical processing may lead to distortion of the responses.

The Instrument

Finally, a defective instrument for data collection may cause distortion in a number of ways. These are explained below.

1. The questionnaire is too lengthy containing a number of questions.
2. The questionnaire has an element of ambiguity in the questions.
3. The language used in a question is suggestive of a particular response.
4. The layout of the instrument, the extent of space available for response, the type of printing and the quality of paper used are inadequate and of poor quality.

CRITERIA FOR A GOOD SCALE

There are two important criteria for ascertaining whether the scale developed is good or not. These are reliability and validity. We first discuss reliability.

Reliability

There are three major methods of estimating the reliability of measurement. These are:

(i) Test-Retest reliability
(ii) The Alternative forms reliability
(iii) Split-Half reliability

Test–Retest Reliability

This form of reliability involves repeated measurement of the same respondent or group using the same scaling technique under similar conditions. This would involve administering a test at two points of time to the same person or a group of persons. The scores of the two tests would then be correlated. If the correlation is low, then the reliability too is less.

A point to note is that reliability is a necessary contribution to validity but it is not a sufficient condition for validity. The relationship between reliability and validity can be better understood by an example. Suppose a person takes his weight on a weighing machine which gives accurate results, then the scale is both reliable and valid. If, on the contrary, the weighing machine always records, say 2 kg. more than his actual weight, then the scale is reliable but not valid as it fails to measure what it is supposed to. As the scale does not satisfy validity, reliability is hardly useful.

Alternative-Forms Reliability

Alternative-forms reliability involves the same respondent being given a set of two forms. The forms are considered equivalent but are not identical. The results obtained on the basis of these forms are compared to ascertain whether there is considerable difference between the two scores.

As each person in the group is given two forms and as the results of these two forms are to be compared, this approach needs more time. Also, it is expensive.

Split-Half Reliability

Another approach to reliability involves administering the measuring instrument only once to test the internal consistency. The split-half technique can be used in case of a multi-item instrument. In fact it is another version of the alternative-forms technique. It involves splitting of a multi-item measurement instrument into two equivalent groups. The item responses of the two groups are then correlated to estimate reliability. A high degree of correlation indicates that there is similarity or homogeneity among the items.

Validity

The second attribute that a scale should have is its validity.

> By validity is meant the success of the scale in measuring what it sets out to measure, so that differences between individuals' scores can be taken as representing true differences in the characteristic under study.

While the concept of validity is simple to understand, it becomes difficult to apply the test of validity in practice. As Moser and Kalton have pointed out, there are **four approaches** that can be commonly distinguished.

1. Content validity

The first is the content validity, which implies that the contents of the scale correspond to the contents of the attitude system and that they are comprehensive enough to cover the full range of the attitude. The researcher should first define the problem clearly, identify the items to be measured, and evolve a suitable scale for the purpose. Despite all this care, he may be criticised on the ground that the scale developed by him lacks content validiy. This happens because, whether or not a given scale contains the content validity will depend on the judgement of the researcher and, this is likely to vary from individual to individual. To avoid this, it may be preferable to approach a group of knowledgeable persons, rather than leaving it to one person alone.

2. Construct Validity

One of the difficulties arising in attitude measurement is that it is perhaps impossible to measure attitude directly. It can be measured only indirectly on the basis of answers given by the respondents. In a situation of this type, the test of construct validity is used. The concept of construct validity is more complex than that of content validity. In order to apply construct validity, the researcher postulates the nature and extent of association between the attitude and other specified variables. He then examines whether these relationships exist. If not, there could be two possible explanations. First, his scale might be invalid as it does not satisfactorily measure what it set out to measure. Second, his theory might be deficient in some way and it may be difficult for him to identify it. The point to emphasise is that the construct validity is based on theoretical considerations. *For example*, the status of an individual in a society may be dependent upon such variables as the level of education, occupation or ownership of a car and a house. Thus, on the basis of theory, an elite class should have a high degree of association amongst these factors. The existence of a high degree of correlation in this case is a supporting evidence and can be regarded as a test of validity.

3. Predictive Validity

Predictive validity signifies how best the researcher can guess the future performance, from his knowledge of the attitude score. *For example*, an opinion questionnaire which forms the basis for correctly forecasting the demand for a product has predictive validity. The procedure for predictive validity first measures the attitude and then predicts the future behaviour on the basis of this measurement.

This is followed by the measurement of the future behaviour at an appropriate time. Finally, the obtained scores are compared with the earlier predicted scores. If the two series of scores are closely associated, the scale is said to have predictive validity.

4. Concurrent Validity

In the case of concurrent validity, an attitude scale on one variable can be used to estimate scores on another variable. *For example*, one may decide the social status of respondents on the basis of their attitude toward savings. Here, the attitude scale as also the criterion measure are administered almost at the same time. It may be noted that a high degree of concurrent validity may sometimes be spurious as the collection of one set of data may influence the collection of another set.

Practicality

The foregoing discussion shows that the scientific requirements of a research study should be valid. In contrast, the operational requirements call for it to be practical. This implies that the handling of a research study should be economical, convenient, and the results should be interpretable.

Economy

Often one has to strike a balance between the ideal research and the budget. Data not freely available and instrument length is one area where economic factors become dominant. The choice of data collection method is also subject to economic factors.

Convenience

Any device used for measurement should not be inconvenient to administer. A questionnaire or a measurement scale should have a set of clear instructions to elicit better response. The more complex the concepts and constructs, the greater is the need to provide very clear and complete instructions.

Interpretability

When persons other than the test designers have to interpret the results, this aspect becomes important. It is usually an issue with standardized tests. In such cases, the researcher who is designing the measuring instrument must provide important and relevant information so as to facilitate interpretation in proper perspective.

DEVELOPMENT OF MARKETING MEASURES[2]

Suppose we have to develop a measurement for a particular concept such as customer satisfaction in respect of a particular product, how should we proceed in this regard? We have to proceed in a systematic manner, involving a number of steps. These steps are briefly explained below.

1. Specify Domain of Concept

It is very important to develop a sound conceptual definition. For example, how do we define customer satisfaction? It may be necessary not only to review the available literature but also to discuss the concept of customer satisfaction with knowledgeable persons.

2. Generate Sample of Items

This step requires that a list of specific items in the form of questions, phrases or statements be prepared. It may be noted that items should cover each aspect of the concept as defined in Step 1. Here, too, a careful review of the literature and discussion with well-informed individuals, consumers and executives of trade associations will be helpful in developing an appropriate list of items.

[2] Tull, Donald S. and Del I. Hawkins: *Marketing Research: Measurement and Method*, New Delhi. Prentice-Hall of India Private Limited, 1998, pp. 319–21

3. Collect Data

The items included in Step 2 should be placed in a proper format. This format should then be used to collect information from the target group.

4. Improve the Measure

On the basis of the information gathered in Step 3, one can know that certain items do not correlate with the total score for the overall measure. As such, such items need to be eliminated. Sometimes one may find that the results are extremely unsatisfactory and unexpected. In such cases, it is advisable to go back to earlier steps relating to the conceptual definition and the generation of sample items.

5. Collect Data for Reliability and Validity Assessments

Having eliminated superfluous items from the measurement instrument, one can now collect data afresh on the basis of the revised instrument.

6. Assess Reliability

Having collected new data on the basis of the revised instrument, this should be analysed for reliability. It is advisable not to depend on one assessment, but two or more reliability assessments should be used. On the basis of this assessment, unrealiable items should be eliminated from the overall measurement instrument.

7. Assess Validity

After having ensured the reliability of the measurement in Step 6, its validity needs to be examined. While any method of assessing validity can be used, construct validity is preferable.

8. Develop Norms

This is the final step that is concerned with the administration of the measurement instrument to various groups of people such as demographic groups, users, non-users, etc. Averages and variances should be calculated as these facilitate better interpretation of data collected. When measurement is to be used in subsequent studies (or multiple studies), these calculations will be all the more useful. No doubt, adherence to all the above-mentioned steps would require not only more time but also more money. If one cannot wait that long or is unable to bear the increased cost, one can make necessary adjustments to reduce these steps in accordance with the availability of time and finance.

Summary

At the outset, the chapter has defined the term ‘measurement’. This is followed by a description of four types of scales, namely, nominal, ordinal, interval and ratio suggesting that from the viewpoint of data analysis, these are on an increasing order of sophistication. It then emphasises that measurement is more difficult in marketing research compared to physical sciences.

Subsequently, the chapter focuses on major sources of errors in measurement, namely, respondent, situation, measurer or interviewer and instrument. This is followed by a discussion on two major criteria, viz. reliability and validity, used for ascertaining whether the scale developed is good or not. The Chapter then explains three types of reliability: test–retest, alternative forms, and split-half. This is followed by a discussion on four types of validity, namely, content validity, construct validity, predictive validity, and concurrent validity.

At the end, the chapter suggests a number of steps needed for the development of good marketing measures.

Key Terms and Concepts

Measurement 141
Nominal scale 142
Ordinal scale 143
Interval scale 144
Ratio scale 144
Validity 148
Reliability 148
Test-Retest Reliability 148
Alternative Forms of Reliability 148
Split-Half Reliability 148
Content Validity 149
Construct Validity 149
Predictive Validity 149
Concurrent Validity 149

Questions

1. What is meant by measurement? Why is it important in research?
2. What is a nominal scale? What statistical techniques can be used with this scale?
3. What is an ordinal scale? What statistical techniques can be used with this scale?
4. What is an interval scale? What statistical techniques can be used with this scale?
5. What is a ratio scale? What statistical techniques can be used with this scale?
6. Develop each of the four types of scales, mentioned in Questions 2 to 5, to measure customer satisfaction.
7. Indicate which type of scale (nominal, ordinal, interval and ratio) is being used in each of the following questions. Justify your answer.
   (i) What is your monthly income?
   (ii) How much time do you spend in the university library every day?
   —Less than 1 hour
   —1 to 2 hours
   —2 to 3 hours
   —3 to 4 hours
   —More than 4 hours

(iii) Your college/university brings out a quarterly magazine. How satisfied are you with it?
—Very satisfied
—Satisfied
—Neither satisfied nor dissatisfied
—Dissatisfied
—Very dissatisfied
(iv) What is the level of your education?
—Upto middle level
—Matriculation
—Higher secondary
—Graduation
—Post-graduation

8. Mention the type of scale represented by each of the following items or series of items:
   (i) a metre
   (ii) a series of value judgements ranging from zero to ten indicating zero as the poorest and ten as the best
   (iii) a series of value judgements ranging from "extremely dissatisfied" to "fully satisfied".
9. Describe the main difficulties one faces in measurement.
10. What are the major sources of error in measurement?
11. What is meant by reliability of a test?
12. Describe each of the following:
    (i) Test-Retest reliability
    (ii) Alternative forms of reliability
    (iii) Split-Half reliability
13. What is meant by validity of a test?
14. Explain the following types of validity:
    (i) Content validity
    (ii) Construct validity
    (iii) Predictive validity
    (iv) Concurrent validity
15. What is the difference between reliability and validity?
16. How are measurement accuracy, reliability, and validity related?
17. What are the criteria for a good scale?
18. What factors would you take into account while developing a good marketing measure?
19. What are the main sources of error in measurement?
20. Explain how errors in measurement can arise from the following:
    (i) Respondent
    (ii) Situation
    (iii) Measurer
    (iv) Instrument

10 Attitude Scales

Learning Objectives

After reading this chapter, you should be able to understand:

1. The concept of attitude
2. The components of attitude
3. The general procedure in attitude scaling
4. Selected attitude scales
5. The limitations of attitude measurement

Marketing research is often concerned with the behaviour of the consumer. In this respect, marketing researchers have drawn heavily on the behavioural sciences such as psychology and sociology. In fact, the contribution of these sciences to marketing research has been very significant, especially with regard to two aspects. First, the research techniques used by psychologists and sociologists, being of considerable relevance to marketing researchers, have been amply used by them. Second, the concepts and theories of these behavioural sciences have also proved to be relevant to marketing researchers.[1]

If the attitude of the public towards a company or its product is unfavourable, the company will not be able to sustain itself for too long. It is, therefore, in the interest of the company to ensure that people have a favourable attitude toward its product. However, this by itself is not enough. The company must also look into the future to anticipate the preferences of the public. Thus, a study of attitudes becomes very relevant to marketing researchers. Another area where attitudes seem to play a major part is advertising. In these days of increasing competition, advertising has become almost unavoidable, and it makes use of various psychological techniques. *For example*, take the case of copy research. A marketing researcher would like to decide that message the advertisement should carry, how it should be conveyed and the most effective mode of taking this message to the consumer. To give yet another example of the importance of attitude measurement in marketing research, take the case of a manufacturer who wants to know how much his product is likely

[1] Crespi, Irving, "General Concepts" in *Handbook of Marketing Research* (Ed. Robert Ferber), New York, McGraw-Hill Book Company, 1974, pp. 3–9.

to sell. For this purpose, he may have to undertake research on buying behaviour. By observing customers as they buy goods, he can learn their preferences for a particular brand. Apart from this direct observation, which would need a long time, he may embark upon an attitudinal survey. This would reveal the likes and dislikes of the consumers in respect of certain brands, which would be extremely helpful to the manufacturer.

THE CONCEPT OF ATTITUDE

The dictionary meaning of 'attitude' is 'settled behaviour, as indicating opinion'. This, however, does not help us much except that it implies that in a given situation a person will act 'automatically' in a certain manner, depending on his attitude. As far back as 1928, Thurstone defined attitudes as "the sum total of man's inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats and convictions about any specific topic."[2] Attitude is a subjective and personal affair. The term 'opinion' symbolises an attitude. In fact, it is the verbal expression of attitude.

Apart from this, the term 'attitude' has been defined differently by different authors. A few of these definitions are given below:

- Attitudes are individual mental processes which determine both the actual and potential responses of each person in a social world. Since an attitude is always directed toward some object it may be defined as "the state of mind of the individual toward a value."[3]
- Attitude is a mental and neural state of readiness organized through experience exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related.
- Attitude is the predisposition of the individual to evaluate some symbol or object or aspect of his world in a favourable manner.[4]
- An enduring system of positive or negative evaluations, emotional feelings, and pro and con action tendencies with respect to a social object.[5]
- An attitude is the degree of positive or negative affect associated with some psychological object.[6]
- An attitude, roughly, is a residuum of experience, by which further activity is conditioned and controlled…We may think of attitudes as acquired tendencies to act in specific ways toward objects.[7]

Though the foregoing definitions make it abundantly clear that defining 'attitudes' is a difficult task, one does find that there is a common thread running through all of them. Following Allport,[8] an essential feature of attitude is the preparation or readiness to response. Further, it is not behaviour but a pre-condition for it. Social psychologists are generally of the view that attitude involves

[2] Thurstone, Louis, "Attitude can be Measured" in *American Journal of Sociology*, Vol. 33, January, 1928, p. 530.

[3] This definition and the one that follows were given by Allport in his article. See Allport, G.W., "Attitudes" in (Ed. C. Murchison), *Handbook of Social Psychology*, Worester, Mass., Clark University Press, 1935, pp. 6 and 8.

[4] Katz, D., "The Functional Approach to the Study of Attitudes" in *Public Opinion Quarterly*, 1960, vol. 24, p. 168.

[5] Krech, D., R.S. Crutchfield and E.L. Ballachey, *Individual in Society*, New York, MacGraw-Hill, 1962, p. 177.

[6] Thurstone, L.L., "Comment" in *American Journal of Sociology*, Vol. 52, 1946, pp. 39–50.

[7] Krueger, E.T. and W.C. Reckless, *Social Psychology*, New York, Longmans, Green, 1931, p. 238.

[8] Allport, Gordon W., *op. cit*.

some evaluation component for or against an item or acceptance or rejection of an item. Attitudes will indicate "the response of an individual to a social object or phenomenon, and the response will have affective or evaluations connotations."[9]

COMPONENTS OF ATTITUDE

There are three main components of attitudes:

- A cognitive component
- An affective component
- A behavioural component

A cognitive component indicates that the respondent is aware of and knows about a given object or phenomenon. This component is very important for many types of information needs. In marketing research, we want to know whether the respondent has some idea of product features, advertising campaigns, pricing of the product as also its availability, competitive product and such other aspects.

Affective component indicates the respondent's liking and preference for an object or phenomenon. When the respondent states: "I like this product", "Advertisement for product X is not good", he is showing affective component. This component, like the earlier one, is quite important in knowing the feelings and preferences of the respondent towards a certain product or service.

The behaviour component indicates the respondent's intention to buy and his actual purchase behaviour. Prior to buying a product or service, the respondent must be inclined to do so. Hence intention to purchase precedes the actual purchase. A company would very much like to know whether the respondent's intention is to buy its product. If this is so, it is reasonably assured about the product's sale in the future.

Behaviour refers to what the respondent has done or is doing in the field of marketing. This includes the respondent's purchase of a product or service, the pattern of purchase, the quantum of product purchased as also the main characteristics of the buyer.

GENERAL PROCEDURE IN ATTITUDE SCALING

Although there are a number of methods available for the measurement of attitude, the most commonly used approach is the self-report, where a person is asked directly how he feels about an object. The other alternative methods are observation of behaviour, indirect techniques such as word-association tests, sentence-completion tests, story-telling, performance of 'objective' tasks and physiological reactions. Since the self-report method of attitude measurement is most frequently used, the discussion here is based primarily on it.

First, one should assemble a set of items or statements related to the subject of enquiry. From this pool of items, a final choice of items is to be made for inclusion in the scale. It is necessary to exercise sufficient care so that complex, imprecise, vague or ambiguous items can be avoided. Also, the statements should be written in simple language so that the respondent easily understands them.

Having collected a set of items or statements, the next task is to choose the items for inclusion in the final scale. By a process of elimination, unsuitable items should be discarded, as a result of which the items left in the pool will form the final scale. While discarding the unsuitable items, it

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[9] Dawes, Robyn M., *Fundamentals of Attitude Measurement*, New York, John Wiley and Sons, Inc., 1972, p. 16.

should be ensured that the items retained are such as to comprehensively cover the attitude dimension. For this purpose, an exploratory study is sometimes undertaken in which some persons are asked to respond to all the items of the pool. Another approach, as is used in the Thurstone scales, is to ask a group of judges to assess the suitability of items for the final scale.

Finally, the scale, once formed, should be tested in regard to its reliability and validity. If the scale satisfies these criteria, it can be used in the survey.

SELECTED ATTITUDE SCALES

We now give a brief discussion of some attitude scales that are frequently used in marketing research. Since this subject is vast, it is not possible to cover it exhaustively in one single chapter. All the same. the following discussion will give the reader some idea of the more important of the attitude scales.

Paired-comparison Scale

As the name indicates, a paired-comparison scale requires the respondent to pick two objects of a set with regard to an attribute of interest. A series of paired judgements between objects is made by the respondent on the basis of his preference, extent of a certain attribute present or some other consideration. Suppose the respondent is asked to show his preference from amongst five brands of tea A, B, C, D and E with respect to the flavour. He is then required to show his preference for a particular brand out of each of the possible pairs. In this case, the paired comparisons will involve:

A and B	B and D
A and C	B and E
A and D	C and D
A and E	C and E
B and C	D and E

It will be seen that each brand has been put in comparison with the others, one at a time. Since there are 5 brands to be evaluated, there are in all 10 paired comparisons. The total number of paired comparisons can be derived by a simple calculation, [n(n – 1) ÷ 2]. In this case 5(5 – 1) ÷ 2 =10. Likewise, when there are 15 brands to be evaluated, there will be in all 105 paired comparisons. When the number of brands or objects to be evaluated is large, the paired-comparison scale is not preferred on account of an excessively large number of pairs involved. This is an important limitation of the method.

Table 10.1 shows some hypothetical paired-comparison data in two parts—Matrix A and Matrix B.

Table 10.1 Paired-Comparison Data

Matrix A

	A	B	C	D	E
A	—	0.53	0.85	0.25	0.30
B	0.47	—	0.68	0.40	0.45
C	0.15	0.32	—	0.49	0.25
D	0.75	0.60	0.51	—	0.20
E	0.70	0.55	0.75	0.80	—

Matrix B

	A	B	C	D	E
A	—	1	1	0	0
B	0	—	1	0	0
C	0	0	—	0	0
D	1	1	1	—	0
E	1	1	1	1	—
Total	2	3	4	1	0

In Matrix A of Table 10.1, each cell entry shows the proportion of respondents who believed that the 'column' brand had the attribute under consideration in greater measure than the 'row' brand. For example, take column C and row B. The cell entry is 0.68 which indicates that while comparing brand B with brand C, 68 per cent of the respondents believed that brand C tea was tastier than brand B.

Apart from the large number of comparisons required in this method, it does not seem to be realistic as in real life buying decisions are hardly ever made in this manner. Thus, it is possible that in a paired comparison situation a brand may be preferable while in a real market situation, it may perform poorly.

In Matrix B of Table 10.1 the figures of Matrix A have been converted into 0 or 1. Where the preference figure is more than 0.50, it has been changed to 1 and where it is less than 0.50, it has been changed to 0. This is because a paired comparison with 51 per cent preferring, say, brand A means that a majority of the respondents have voted in its favour and therefore, 1 point is given. In the other case, as only a minority of respondents have voted for it, a zero point is given. The column totals in Matrix B show the extent of preference in case of each brand. It should be obvious from the column totals that brand C is at the top position followed by brands B, A, D and E, in that order.

There is also a possibility of a peculiar judgement. *For example*, a respondent may prefer brand A to brand B, brand B to brand C, and brand C to brand A. This is called a circular trial, which shows that the respondent's judgements are not transitive. In a situation like this, the researcher should examine two issues namely, (i) how serious are the respondent's violations of transitivity, and (ii) if the respondent's violations are not very serious, how can the data be made transitive by making the minimum possible changes in the original paired-comparisons table?[10]

It should be noted that this discussion is based on the assumption that the respondent has invariably to make a choice between two brands or objects. When the respondent is indifferent or feels that the two brands are equally good or bad with respect to a particular attribute, it is a case of a tie. Such cases are rare.

Another problem that is likely to be faced in paired comparisons is that of order bias. It is felt that there usually is a bias in favour of the first item of the pair. However, there is no conclusive evidence in this regard. Even so, the effects or order bias can be controlled by randomisation of the testing order.

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[10] Based on Green Paul E. and Donald S. Tull, *op. cit.*, p. 172.

Thurstone Scale

The method of **equal-appearing intervals**, as originally described by Thurstone and Chave,[11] is one of the best-known techniques in attitude measurement. First of all, a large number of statements pertaining to the subject of enquiry are collected. This can be done from a variety of sources such as personal experience, the existing literature on the subject and discussion with knowledgeable persons. The statements should range from one extreme of favourable attitude to the other extreme of unfavourable attitude. Although there is no definite number of statements that should be collected, the number should be fairly large. Thurstone and Chave have given **five criteria**[12] for selecting the statements. These are: (1) The statements should be brief so that they may not cause fatigue to the subjects who are to read the whole list. (2) They should be such that can be accepted or rejected in accordance with the attitude of the respondent. (3) The acceptance or rejection of the statement should indicate something regarding the respondent's attitude regarding the issue in question. (4) As double-barrelled statements tend to be highly ambiguous, these should be avoided. (5) The researcher must ensure that a large number of statements included in the list belong to the attitude variable that is to be measured.

Each statement is written on a separate card and subjects are asked to sort these statements into a number of intervals. Thurstone and Chave developed a list of 130 statements about the church. These were to be sorted into eleven piles "to represent an evenly graduated series of attitudes from those extremely against the chruch to those which are very much in favour of the chruch."[13] In addition to the cards containing the statements, each subject was given 11 cards, each one of these bearing a letter—the first card having letter A, the second B, and so on. The first card with letter A seemed to represent the most unfavourable attitude and the last card with letter K seemed to reflect the most favourable attitude. The middle card with letter F was described as the 'neutral' card, representing neither a favourable nor an unfavourable attitude about the object. Thus, the cards between A and F seemed to represent the varying degrees of unfavourable attitude while those between F and K were supposed to represent the varying degrees of favourable attitude as shown in the following Fig.10.1.

A B C D E F G H I J K

Unfavourable Neutral Favourable

Fig. 10.1 The Thurstone Equal-appearing Continuum

Only the middle and the two extreme cards were to be defined for the respondents. The remaining cards were not to be defined so that the intervals between two successive piles would represent equal-appearing intervals for each respondent. In such a case, the piles bearing letters from A to K could be regarded as bearing integers from 1 to 11, thereby indicating that the respondent had rated each statement on an 11-point rating scale. Thus, an 11-point rating scale becomes the psychological continuum on which the statements have been judged. It then becomes necessary to obtain a typical or average value in respect of each statement. This value can then be regarded as the scale value of the statement. Thurstone and Chave used the median of the distribution for each statement as the average value. This is illustrated in Table 10.2.

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[11] Thurstone, L.L. and E.G. Chave, *The Measurement of Attitude*, Chicago, The University of Chicago Press 1929.

[12] Ibid., pp. 22–23.

[13] Ibid., p. 30.

The table gives the data in respect of three statements. For each statement, there are three rows: the first row shows the frequency, i.e. the number of respondents placing the statement in respective categories; the second row shows these frequencies as proportions to the total frequency which happens to be 200 in this table and the third row gives the cumulative proportions.

Table 10.2 Summary Table for Judgements Obtained by the Method of Equal-Appearing Intervals

Statement		Sorting Categories												
		A 1	B 2	C 3	D 4	E 5	F 6	G 7	H 8	I 9	J 10	K 11	Scale value	Q value
	f	2	2	6	2	6	62	64	26	18	8	4		
1	p	0.01	0.01	0.03	0.01	0.03	0.31	0.32	0.13	0.09	0.04	0.02	6.8	1.7
	cp	0.01	0.02	0.05	0.06	0.09	0.40	0.72	0.85	0.94	0.98	1.00		
	f	0	0	0	10	40	28	50	26	28	14	4		
2	p	0.00	0.00	0.00	0.05	0.20	0.14	0.25	0.13	0.14	0.07	0.02	6.9	2.8
	cp	0.00	0.00	0.00	0.05	0.25	0.39	0.64	0.77	0.91	0.98	1.00		
	f	0	0	0	2	8	6	26	44	56	44	14		
3	p	0.00	0.00	0.00	0.01	0.04	0.03	0.13	0.22	0.28	0.22	0.07	8.7	2.0
	cp	0.00	0.00	0.00	0.01	0.05	0.08	0.21	0.43	0.71	0.93	1.00		

Source: Edwards, Allen L., Bombay, Vakils, Feffer and Simons Pvt. Ltd., 1969 (Indian Reprint), p. 87. Reprinted with permission of the author.

The scale value is the median value, which has been obtained by applying the usual formula for calculating median in a class-interval series. Symbolically

$$\text{Median or Scale Value } S = l\left(\frac{0.50 - \Sigma\, p_b}{p_w}\right) \times i$$

where, l = the lower limit of the interval in which the median lies.

p_b = the sum of the proportions below the interval in which the median lies

P_W = the proportions within the interval in which the median lies.

i = the width of the interval.

Applying the above formula to the figures pertaining to statement 1 in the foregoing table, we get

$$S = 6.5 + \left(\frac{0.50 - 0.40}{0.32}\right) 1.0 = 6.8 \text{ approx.}$$

The other scale values 6.9 and 8.7 in respect of statements 2 and 3 respectively, as given in the table, can be obtained in the same manner.

In addition to the scale value, the table gives the Q value for each of the three statements. The Q value is the interquartile range which was used by Thurstone and Chave as a measure of the variation of the distribution of judgements in respect of a particular statement. As the interquartile range consists of the middle 50 per cent of the judgements, it can be found out by finding the upper quartile Q_3 and the lower Quartile Q_1 and then subtracting the value of Q_1 from that of Q_3.

Since Q_3 is the size of the $3\left(\frac{n}{4}\right)$th item, the earlier formula can be used with the modification that instead of 0.50, we should use 0.75. Thus,

$$Q_3 = l + \left(\frac{0.75 - \Sigma p_b}{p_w}\right) \text{i}$$

$$= 7.5 + \left(\frac{0.75 - 0.72}{0.13}\right) 1.0$$

$$= 7.7$$

Likewise, Q_1 can be calculated as follows:

$$Q_1 = l + \left(\frac{0.25 - \Sigma p_b}{p_w}\right) i$$

$$= 5.5 + \left(\frac{0.25 - 0.09}{0.31}\right) 1.0 = 6.0$$

The difference between Q_3 and Q_1 is

$$Q = Q_3 - Q_1 = 7.7 - 6.0 = 1.7$$

As was mentioned earlier, this is the interquartile range which shows the spread of the middle 50 per cent of the judgements. If the value of Q is small, it indicates that there is agreement among the respondents in judging the degree of favourableness or unfavourableness of a statement. By the same token, a large value of Q indicates disagreement among the judges regarding the degree of favourableness or unfavourableness of a statement and therefore the statement is not appropriate. Thurstone and Chave regarded statements having relatively large values of Q as ambiguous.

In constructing an attitude scale by the method of equal-appearing intervals, one may select, tentatively, say 20 to 30 statements. The scale values of the statements should be relatively equally spaced and their Q values should be relatively small. When two or more statements have the same value of Q and when only one is to be retained, then the statement having the lowest value of Q should be chosen.

In addition to Q, Thurstone and Chave gave another criterion that could be used as a basis for rejecting statements. However, as this criterion, called the criterion of irrelevance, has not been widely used in scales constructed by the method of equal-appearing intervals it is not discussed here.[14]

On the basis of the above procedure, the researcher selects some 20 to 30 statements out of a large number of statements. The selected ones are then embodied in a questionnaire. They are included in a random order so that there is no hierarchy of scale values. The questionnaire is then ready to be administered to one or more respondents. Each respondent is asked to endorse all those statements with which he agrees. The average of the scale values of all the statements he endorses becomes his scale score. Suppose the respondent endorses statements 1, 2 and 3 in the above example his scale score will be $\frac{6.8 + 6.9 + 8.7}{3} = \frac{22.4}{3} = 7.5$ approx. Since the neutral attitude has a scale value of 6 in an 11-point scale, a scale score of 7.5 shows that the respondent has a favourable attitude towards the object. It may be emphasised here that the scale does not require any scoring or judging of distances on the part of the respondent but merely a checking of statements with which he agrees.

[14] For a brief account of this criterion, *see* Edwards, Alien L., op. cit., pp. 98–101.

Thus, the judgement of distance is a part of the construction process which is taken care of before the scale is administered to the respondent.

The equal-appearing intervals scale has been criticised on account of several limitations. First, the large number of persons, whose cooperation is required to develop such a scale, may not be available. Second, the scale can be developed only after considerable effort, thereby making it somewhat cumbersome. Third, it needs a good deal of time to construct, which sometimes may not be available. Fourth, respondents may not like to attempt the scale as it requires considerable reading on their part. Fifth, it is said that the scale values assigned to statements are likely to be influenced by the attitudes of the judges themselves. Sixth, it is criticised on account of the method of scoring since respondents are asked merely to select those statements with which they agree, thus there is a possibility of two or more respondents having the same attitude score. For example, a respondent A agrees with statements having scale values 6, 8 and 10; another respondent B agrees with statements having scale values 4, 8 and 12 and yet another respondent C agrees with two statements having scale values 16 and 8. In each of the three cases, the average attitude score is 8. But, it is a moot point whether it can be said that all the three respondents have the same attitudes towards the object. Finally, the equal-appearing interval scale has been criticised on the ground that it fails to take into account the intensity of the respondent's feelings.

The Summated Ratings Scale

The summated ratings scale, associated with Renis Likert,[15] is constructed and used in a somewhat different manner from the equal-appearing intervals scale. The major steps involved in the construction of a summated ratings scale are discussed below.

First, a large number of statements, as in the method of equal-appearing intervals, are collected. The researcher then carefully considers each statement with a view to eliminating those statements which are either ambiguous, irrelevant or otherwise deficient. The remaining statements are then given to a few respondents who are asked to indicate their reaction to using a five-point rating system: strongly approve, approve, undecided, disapprove and strongly disapprove. These categories are assigned values of 5, 4, 3, 2 and 1, respectively. In case of negatively worded statements, this scoring is reversed. The correlation between the statement scores and the total score, i.e. the total score of all statements is then ascertained. Those statements which have a high correlation with the total score are then selected for the final scale, which generally consists of twenty to twenty-five statements. It may be emphasized that the statements should be worded in such a way that about one-half of them have one end of the attitude continuum corresponding to the left or upper part of the reaction alternatives and the other half have the same end of the attitudes continuum corresponding to the right or lower part of the reaction alternative.[16]

This is necessary to avoid stereotyped response. Another point that needs to be borne in mind is that statements which get the same response from all the respondents should be excluded. In other words, the statements should be included in the final scale when there is likely to be some variation in the responses. It may also be pointed out that neutral statements normally do not work well in Likert Scales.

At this stage, let us understand the differences between the Thurstone scale and the Likert scale.

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[15] Likert, Renis, "*A Technique for the Measurement of Attitudes*" in Archives of Psychology, No. 140, 1932.

[16] Ibid., pp. 44–53.

In the former, a respondent is expected to endorse statements that are close to his true position on the attitude continuum. The farther away a statement is from this position, the less likely is the respondent to endorse it. This may give a bell-shaped probability distribution. The 'true' attitude scores of the respondent will lie on the maximum ordinate of this distribution. In contrast, in the Likert scale, a respondent makes some response to every item, and a high favourable score of a respondent indicates that he has made more responses to the "strongly favourable" than the respondent with less favourable reactions.[17] In a sense, this is a cumulative type of measurement as the attitude score of a respondent shows the cumulative favourable responses.

The Likert scale seems to be less time-consuming and less laborious than the Thurstone scale. Likert[18] claimed the relative simplicity and ease of the summated rating scale over the equal-appearing interval scale. Some researchers[19] carried out comparative studies of the two types of scales and found that the time required to construct an equal-appearing interval scale would be almost twice that required by the summated rating scale. However, as an excessively large number of judges may not be required in order to obtain reliable scale values, Edwards has held subsequently that "the two methods would be fairly comparable with respect to the time and labour required."[20] However, additional research is needed on this point so that a definite conclusion can be arrived at.

The Likert scales normally yield higher-reliability co-efficients with fewer items as compared to the Thurstone scales.

Finally, the existing evidence shows that the attitude of the judging group is hardly of any importance in ascertaining the scale values of items under the Thurstone technique.[21]

Scalogram Analysis

Guttman proposed a method for scaling attitude items. He held that attitude items can be arranged in such an order that a respondent who positively answers to a particular item also responds positively to all other items having a lower rank.[22] This technique, known as the Guttman scalogram technique, is based on the assumption that the ordering of certain stimuli is possible Thus,

> ...if an individual dominates a particular stimulus, he will also dominate all the stimuli ordered below that stimulus; also, if he fails to dominate a particular stimulus, he will fail to dominate any of the stimuli above the stimulus in the order.[23]

Consider, for example, the following five arithmetical problems that are presented according to increasing levels of difficulty:

(1) 6 + 4 =
(2) 80 + 33 =

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[17] Based on Remmers, H.H., *Introduction to Opinion and Attitude Measurement*, New York, Harper and Brothers, Publishers, 1954, p. 96.
[18] Likert, Renis, op. cit.
[19] Edwards, A.L. and Katherine C.A. Kenney, "A Comparison of the Thurstone and Likert Techniques of Attitude Scale Construction" in *Journal of Applied Psychology*, 1964, Vol. 30, pp. 72–83.
[20] Ibid.
[21] Ibid.
[22] Shaw, Marvin E. and Jack M. Wright, *Scales for the Measurement of Attitude*, New York, McGraw-Hill Book Company, 1967, p. 25.
[23] Dawes, Robyn M., *Fundamentals of Attitude Measurement*, New York, John Wiley and Sons, Inc., 1972, p. 45.

(3) 59 – 21 + 87 =
(4) 15 (28 – 13) + 5 =
(5) (25 × 12) ÷ (10 – 4 + 29)

An individual who attempts a correct answer to problem (5) is expected to get all the earlier problems right. Likewise, anyone who gets problem (4) right will get problems (1) to (3) right, and so on. By the same token, one who fails to obtain a correct answer to a certain item can be expected to fail in all the problems that are more difficult than that one. In the above example containing five graded problems, we might anticipate only six patterns of answers as follows:

Table 10.3 Scalogram

(1)	(2)	(3)	(4)	(5)	Score
+	+	+	+	+	5
+	+	+	+	–	4
+	+	+	–	–	3
+	+	–	–	–	2
+	–	–	–	–	1
–	–	–	–	–	0

A table such as the above one, containing the individuals' response, is called a scalogram.
In the case of attitude statements, this would mean that an individual with a more favourable attitude score than another individual must also be just as favourable or more favourable in his response to every statement in the set than the other individual.[24] A set of attitude statements for which responses meet this requirement constitutes a unidimensional scale.

We discuss below an important characteristic of a unidimensional scale. Assume that there are five attitude statements ranging from the most favourable to the least favourable with respect to some psychological aspect. Now, we rank these statements in such a manner that the most favourable statement is assigned rank 1, the next most favourable rank 2, and so on, with the least favourable statement standing at rank 5. Assume that there are five respondents whose attitude we want to measure. Each respondent is asked whether he agrees with the statements or not. If he agrees with a statement, he is given a weight of 1 and if he disagrees he is assigned a weight of 0. On this basis, we obtain a score for each respondent, i.e. the total weight of his responses to the statements. If our assumption that the attitude statements fall along a unidimensional continuum as also the responses of the individuals to the statements are determined only by their position on the same continuum, then the only possible outcomes of the comparisons are the same as shown in Table 10.4.[25]

It may be emphasized here that ordinarily the researcher would not know in advance whether a given set of attitude statements falls along a unidimensional continuum from the least to the most favourable, the objective of the scalogram analysis is to ascertain whether this hypothesis holds good.

[24] Edwards, Allen L., op cit., p. 172.
[25] Based on Edwards, Allen L., *op. cit.*, p. 176.

Table 10.4 Scores and Ranks of Respondents

Respondents	1	2	3	4	5	Scores of respondents	Ranks of respondents
A	1	1	1	1	1	5	1
B	0	1	1	1	1	4	2
C	0	0	1	1	1	3	3
D	0	0	0	1	1	2	4
E	0	0	0	0	1	1	5
F	0	0	0	0	0	0	6

To evaluate the scalability of a set of statements, several researches have been done. As a result, a few techniques[26] such as the Cornell Technique, the coefficient of reproducibility, are used.

Intensity Function

One of the major methodological problems in attitude measurement pertains to the division of the respondents, with respect to a particular attitude, into two groups, i.e. those who are in 'favour' and those who are 'against', and the estimation of proportions of these groups. However, in practice one finds that different researchers using differently worded questions on the same subject have arrived at different proportions of the population in the 'favourable' and 'unfavourable' groups. This is known as the question bias. The theory of scale analysis offers a solution to this problem.

Guttman and his associates have done considerable work on this problem. They hold that the intensity function provides the basis for determining the psychological zero point along an attitude continuum. Although the intensity can be measured in many ways, the most frequently used procedure is to include an intensity item after each attitude item in the scale. An intensity item, for example, could be: How strongly do you feel about this? followed by the possible answer categories, namely, very strongly, moderately strongly, not so strongly, not at all strongly. It is desirable to keep all reference to the attitude item out of the intensity item or else the intensity responses would not be independent of the content responses.

There are certain **limitations** of the technique of the scalogram analysis. First, the technique is methodologically weak as it does not have any objective and quantified criteria for determining cutting points, which enable the researcher to divide his population into favourable and unfavourable groups. Second, the selection of the original sample attitude statements or items from the population for testing the hypothesis of scalability is of an extremely subjective nature. Despite these limitations, the scalogram analysis, based on the concept of unidimensionality, is regarded as an important method of attitude measurement. Moreover, certain improvements such as the scale of discrimination technique of Edwards and Kilpatrick[27] have been suggested.

[26] For details, see for example, Edwards, Allen L., *op. cit.*, pp. 178–88.

[27] Edwards, A.L. and Franklin P. Kilpatrick: "A Technique for the Construction of Attitude Scales" in *Journal of Applied Psychology*, 1948, Vol. 32, pp. 374–83.

The Semantic Differential

Osgood[28] has developed a scaling procedure known as the semantic differential that has been receiving increasing attention by marketing researchers. The original work of Osgood and his associates indicated the emergence of three dominant factors: "An evaluation factor (represented by scales like good–bad, kind–cruel and honest–dishonest), a potency factor (represented by scales like strong–weak, hard–soft and heavy–light) and an activity factor (represented by scales like active–passive, fast–slow and hot–cold)."[29] Marketing researchers have modified the work of Osgood to some extent. Instead of using simple one-word concepts, they have preferred to used descriptive phrases.

The semantic differential scale can be used in a number of cases such as comparison of brands, determining the effectiveness of advertising on attitude change, comparison of companies' images, etc.

It may be mentioned here that in marketing research the semantic differential scale is a bipolar one, conforming to the basic concept of motivation, that of attraction to or repulsion from an object. This use is different from the original intention to use this scale to measure changes in the meaning of an object in three-dimensional space.

In order to formulate a suitable semantic differential scale, several factors[30] should be considered. First, whether the cues should be balanced or unbalanced? A scale is balanced when either side of the indifferent cue has an equal number of cues. *For example*, take the following question regarding the quality of service offered by a bank.

How would you describe the quality of service of the XYZ bank ?

__________________ Very efficient
__________________ Efficient
__________________ Moderately efficient
__________________ Neither efficient nor inefficient
__________________ Moderately inefficient
__________________ Inefficient
__________________ Very inefficient

In the above example, there are three cues on either side of the neutral category of 'neither efficient not inefficient'. Thus, it is a balanced scale.

Second, which type of cue—numerical, graphic, verbal, or some combination of these—should be used? The semantic scale in its original form used a graphic cue such as follows:

Efficient—:—:—:—:—:—:—Inefficient

Respondents were asked to place an X on the line that represented their attitude. However, numerical and verbal cues are now frequently combined.

Third, how many cues should be used in the scale? The number of cues depends on such factors as the type of respondent, the research environment and the nature of the analysis. If the respondent is educated, he will be able to scale more cues without any difficulty. As regards research environment, it may be regarded as favourable if the interview is short and to the point. If a simple analysis, say, the chi-square test can serve the purpose, a relatively small number of cues, say, two or three will be adequate.

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[28] Osgood, Charles E., "Cross-cultural Comparability in Attitude Measurement via Multilingual Semantic Differentials" in *Current Studies in Social Psychology* (Ed. L. Steiner and M. Fishbein), New York, Holt, Rinehart and Winston, 1965.

[29] *Ibid.*, p. 110. Also in *Readings in Attitude Theory and Measurement* (Ed. M. Fishbein), New York, John Wiley and Sons, Inc., 1967.

[30] Based on Hughes, G. David, "The Measurement of Beliefs and Attitudes" in *Handbook of Marketing Research*, *op. cit.*, pp. 3.23–3.26.

Fourth, whether the scale should be of the forced or non-forced variety? Since a respondent cannot report his attitude correctly unless he is aware of the object or its dimension, he may be asked to check the mid-point of the scale when he is not aware of the object. Researches have shown that this forcing of an attitude where one does not exist is misleading especially as measures of central tendency and dispersion get distorted. A better approach would be to use a non-forced variety scale.

Finally, the researcher has to select the antonyms. Since only one antonym pair is used, the method is more like a graded check list than a semantic differential scale.

Stapel Scale

The stapel scale is a modification of the semantic differential scale. It has a unipolar 10-point nonverbal rating with values from +5 to –5. It aims at measuring both the direction and intensity of attitudes at the same time. It differs from the semantic differential scale in that its scale values indicate how close the descriptor or adjective fits the object evaluated.

Respondents are asked to evaluate how accurately the adjective or phrase describes the object to be evaluated. Table 10.5 shows a format of a stapel scale.

It may be noted that ratings in the stapel scale are analysed in the same way as those in the semantic differential scale.

Another point to note is that the stapel scale can be used for more than one product or object. In such a case the scale will give the comparative profile of the objects under evaluation. Figure 10.2 presents such a stapel scale for two banks on the basis of some pre-defined qalities.

Table 10.5 Format of Stapel Scale

	Bank
+5	+5
+4	+4
+3	+3
+2	+2
+1	+1
Prompt Service	Cordial Service
–1	–1
–2	–2
–3	–3
–4	–4
–5	–5

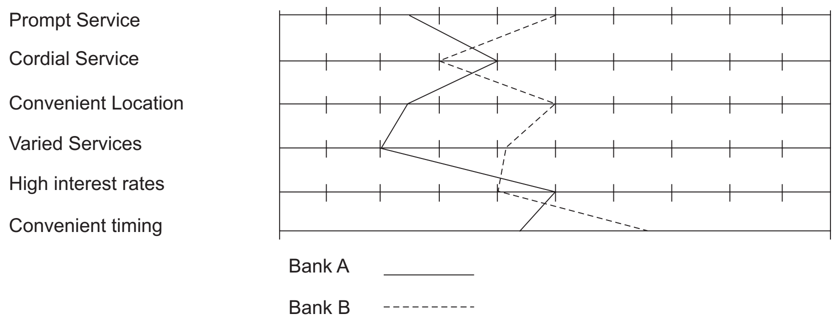


Fig. 10.2 Stapel Scale Comparative Profile of two Banks

The major advantages of the Stapel scale are that it is very convenient to administer and that it does not require truly bipolar adjectives or phrases. Further, the results obtained through this scale are similar to those from semantic differential scale.

RATING METHODS[31]

One of the easiest methods of data collection in marketing research is the rating method. This method is also commonly used in behavioural sciences. Here a respondent has to indicate his rating of a product, service or concept along a continuum or in an ordered set of categories. Rating allows a respondent to register a degree (or an amount) of a characteristic or attribute directly on a scale. Some scales such as the semantic differential and the Likert Summated scale also use rating method as we will see later.

The Rating method can be numerical, graphic, verbal or a combination of two or more of these forms. Figure 10.3 illustrates five rating scales – panel (a) to panel (e). Panel (a) contains six statements ranging from 'Strongly disagree' to 'Strongly agree'. The respondent is asked to mark in the blank space against the statement which indicates truly his feeling.

Panel (b) has seven integers from 1 to 7 as well as the verbal description against each number. The respondent is asked to mark the number against that descriptive statement which is nearest to his attitude.

A graduated thermometer is shown in panel (c). It shows 1 to 13 numbers as also three descriptive statements.

Panel (d) shows six categories ranging from 'Undoubtedly the Best' to 'Below Average'.

Finally, panel (e) shows five categories from 'quite good' to 'very poor'. The respondent is asked about the quality of one type of washing machine as also about the after-sale service in respect of the same product. He is asked to indicate the category that expresses his attitude towards quality and after-sale service.

It may be noted that at times the numerical correspondence shown in Panels (a) and (c) is wrongly taken as interval or ratio-scaled data. Even in Panel (b), (d) and (e), the researcher may take the responses as if they are interval-scale.

These are only some examples of rating scales. In practice, one comes across several other types of rating scales in marketing research. We now turn to itemized rating scale.

Panel (a)	Panel (b)
I strongly disagree with the statement.	7 Extremely smooth
I generally disagree with the statement.	6 Somewhat smooth
I moderately disagree with the statement.	5 Slightly smooth
I moderately agree with the statement.	4 Neither smooth nor harsh
I generally agree with the statement.	3 Slightly harsh
I strongly agree with the statement.	2 Somewhat harsh
	1 Very harsh

[31] Based on Green, Panel E., Donald S. Tull and Gerald Albaum: *Research For Marketing Decisions*, New Delhi, Prentice-Hall of India Private Limited, 2004, pp. 286–87.

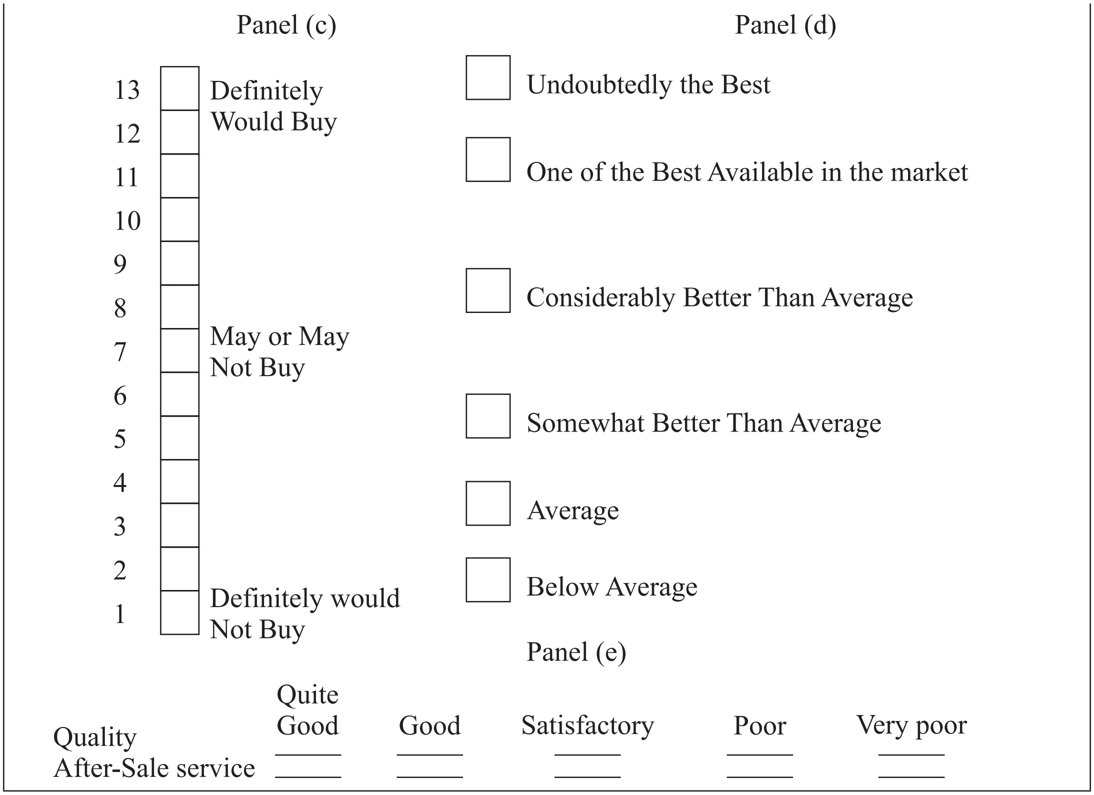


Fig. 10.3 Examples of Rating Scales Used in Marketing Research

Adapted from Figure 8.2 (Page 286) in Green, Tull and Albaum: *Research for Marketing Decisions,* Prentice-Hall of India, New Delhi, 2004.

Itemised Rating Scale

Under this scale, a respondent is asked to show his attitude by marking a position on a continuum, which has a range of possible views on an attitude object. The different positions on the continuum are given in a sequential order representing the degree of attitude held. A descriptive statement is given against each position. An example of such a scale is given below:-

How would you rate the quality of after-sales service of XYZ company?				
Excellent	Good	Satisfactory	Poor	Extremely poor

It can be seen that this scale is quite simple. A respondent can mark his attitudinal position without any difficulty. However, there are some relevant considerations which should be looked into by the researcher before he uses the scale. These considerations are briefly explained below.

1. How many categories should be in the scale?
   The researcher has full freedom to decide the number of categories that the scale should have. In our example, there are five categories from excellent to extremely poor. The researcher can

even have two categories in the scale *viz*. good and bad after-sales service. The use of just two categories in the scale will only provide the properties of a nominal scale, which permits only very limited analysis. However, when the scale is being used when the questionnaire is too lengthy or when the respondents have very limited education, this scale would be appropriate. In contrast to mere two categories, the researcher may use a large number of categories in order to provide greater flexibility to the respondents. In such a case, the scale will provide ordinal data. It will be far more sensitive as compared to the scale having only two categories. A point to note is that too numerous categories may sometimes defeat the very purpose of attitude measurement. This is because the respondents may not be able to indicate their exact attitude from amongst several categories. As such, the researcher has to carefully decide the number of categories his scale should have.

2. Should the scale have balanced or unbalanced terms?
   Another pertinent issue in choosing a proper rating scale is how many favourable versus unfavourable terms are to be used. In our earlier example, there were five categories of which two were favourable and two unfavourable. The category in the middle of the continuum is 'satisfactory' which, in fact, is a neutral category. Let us take a different example.

How would you rate the quality of after-sales service of XYZ company?				
Good	Average	Below average	Poor	Extremely poor

   Here, we find that the favourable term is only one and one is the neutral category (average). The remaining three categories are unfavourable. Obviously, in such a case the responses would be mostly unfavourable. If a respondent wants to show that the service is very good, he is unable to do so. In view of this, the researcher should be careful to avoid unbalanced scale.

3. Should the scale have even or odd number of categories?
   As we have seen in the first example, an odd number of categories allows the respondent to be neutral. He may not say that the after-sales service is good or is bad. He may say it is satisfactory, which implies it is neither good nor bad. When the scale has an even number of categories, the respondent cannot remain indifferent or neutral as he has to show his attitudinal position either good or bad. In view of this, it is advisable to have an odd number of categories.

Rank-Order Scale

Rank-Order Scale is widely used in marketing research. Under this scale, the respondents are asked to rank various objects with regard to the attitude in question. For example, they may be asked to rank some specified print advertisements on the basis of one of the factors such as their:

Awareness
Liking
Preference
Intention to buy

As the respondents give their ranking, this turns out to be an ordinal scale. It is comparative in nature.

This method has some advantages. It is simple to administer. Further, it need relatively less time as compared to other scales such as paired comparison. Again, as the instructions for ranking objects can be easily understood by a layman, it can be used on self-administered questionnaires.

This scale, however, is not free from limitations. First it produces only ordinal data, which in several cases cannot be used for further analysis. Second, the comparative nature of the method may lead the respondents to rank objects regardless of their attitudinal position towards the objects as a group.

In view of this, the researcher must seriously consider merits and demerits of several scaling methods and choose the one which is most appropriate in meeting the specific requirements of the study.

Constant Sum Scale

Constant sum scale has become quite popular in marketing research on account of its simplicity and ease of instructions. Under this scale, the respondent is given some specific number of points such as 10 or 100 and asked to divide or allocate them among the alternatives in such a way so as to reflect the relative importance of some attitudinal characteristic being studied.

Example

There are five brands of tea A, B, C, D, and E. Out of the total points 100, assign points to each of the five brands so as to indicate your relative degree of liking for five brands of tea.

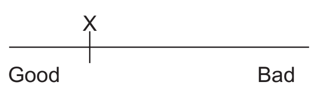
Brand	Response
A	15
B	25
C	20
D	10
E	30
	100

Although this scale is now being increasingly used in marketing research, there are some limitations of the scale. First, there is some uncertainty pertaining to the nature of data. One is not sure whether the responses provide interval or ratio data. Second, when the number of categories of some attribute under study is large, it becomes difficult for the respondent to allocate the number of points. As such, the scale will be more meaningful when there are a few categories.

Graphic Rating Scales

The graphic rating scale was originally introduced by researchers to bring out fine differences in the responses. Theoretically, any number of ratings can be displayed provided respondents are sophisticated enough to differentiate their attitudinal position and indicate it. Respondents are asked to indicate their response at a specific point along a continuum. This scale brings out interval data

The example of a graphic sale is given below:



Apart from a straight line having the extreme opposite attributes on both the ends as shown above, many graphic rating scales use pictures or visuals to communicate with the respondents.

This scale suffers from two limitations. First, it becomes difficult to code and analyse the data. Second, it needs more time as compared to scales having predetermined categories. However, this scale is very appropriate when the respondents are children.

To sum up, itemized rating scales are very frequently used by researchers for measuring attitudes of the respondents. It is very difficult to say as to which is the best format for itemized rating scales. The decision to choose a particular format is to be taken by the researcher. While choosing a particular format, the researcher should keep two factors in mind, viz. the nature of the information to be collected and the characteristics of the respondents.

WHICH SCALE TO USE?

We have discussed a variety of scales in this chapter. On measuring attitudes, one faces a major problem—out of so many types of attitude scales that are available, which one should be chosen. The problem does not end here. A number of other issues also arise, such as how many scale points to use. Again, one has to decide whether or not to reverse some of the items of the scale. Apart from these considerations, the final choice of the scale will also depend on the nature of the research problem and how the scale will be administered. Another consideration is the characteristics of the respondents and their experience and ability to respond. Finally, how far the respondents are ready to cooperate in the survey and their commitment towards it is yet another problem.

It may be noted that rating scales will also depend on the level of education of the respondents and their culture. Obviously, respondents with low levels of education and who are inexperienced would not understand the utility of rating scales. As such, the researcher has to spend considerable time to explain the scale items and interview them. Thus, the different socio-economic environments and varying levels of education have to be looked into before a final choice of a rating scale can be made.

LIMITATIONS OF ATTITUDE MEASUREMENT[32]

While a good deal of progress has been made in evolving techniques of measuring attitudes, there are certain limitations of techniques. First, attitude scales have been criticised on account of their inability to predict behaviour, as it cannot be said that the attitude of the respondents will remain unchanged in the future. However, some authors have not regarded this as a limitation of attitude scales. They hold the view that this is on account of the absence of a suitable model of behaviour. Second, attitude scales normally tend to overlook the immediate environment of the consumers. It is known that a person is motivated by his perception of his needs and goals, which are influenced by his environment. In view of this, attitude scales giving scant attention, if at all, to the individual needs and goals, are not likely to be very useful to the marketing management. Finally, the relationship between attitudes and buying behaviour still continues to be indistinct. Scaling devices have remained either descriptive or diagnostic. The former type of researches may help us in identifying the needs of the market so that new segments may be determined. The latter type of studies usually compare the attitudes of respondents with some earlier attitudes taken as the benchmark. However, benchmark attitudes are a poor substitute for a model.

In view of these limitations, attitude scales should be used with great care and caution. Recent researches suggest that instead of unidimensional scales, multidimensional scales are being evolved.

[32] Based on Ibid., pp. 3.23–3.26.

This is the right approach as the attitude of the consumer towards a certain brand or product is not based on a single factor but a number of factors including the economic, social, demographic and psychological. Since buying behaviour is multi-dimensional, models dealing with a number of variables instead of a single one would be more helpful in understanding and analysing it. Thus, the refinement of concepts with a view to evolving more suitable scales for the measurements of buying behaviour will prove to be highly rewarding to marketing researchers. This has been pointed out by Green and Carmone.[33] They hold the view that multi-dimensional scales of attitude measurement will be helpful in a number of cases such as market segmentation, product life cycle analysis, measurement of advertising effectiveness, test marketing, evaluation of sales force and brand switching research. This area of marketing research is extremely promising but a good deal of work is called for before the new scaling methods can be used with satisfaction.

Summary

This chapter has first dealt with the concept of attitude and its components. It then describes the commonly used procedure in attitude scaling. This approach involves self reporting wherein a person is asked directly how he feels about an object. The other alternative methods are observation of behaviour and use of indirect techniques such as word-association tests, sentence completion tests, story telling, etc.

The subsequent discussion is centred around some attitude scales. The scales covered in this discussion are Paired-Comparison scale, Thurnstone scale Summated Rating scale, Scalogram Analysis, Semantic Differential, Staple scale, Itemised Rating scale, Rank-Order scale, constant sum scale and Graphic Rating Scale. As so many scales are available, the researcher faces a major question-which scale should be used? The chapter deals with it briefly. This is followed by a discussion on the steps required for developing a suitable scale for attitude measurement. Finally, in view of the limitations of attitude measurement on account of a number of factors influencing it, the need for a multi-dimensional scale has been emphasized.

Key Terms and Concepts

Attitude 155
Scaling 156
Paired comparison scales 157
Thurstone Scale 159
Summated Rating Scale 162
Scalogram 163
Semantic Differential scale 166
Stapel scale 167
Itemised Rating scalev 169
Rank-Order scale 170
Constant sum scale 171
Graphic Rating Scale 171
Attitude Measurement 172

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[33] Green and Carmone, "Marketing Applications of MDS: Assessment and Outlook" in *Journal of Marketing*, Vol. 39, January, 1975, pp. 24–31.

Questions

1. What do you understand by "Attitude"?
2. What are the main components of attitude?
3. What is a Paired–Comparison scale?
4. How is a Thurstone equal–appearing interval scale constructed?
5. How is a Likert summated rating scale constructed? What are its advantages?
6. What is a semantic differential scale?
7. What is a scalogram analysis?
8. What is a stapel scale? How does it differ from a semantic differential scale?
9. Explain the following types of scales:
   (a) Itemized rating scale.
   (b) Rank–order scale
   (c) Constant sum scale
10. What is multi-dimensional scaling?
11. Why should a multi-dimensional scale be preferred to a uni–dimensional one?
12. What are the limitations of attitude measurement?
13. What is a graphic rating scale? What are its limitations?

11 Sampling: Process and Designs

Learning Objectives

After reading this chapter, you should be able to understand:

- Some basic terms related to sampling
- Estimation and testing of hypotheses
- The advantages and limitations of sampling
- The sampling process
- Types of probability and non-probability sample designs
- The characteristics of a good sample design
- Comparison between stratified sampling and cluster sampling

Once the researcher has formulated the problem and developed a research design including the questionnaire, he has to decide whether the information is to be collected from all the people comprising the population. In case the data are collected from each member of the population of interest, it is known as the **census survey**. If, on the other hand, data are to be collected only from some members of the population, it is known as the **sample survey**. Thus, the researcher has to decide whether he will conduct a census or a sample survey to collect the data needed for his study.

Let us discuss some basic aspects of sampling. As we are concerned with the practical aspects of sampling rather than the theoretical considerations, it would be interesting to know why we should use sampling vis-à-vis complete coverage of population. What are the different types of sample designs available from which one may be selected? What procedure is involved in drawing a sample out of a given population? This chapter attempts to provide answers to these questions.

SOME BASIC TERMS[1]

Population

In statistical usage the term population is applied to any finite or infinite collection of individuals. It has displaced the older term *universe*, which is derived from the *universe of discourse* of logic.

1 The definitions given here are reproduced from Kendall, Sir Maurice G. and William R. Buckland, *A Dictionary of Statistical Terms*, London, Longman Group Ltd., 1984. Reprinted with the kind permission of the International Statistical Institute, Voorburg, The Netherlands.

It is practically synonymous with *aggregate* and does not necessarily refer to a collection of living organisms.

Census

The complete enumeration of a population or groups at a point in time with respect to well-defined characteristics such as population, production, traffic on particular roads. In some connection the term is associated with the data collected rather than the extent of the collection so that the term Sample Census has a distinct meaning.

The partial enumeration resulting from a failure to cover the whole population, as distinct from a designed sample enquiry, may be referred to as an 'incomplete census'.

Sample

A part of a population, or a subset from a set of units, which is provided by some process or other, usually by deliberate selection with the object of investigating the properties of the parent population or set.

Sample Survey

A survey which is carried out using a sampling method, i.e. in which a portion only, and not the whole population, is surveyed.

Sampling Unit

One of the units into which an aggregate is divided or regarded as divided for the purposes of sampling, each unit being regarded as individual and indivisible when the selection is made. The definition of unit may be made on some natural basis, for example, households, persons, units of product, tickets, etc. or on some arbitrary basis, e.g. areas defined by grid coordinates on a map. In the case of *multi-stage sampling* the units are different at different stages of sampling, being 'large' at the first stage and growing progressively smaller with each stage in the process of selection. The term *sample unit* is sometimes used in a synonymous sense.

Frame

A list, map or other specification of the units which constitute the available information relating to the population designated for a particular sampling scheme. There is a frame corresponding to each state of sampling in a multi-stage sampling scheme. The frame may or may not contain information about the *size* or other supplementary information of the units, but it should have enough details so that a unit, if included in the sample, may be located and taken up for inquiry. The nature of the frame exerts a considerable influence over the structure of a sample survey. It is rarely perfect, and may be inaccurate, incomplete, inadequately described, out of date or subject to some degree of duplication. Reasonable reliability in the frame is a desirable condition for the reliability of a sample survey based on it.

In multi-stage sampling it is sometimes possible to construct the frame at higher stages during the progress of the sample survey itself. *For example*, certain first stage units may be selected in the first instance; and then more detailed lists or maps be constructed by compilation of available information or by direct observation only of the first-stage units actually selected.

Sampling Error

That part of the difference between a population value and an estimate thereof, derived from a random sample, which is due to the fact that only a sample of values is observed; as distinct from errors due to imperfect selection, bias in response or estimation, errors of observation and recording, etc. The totality of sampling errors in all possible samples of the same size generates the sampling distribution of the statistic which is being used to estimate the parent value.

Bias

Generally, an effect which deprives a statistical result of representativeness by systematically distorting it, as distinct from a random error which may distort on any one occasion but balances out on the average.

Biased Sample

A sample obtained by a biased sampling process, that is to say, a process which incorporates a systematic component of error, as distinct from random error which balances out on the average. Non-random sampling is often, though not inevitably, subject to bias, particularly when entrusted to subjective judgement on the part of human beings.

ESTIMATION AND TESTING OF HYPOTHESES

At this stage, it is worthwhile to distinguish two objectives of sample surveys—(i) to estimate certain population parameters, and (ii) to test a hypothesis.

Estimation of a parameter refers to a situation in which the presence of a certain characteristic in a given population is to be estimated. *For example*, we may be interested in ascertaining the average annual expenditure incurred on smoking or the proportion of employees working overtime in an industrial unit, and so on. In the first example, parameter refers to the average annual expenditure on smoking and in the second example, the proportion of employees working overtime. In order to estimate a parameter, first a sample is chosen, the elements in the sample are contacted and the necessary information is collected from them. From the information thus gathered, the relevant statistic (average or proportion) is calculated. This statistic is used as an estimate of the population parameter.

The second objective of sample surveys may be to test a hypothesis involving a comparison of two or more numerical values. *For example*, we may like to test the hypothesis that at least 60 per cent of households have telephones in a town. A sample survey is undertaken and the relevant survey data reveal that this percentage is 55. The question now is whether these two percentages are significantly different.

ADVANTAGES OF SAMPLING

The following are several advantages of sampling:

1. Sampling is cheaper than a census survey. It is obviously more economical, for instance, to cover a sample of households than all the households in a territory although the cost per unit of study may be higher in a sample survey than in a census survey.
2. Since magnitude of operations involved in a sample survey is small, both the execution of the field work and the analysis of the results can be carried out speedily.

3. Sampling results in greater economy of effort as a relatively small staff is required to carry out the survey and to tabulate and process the survey data.
4. A sample survey enables the researcher to collect more detailed information than would otherwise be possible in a census survey. Also, information of a more specialised type can be collected, which would not be possible in a census survey on account of the availability of a small number of specialists.
5. Since the scale of operations involved in a sample survey is small, the quality of the interviewing, supervision and other related activities can be better than the quality in a census survey.

LIMITATIONS OF SAMPLING

1. When the information is needed on every unit in the population such as individuals, dwelling units or business establishments, a sample survey cannot be of much help for it fails to provide information on individual count.
2. Sampling gives rise to certain errors. If these errors are too large, the results of the sample survey will be of extremely limited use.
3. While in a census survey it may be easy to check the omissions of certain units in view of complete coverage, this is not so in the case of a sample survey.

THE SAMPLING PROCESS[2]

Having looked into the major advantages and limitations of sampling, we now turn to the sampling process. It is the procedure required right from defining a population to the actual selection of sample elements. **There are seven steps involved in this process as shown in Fig. 11.1.**

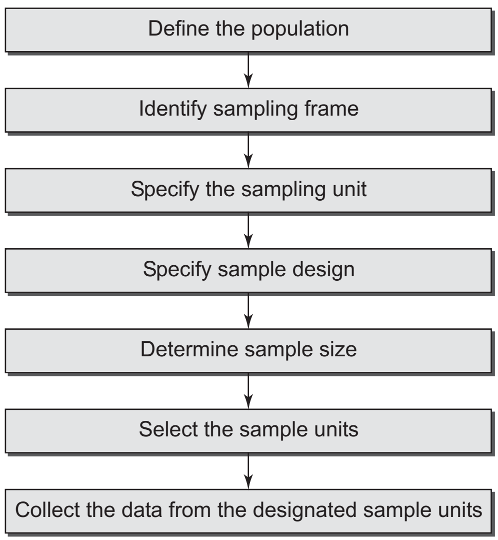

Fig. 11.1 The Sampling Process

[2] The discussion is based on Tull, Donald S. and D. Hawkins, *Marketing Research—Measurement and Method*, New York, Macmillan Publishing Company, 1984, pp. 380–386 and 395.

Step 1

Define the population. It is the aggregate of all the elements defined prior to selection of the sample. It is necessary to define population in terms of (i) elements, (ii) sampling units, (iii) extent, and (iv) time. A few examples are given here.

If we were to conduct a survey on the consumption of tea in Gujarat, then these specifications might be as follows

(i) Element: Housewives
(ii) Sampling units: Households, then housewives
(iii) Extent: Gujarat State
(iv) Time: January 1–10, 2006

If we were to monitor the sales of a product recently introduced by us, the population might be

(i) Element: Our product
(ii) Sampling units: Retail outlets, super markets, then our product
(iii) Extent: Delhi and New Delhi
(iv) Time: October 7–14, 2006

It may be emphasized that all these four specifications must be contained in the designated population. Omission of any of them would render the definition of population incomplete.

Step 2

Identify the sampling frame, which could be a telephone directory, a list of blocks and localities of a city, a map or any other list consisting of all the sampling units. It may be pointed out that if the frame is incomplete or otherwise defective, sampling will not be able to overcome these shortcomings.

The question is—How to ensure that the frame is perfect and free from any defect? Leslie Kish[3] has observed that a perfect frame is one where "every element appears on the list separately, once, only once, and nothing else appears on the list." This type of perfect frame would indicate one-to-one correspondence between frame units and sampling units. But such perfect frames are rather rare. Accordingly, one has to use frames with one deficiency or another, but one should ensure that the frame is not too deficient so as to be given up altogether.

This raises a pertinent question: What are the criteria for a suitable frame? In order to examine the suitability or otherwise of a sampling frame, a number of questions[4] need be asked. These are:

1. Does it adequately cover the population to be surveyed?
2. How complete is the frame? Is every unit that should be included represented?
3. Is it accurate? Is the information about each individual unit correct? Does the frame as a whole contain units which no longer exist?
4. Is there any duplication? If so, then the probability of selection is disturbed as a unit can enter the sample more than once.
5. Is the frame up-to-date? It could have met all the criteria when compiled but could well be deficient when it came to be used. This could well be true of all frames involving the human population as change is taking place continuously.

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[3] Kish, Leslie, *Survey Sampling*, New York, John Wiley and Sons, Inc., 1965, p. 53.

[4] Based on Blaunden, R.M., "Sampling Frames" in *Marketing Research—Selected Reading*. (Ed.: Joseph Sailbert), Corden Wills, Penguin Books, 1970, pp. 173–174.

6. How convenient is it to use? Is it readily accessible? Is it arranged in a way suitable for sampling? Can it easily be re-arranged so as to enable us to introduce stratification and to undertake multi-stage sampling?

These are demanding criteria and it is most unlikely that any frame would meet them all. Nevertheless, they are the factors to be borne in mind whenever we undertake random sampling.

In marketing research most of the frames are from census reports, electoral registers, lists of member units of trade and industry associations, lists of members of professional bodies, lists of dwelling units maintained by local bodies, returns from an earlier survey and large scale maps.

Step 3

Specify the sampling unit. The sampling unit is the basic unit containing the elements of the target population. The sampling unit may be different from the element. *For example*, if one wanted a sample of housewives, it might be possible to have access to such a sample directly. However, it might be easier to select households as the sampling unit and then interview housewives in each of the selected households.

As mentioned in the preceding step, the sampling frame should be complete and accurate otherwise the selection of the sampling unit might be defective. It is necessary to get a further specification of the sampling unit both in personal interviews and in telephone interviews. Thus, in personal interviews, a pertinent question is—of the several persons in a household, who should be interviewed? If interviews are held during office timings when the heads of families and other employed persons are away, interviewing would under-represent employed persons and over-represent elderly persons, housewives and the unemployed. In view of these considerations, it is necessary to have a random process of selection of the adult residents of each household. One method that could be used for this purpose is to list all the eligible persons living at a particular address and then select one of them.

Step 4

Specify the sampling method. It indicates how the sample units are selected. One of the most important decisions in this regard is to determine which of the two—probability and non-probability sample—is to be chosen. Probability samples are also known as random samples and non-probability samples as non-random samples.

In case of a probability sample, the probability or chance of every unit in the population being included in the sample is known. Further, the selection of specific units in the sample depends entirely on chance. No substitution of one unit for another is permissible. This means that no human judgement is involved in the selection of a sample. In contrast, in a non-probability sample, the probability of inclusion of any unit in the population in the sample is not known. In addition, the selection of units within a sample involves human judgement rather than pure chance.

In case of a probability sample, it is possible to measure the sampling error and thereby determine the degree of precision in the estimates with the help of the theory of probability. This theory also enables us to consider, from amongst the various possible sample designs, the one that will give the maximum information per rupee. This is not possible when a non-probability sample is used.

Probability sampling enables us to choose representative sample designs. It also enables us to estimate the extent to which the results based on such a sample are likely to be different from what we would have obtained had we covered the population in our study. Conversely, the use of probability sampling enables us to determine the sample size for a given degree of precision, indicating that our sample results do not differ by more than a specified amount from those yielded by a study covering the entire population.

Although non-probability sampling does not yield these benefits, on account of its convenience and economy, it is often preferred to probability sampling. If the researcher is convinced that the risks involved in the use of a non-probability sample are more than offset by its being relatively cheap and convenient, his choice should be in favour of non-probability sampling.

There are various types of sample designs which can be covered under the two broad groups—**random or probability samples and non-random or non-probability samples.** The main types of sample designs in each of these two categories are discussed a little later.

Step 5

Determine the sample size. In other words, one has to decide how many elements of the target population are to be chosen. The problem of sample size is discussed in the next chapter.

Step 6

Specify the sampling plan. This means that one should indicate how decisions made so far are to be implemented. *For example*, if a survey of households is to be conducted, a sampling plan should define a household, contain instructions to the interviewer as to how he should take a systematic sample of households, advise him on what he should do when no one is available on his visit to the household, and so on. These are some pertinent issues in a sampling survey to which a sampling plan should provide answers.

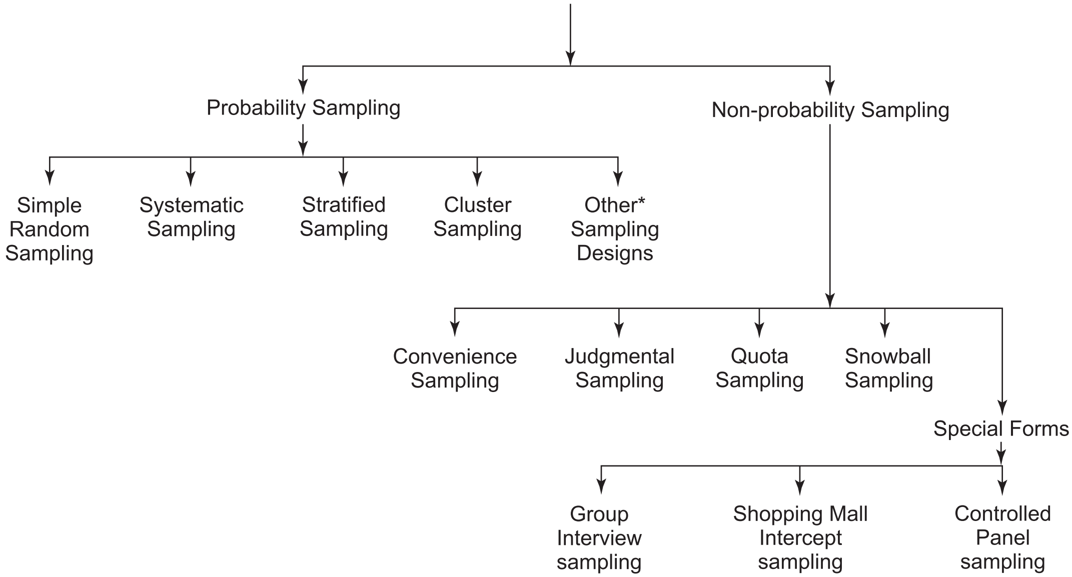
Step 7

Select the sample. This is the final step in the sampling process. A good deal of office and fieldwork is involved in the actual selection of the sampling elements. Most of the problems in this stage are faced by the interviewer while contacting the sample-respondents. Some of these problems will be discussed in Chapter 12.

TYPES OF SAMPLE DESIGNS

After having described the sampling process, let us discuss the types of sample designs. Table 11.1 shows different sample designs. There are two broad categories of sample designs: probability sample and non-probability sample designs. Within these broad categories, there are a number of sample designs. We first discuss probability sample designs.

Table 11.1 **Types of Sampling Designs**



PROBABILITY SAMPLING

Random Sampling

A random sample gives every unit of the population a known and non-zero probability of being selected. Since random sampling implies equal probability to every unit in the population, it is necessary that the selection of the sample must be free from human judgement.

There is some confusion between the two terms ‘random sampling’ and ‘unrestricted random sampling’.[5] In the latter case, each unit in the population has an equal chance of being selected in the sample. Such a sample is drawn ‘with replacement’, which means that the unit selected at each draw is replaced into the population before another draw is made from it. As such, a unit can be included more than once in the sample. Most statistical theory relates to ‘unrestricted random sampling. In order to distinguish between these two samples, i.e. sample, without replacement and sample with replacement, the terms ‘simple random sample’ and ‘unrestricted random sample’ are used. If the latter is devised in such a manner that no unit can be included more than once, it will then be known as the simple random sampling.

It may be noted that while both simple random sampling and unrestricted random sampling give an equal probability to each unit of the population for being included in the sample, there are other sample designs too which provide equal probability to the units. The process of randomness is the very core of simple and unrestricted random sampling. The selection of a sample must be free from bias which can be ensured only when the process of selection is free from human judgement.

[5] *See*, Moser, C.A. and G. Kalton, *Survey Methods in Social Investigation*, London, The English Language Book Society and Heinemann Educational Books, 1979 (Low priced edition), p. 80.

* Multi-stage sampling—Area sampling, Multi-phase sampling, Replicated sampling, Sequential sampling, Master samples.

As Moser and Kalton have observed, "*the definition of randomness relates to the mode of selection, not to the resultant sample*".[6] The significance of this statement must be clearly understood. Despite the method of random selection used for drawing a sample, the outcome may not be a representative sample. Since the means of sample distribution constitute a normal distribution, a sample selected may be "close to one of the tails of the sampling distribution." Though the probability of such a situation would be rather remote, it does exist. One cannot doubt the process of randomness on the basis of the unrepresentative nature of a single sample. Once in a while, an unrepresentative sample may be obtained through the random process. In such a case, another sample could be drawn so that it is really representative. However, if on repeated draws one finds that the samples are not representative, then one can question the validity of random selection itself.

The process of randomness does not mean that it is 'haphazard', as a layman may be inclined to think. What it means is that the process of selecting a sample is independent of human judgement. To ensure this, there are two methods that are followed when drawing a random sample. These are: (i) **the lottery method** and (ii) **the use of random numbers.**

In the lottery method, each unit of the population is numbered and shown on a chit of paper or disc. The chits are folded and put in a box from which a sample of the requisite size is to be drawn. In case discs are used, these are well mixed up before a draw is made so that no particular unit can be identified before it gets selected. In the second method, the tables of random numbers are used. The members of the population are numbered from I to *N* from which *n* members are selected. This process is explained below with the help of an illustration.

Suppose a sample of size 50 is to be selected from a population of 500. First, number the 500 units from 1 to 500, the order being quite immaterial. While numbering the units, ensure that each unit in the population has uniform digits, in this case, three. Thus, 1st unit would have a three digit number 001, 2nd unit 002, 10th unit 010, 11th unit 011, and so on. After the units have been given three-digit numbers, the table of random numbers is to be used. One may start from the left-hand top corner of the table of random numbers and proceed systematically down sets of three-digit columns, rejecting numbers over 500 and those which have occurred earlier.

Using the first thousand numbers from the table of random numbers (an excerpt from the table is given as Appendix A), a sample of 50 out of 500 will thus be chosen.

Sample of 50				
231	092	434	318	032
055	259	325	263	194
148	113	211	239	144
389	455	207	108	337
117	126	398	379	224
433	426	225	420	006
495	062	485	122	068
367	401	035	441	043
070	100	171	493	500
313	488	047	310	222

[6] Ibid., p. 84.

Systematic Sampling

In practice, the method followed in systematic sampling is simpler than that explained earlier. First, a sampling fraction is calculated. For instance, in the foregoing example, a sample of 50 out of 500 units was chosen. The sampling fraction k is N/n where N is the total number of units in the population and n is the size of the sample. In the above example, k is 500/50 = 10. Second, a number between 1 and 10 is chosen at random. Suppose the number thus selected happens to be 9. Then, the sample will comprise numbers 9, 19, 29, 39, 49, . . ., 489 and 499.

It will be seen that it is extremely convenient to select a sample in this way. The main point to note is that once the first unit in the sample is selected, the selection of subsequent units in the sample becomes obvious. In view of this, it has been questioned whether the process of selection for subsequent units is random. Here, the selection of a unit is dependent on the selection of a preceding unit in contrast to simple random sampling where the selection of units is independent of each other. Systematic random sampling is sometimes called quasi-random sampling.

Stratified Random Sampling

A stratified random sample is one where the population is divided into mutually exclusive and mutually exhaustive strata or sub-groups and then a simple random sample is selected within each of the strata or sub-groups. Thus, human population may be divided into different strata on the basis of sex, age groups, occupation, education or regions. It may be noted that stratification does not mean absence of randomness. All that it means is that the population is first divided into certain strata and then a simple random sample is chosen within each stratum of the population.
The following example will make this clear.

Strata income per month (Rs) (1)	**Population number of households (2)**	**Sample (Proportionate) (3)**	**Sample (Disproportionate) (4)**
0– 500	5,000	50	75
501– 1000	4,000	40	20
1001– 2000	3,000	30	20
2001– 3000	2,000	20	25
3001 +	1,000	10	10
	15,000	150	150

In the above example, the population consists of 15,000 households, divided into five strata on the basis of monthly income. Column (3) of the table shows the sample, i.e., number of households selected from each stratum. The sample constitutes one per cent of the population. A sample of this type, where each stratum has a uniform sampling fraction, is called a proportionate stratified sample. If, on the contrary, the strata have variable sampling fractions, the sample is called a disproportionate stratified sample. The figures given in column (4) of the above table show a disproportionate stratified sample. It will be seen that the sampling fraction varies from one stratum to another. Thus, for example, it is 0.015 for the monthly income Rs 0–500 and 0.01 for the stratum, Rs 3001 +.

It may be noted that a stratified random sample with a uniform sample fraction results in greater precision than a simple random sample. But, this is possible only when the selection within strata is made on a random basis. Further, a stratified proportionate sample is generally convenient on account of practical considerations.

There are some other considerations in favour of the stratified random sample. The researcher may be interested in the results for separate strata rather than for the entire population. A simple random sample will not show results by strata as it presents only an aggregative picture. Another consideration is that it may be administratively expedient to split the population into strata. Thus, the population of a country may be divided into regions, states or districts, so that each of these strata may be put under the charge of a separate supervisor. Yet another consideration could be that one can use different procedures for selecting samples from various strata. Thus, the procedure to select sample households in rural areas may be altogether different from that followed in urban areas. If the data are more variable in strata, a larger sampling fraction in those strata should be taken. This would result in greater overall precision.

Estimation of the Universe Mean, with a Stratified Random Sample

In the preceding pages, we have seen that a stratified random sample comprises a group of simple random samples drawn from strata into which the population has been classified. The simple mean of each stratum is unbiased. To obtain an unbiased estimate of the population mean, the means of the. individual strata should be combined. This is possible by taking a weighted mean of the individual strata means. A numerical example will make this point clear.

Suppose there are three strata in a population. A stratified random sample covering 10 observations, in all, was selected, with the following particulars:

Stratum number	Number of observations	Value of each observation	Total value of all observations
1	3	5, 10, 15	30
2	5	20, 25, 15, 30, 10	100
3	2	35, 25	60

In order to calculate the sample mean for each stratum, the total value of all observations is to be divided by the number of observations. Thus, the sample means are 10, 20 and 30 for stratum 1, 2 and 3 respectively. These means are to be combined into an overall mean. For this purpose, weights are to be assigned to each stratum on the basis of the proportion of the number of observations in the stratum to the total number of observations in the population. Thus, a weight of 3, 5 and 2 should be assigned to the three strata, in that order. Now, the overall mean of the sample means in the three strata can be calculated as folows:

$$\frac{(10 \times 3) + (20 \times 5) + (30 \times 2)}{10}$$

$$= 19$$

Let us take another example. Suppose we have the following data on consumption of sample households:

Income stratum	Sample mean purchase per household (Rs)	Number of households in stratum
Rich	3,000	10,000
Middle class	1,200	30,000
Poor	500	60,000

Then the estimated population mean monthly expenditure per household would be

$$\begin{aligned}\bar{X}_{SY} &= W_1\bar{X}_1 + W_2\bar{X}_2 + W_3\bar{X}_3 \\ &= (0.1)(3000) + (0.3)(1200) + (0.6)(500) \\ &= 300 + 360 + 300 \\ &= \text{Rs } 960\end{aligned}$$

Now, we may generalise this, symbolically, as follows:

Stratum	Sample mean in stratum	Weight of stratum
1	$\bar{X}_1$	W_1
2	$\bar{X}_2$	W_2
.	.	.
.	.	.
.	.	.
h	$\bar{X}_h$	W_h

$$\text{Overall mean } \bar{X} = \frac{W_1\bar{X}_1 + W_2\bar{X}_2 + \ldots W_h\bar{X}_h}{\Sigma W}$$

Estimation of Confidence Interval with Stratified Random Sample

Having calculated the population mean from the sample means for different strata, it is now necessary to estimate its confidence interval. First, an estimate of standard error is to be obtained on the same lines as in the simple random sampling. Second, the estimated standard error is to be multiplied by an appropriate figure (say, by two for 95 per cent confidence and by three for almost 100 per cent confidence), depending upon the degree of confidence desired. Finally, the figure obtained in the preceding step is added to and subtracted from the estimated population mean. This will result in two numbers which are the confidence limits.

In order to estimate the standard error of the mean, it is necessary to have data on sample variance, sample size, and weight for each stratum. Symbolically, the data requirement can be shown as follows:

Stratum	Sample variance in stratum	Sample size in stratum	Weight of stratum
1	S_1^2	n_1	W_1
2	S_2^2	n_2	W_2
.	.	.	.
.	.	.	.
.	.	.	.
h	S_h^2	n_h	W_h

where S_1^2 is the variance of the sample in stratum 1, n_1 is the number of observations or items in stratum 1, and W_1 is the weight of stratum 1, indicating its relative importance. In the same manner, for stratum 2, the sample variance is $S^2{}_2$, the sample size is n_2 and the weight W_2. The subscripts 1, 2 ... h indicate the number of strata.

For estimating the standard error, the following formula may be used:

$$S^2_{\bar{X}SY} = \frac{W_1^2 S_1^2}{n_1} + \frac{W_2^2 S_2^2}{n_2} + \ldots + \frac{W_h^2 S_h^2}{n_h}$$

This gives the value of $S^2_{\bar{X}SY}$ the square root of which is the standard error.

As in illustration, suppose we have the following data pertaining to consumption of sample households in three strata—rich, middle-class and poor.

Income Stratum	Sample variance in stratum (s^2)	Sample size in stratum (n)	Weight of stratum (W)
Rich	6,000	60	0.1
Middle class	4,000	100	0.3
Poor	1,200	240	0.6

The required calculations will be as folows:

$$\begin{aligned} S^2_{\bar{X}SY} &= (0.1)^2\left(\frac{6000}{60}\right) + (0.3)^2\left(\frac{4000}{100}\right) + (0.6)^2\left(\frac{1200}{240}\right) \\ &= (0.01 \times 100) + (0.09 \times 40) + (0.36 \times 5) \\ &= 1 + 3.60 + 1.80 \\ &= 6.4 \end{aligned}$$

The standard error of the mean is

$$S_{\bar{X}SY} = \sqrt{S^2_{\bar{X}SY}} \quad \sqrt{6.4} \;\; 2.53 \text{ units approx.}$$

Although 95 per cent confidence interval is between ± 1.96 standard error, taking it approximately 2, it is necessary to multiply the standard error by 2. This gives a figure of 5.06. This should be added to and subtracted from the sample mean of Rs 960 (previous example). This gives a 95 per cent confidence interval of Rs 954.94 to 965.06. If we take ± 3 as the standard error, then we can get an interval which is almost certain to cover the population mean

$$\text{Rs } 960 \pm 3(5.06)$$

or $$\text{Rs } 960 - 15.18 \text{ and}$$

$$\text{Rs } 960 + 15.18$$

or $$\text{Rs } 944.82 \text{ to Rs } 975.18$$

It may be noted that in the above calculations, differences among strata means did not enter into the standard error, unlike the simple random sample. The calculations were based on the estimated within-stratum variances. It is because of this reason that a stratified random sampling gives a more precise estimate of the population mean than a simple random sampling for a given sample size.

There are three major issues in stratified sampling:

(i) Bases of stratification
(ii) Number of strata
(iii) Sample sizes within strata.

Bases of Stratification

The bases of stratification depend on the variable being studied. Since the survey may be interested in many variables, and not one, it may be necessary to have stratification on the basis of more than one variable. In view of this, strata should be formed on the basis of major variables. In marketing research, stratification is usually resorted to on the basis of demographic characteristics such as age, sex or income, and geographical distribution of the population such as rural–urban break-up by region, state or city.

Number of Strata

Although theoretically, several strata could be used, on account of practical difficulties, it is desirable to limit the number of strata. Since stratification would enhance the cost of the survey, one has to carefully weigh the benefit resulting from it against the cost involved in its introduction. It is only when the benefits are in excess of the cost that stratification should be introduced. As a rule of thumb, not more than six strata may be used when a single overall estimate is to be made. However, if estimates for certain sub-groups of the population are also required to be made, additional strata may be used.

Sample Sizes within Strata

The third major issue concerning stratification is: How much should the size of each stratum be? Since the question of sample size is discussed in far greater detail in the subsequent chapter, it is not taken up here.

While summing up stratified random sampling, it may be pointed out that it will almost always lead to more reliable estimates than simple random sampling. However, the additional precision achieved would be moderate, while the cost of stratified sampling is generally higher per sampling unit on account of more geographic dispersion of the sample within strata.

Disproportionate Stratified Sampling

The preceding section described stratifed sampling which involved the use of the uniform sampling fraction over different strata of the population. At times, it may be preferable to use variable sampling fractions, resulting in disproportionate stratified sampling. When the population in some strata is more heterogeneous than in others, it may be advisable to use variable sampling fractions. The reason is that the use of a uniform sampling fraction may not lead to ‘representative’ samples in such strata. As such, larger sampling fractions may be used in strata with greater variability. Another reason for using disproportionate stratified sampling may be the higher cost per sampling unit in some strata compared to the others. In such a situation, precision can be increased by taking a smaller fraction in the costlier strata and a higher fraction in the cheaper strata. Optimum precision can be obtained for a given cost if the sampling fractions in the different strata happen to be proportional to their standard deviations and inversely proportional to the square root of the costs per unit in the strata.[7] However, in practice, neither the relative variability nor the relative cost of the strata is known. One may find previous surveys dealing with the same or a similar population to be of some guidance in such a situation. Alternatively, one may conduct a pilot survey from which estimates of standard deviations and costs can be obtained. If this too is not possible, one may exercise judgement or use some other measurement in this regard.

A point worth noting is that sampling fractions chosen may be appropriate for one variable or attribute to be studied and may be inappropriate for another. In a survey where one variable or attribute is of considerable importance, it may be advisable to use sampling fractions that are best for it. In all other cases where no priority exists, allocation of sampling fractions to the different strata poses a serious problem. In this context, a major difference between the proportionate and disproportionate stratified samples should be noted. While the former ensures that precision is not reduced as compared to simple random sampling, it is not so in case of the latter. For, an optimum allocation for one variable may result in lower precision than in simple random sampling with respect to another variable. But, gain in precision may not be the only reason for using variable sampling fractions.

Cluster Sampling

Cluster sampling implies that instead of selecting individual units from the population, entire groups or clusters are selected at random. An example will make the concept clear. Suppose we have a population of 25 elements comprising 5 groups, as follows:

Groups		Elements			
1	X_1,	X_2,	X_3,	X_4,	X_5
2	X_6,	X_7,	X_8,	X_9,	X_{10}
3	X_{11},	X_{12},	X_{13},	X_{14},	X_{15}
4	X_{16},	X_{17},	X_{18},	X_{19}.	X_{20}
5	X_{21},	X_{22},	X_{23},	X_{24},	X_{25}

We are required to choose a probability sample of 10 elements.

One way is to select a simple random sample of 10 elements out of the 25. Another way is to select two clusters at random. This may be far more convenient than to use a simple random sample.

For example, if a survey is to be undertaken in a city to collect data from individual households, then, selection of households from all over the city would involve a considerable amount of field

[7] Moser, C.A. and G. Kalton, op. cit., p. 93.

work and consequently, would cost more. Instead, a few localities are first chosen. Then, all the households in these localities are covered in the sample. Apart from reduction in cost, such a cluster sample would be desirable in the absence of a suitable sampling frame for the whole population. If, on the other hand, a sample of individual households from the entire city is to be chosen, it will be necessary to first undertake the listing of all households in view of the non-availability of a satisfactory sampling frame. In the case of cluster sampling, such a listing could be confined to only a few localities which are to be entirely covered in the sample.

A few points regarding cluster sampling may be noted here. ***First***, "whether or not a particular aggregate of units should be called a cluster" will depend on the circumstances of each case. In the foregoing example, localities were taken as clusters and households as individual units. In another case, the households may be taken as a cluster and the members of the households as individual units. ***Second***, it is not necessary that clusters should always be natural aggregates such as localities, polling constituencies, schools or classes. Artificial clusters may be formed, as is generally done in area sampling where grids may be determined on the maps. ***Third***, several levels of clusters may be used in any one sample design. Thus, in a city survey, localities or wards, streets and households may be selected in which case localities or wards are the clusters at the first level and streets at the second level.

In our earlier example of 25 elements in 5 clusters, suppose the numerical values are as follows:

1	10	10	10	10	10
2	20	20	20	20	20
3	30	30	30	30	30
4	40	40	40	40	40
5	50	50	50	50	50

The population mean in this case is

$$\mu = \frac{(10\times 5)+(20\times 5)+(30\times 5)+(40\times 5)+(50\times 5)}{25}$$

$$= \frac{750}{25} = 30$$

Suppose a sample of two clusters — 1st and 2nd — is chosen. The average will then be

$$\frac{(10\times 5)+(20\times 5)}{10} = \frac{50+100}{10} = \frac{150}{10} = 15$$

This shows that the mean value from the sample turns out to be only half of the universe mean. This is the minimum sample mean that we can have. In contrast, the maximum sample mean can be obtained if clusters 4 and 5 are chosen. In that case, the sample mean will be

$$\frac{(40\times 5)+(50\times 5)}{10} = \frac{200+250}{10} = \frac{450}{10} = 45$$

In either case, the sample mean is not realistic. This has happened as the clusters are homogeneous. Suppose the clusters are heterogeneous as follows:

1	10	20	30	40	50
2	10	20	30	40	50
3	10	20	30	40	50
4	10	20	30	40	50
5	10	20	30	40	50

As earlier, a sample of two clusters is selected. Suppose we select the first two clusters, then the sample average will be

$$\frac{(10 \times 2) + (20 \times 2) + (30 \times 2) + (40 \times 2) + (50 \times 2)}{10}$$

$$= \frac{20 + 40 + 60 + 80 + 100}{10} = \frac{300}{10} = 30$$

This coincides with the universe mean. It should be obvious, in this case, that whichever two clusters are chosen, the sample average will be 30 because the values of elements in one cluster are the same as in others.

From the foregoing example, we find that a major limitation of cluster sampling is the high degree of intra-cluster homogeneity. On account of the similarity of one unit in the cluster with its other units, selection of a few clusters may not give a really representative sample. As against this, when clusters have a high degree of intra-cluster heterogeneity, cluster sampling may be more representative.

Comparison between Stratified and Cluster Sampling

Before closing our discussion on cluster sampling, it would be worthwhile to know the major differences between cluster and stratified sampling. On the basis of six factors, a comparison between the two sample designs can be made.

Objective

Whereas the objective of stratified sampling is to increase precision, in contrast the main consideration of cluster sampling is to reduce cost.

Sub-populations

Stratified sampling covers all sub-populations while in the case of cluster sampling, a sample of clusters is chosen.

Within sub-populations

In the case of stratified sampling, there should be homogeneity in each stratum In contrast, each cluster in cluster sampling should be heterogeneous.

Across sub-populations

Stratified sampling should have heterogeneous strata whereas cluster sampling should have homogeneous clusters.

Sampling frame

It is necessary to have a sampling frame covering the entire population in stratified sampling but cluster sampling needs to have sampling frame only for the selected clusters.

Selection of elements

In stratified sampling, elements are selected at random from each stratum whereas in cluster sampling all elements from each selected sector are included.

Multi-Stage Sampling

Multi-stage sampling, as the name implies, involves the selection of units in more than one stage. In such a sampling, the population consists of a number of first stage units, called primary sampling units (PSUs). Each of these PSUs consists of a number of second-stage units. First, a sample is taken of the PSUs, then a sample is taken of the second-stage units. This process continues until the selection of the final sampling units. It may be noted that at each stage of sampling, a sample can be selected with or without stratification.

An illustration would make the concept of multi-stage sampling clear. Suppose a sample of 5000 urban households from all over the country is to be selected. In such a case, the first stage sample may involve the selection of districts. Suppose 25 districts out of say 500 districts are selected. The second stage may involve the selection of cities, say four from each district. Finally, 50 households from each selected city may be chosen. Thus, one would have a sample of 5000 urban households, arrived at in three stages. It is obvious that the final sampling unit is the household.

In the absence of multi-stage sampling of this type, the process of the selection of 5000 urban households from all over the country would be extremely difficult. Besides, such a sample would be very thinly spread over the entire country and if personal interviews are to be conducted for collecting information, it would be an extremely costly affair. In view of these considerations a sampling from a widely spread population is generally based on multi-stage.

The number of stages in a multi-stage sampling varies depending on convenience and the availability of suitable sampling frames at different stages. Often, one or more stages can be further included in order to reduce cost. Thus, in our earlier example, the final stage of sampling comprised 50 households from each of the four selected cities. Since this would involve the selection of households all over the city, it would turn out to be quite expensive and time consuming if personal interviews are to be conducted. In such a case, it may be advisable to select two wards or localities in each of the four selected cities and then to select 25 households from each of the 2 selected wards or localities. Thus, the cost of interviewing as also the time in carrying out the survey could be reduced considerably. It will be seen that an additional stage comprising wards or localities has been introduced here. Thus, this sample has become a four-stage sample—

1st stage—districts
2nd stage—cities
3rd stage—wards or localities
4th and final stage—households

From the preceding discussion, it should be clear that a multi-stage sample results in the concentration of field work. This in turn, leads to saving of time, labour and money. There is another advantage in its use where a suitable sampling frame covering the entire population is not available, a multi-stage sample can be used.

Area Sampling

Area sampling is a form of multi-stage sampling in which maps, rather than lists or registers, are used as the sampling frame. This method is more frequently used in those countries which do not have a satisfactory sampling frame such as population lists.

In area sampling, the overall area to be covered in a survey is divided into several smaller areas within which a random sample is selected. Thus, for example, a city map can be used for area sampling. Various blocks can be identified on the map and this can provide a suitable frame. The entire city area can be divided into these blocks which are then numbered and from which a random sample is finally drawn.

In sampling the blocks, stratification and sampling with probability proportional to a measure of size are commonly employed.[8] However, stratification in area sampling is based on geographical considerations. Thus, when blocks are identified and numbered on the map, they can be grouped into some meaningful strata representing the different neighbourhoods of the town.[9] The point to emphasise is that these blocks must be identifiable without any difficulty.

On the basis of the blocks thus identified, numbered and assigned to strata, a stratified sample of dwellings can be selected. This can be done in either of two ways. First, a sample of dwellings may be drawn from all the dwellings included in a selected block. Second, blocks may be divided into segments of a more or less equal size, and a sample of these segments can be chosen and finally all the dwellings from the selected segments may be taken in the sample. It will thus be seen that the second method introduces another stage of sampling, namely, segments.

Although the above discussion relaters to area sampling with respect to a city or town, the same approach is applicable to a large area, say, a state or a country, the only difference being that one or more additional stages of sampling may have to be introduced.

Finally, it may be pointed out that area sampling is perhaps the only possibility if a suitable sampling frame is not available.

Multi-Phase Sampling

A multi-phase sample should not be confused with a multi-stage sample. The former involves a design where some information is collected from the entire sample and additional information is collected from only a part of the original sample. Suppose a survey is undertaken to determine the nature and extent of health facilities available in a city and the general opinion of the people. In

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[8] Moser, C.A. and G. Kalton, op. cit., p. 119.
[9] Ibid., p. 119.

the first phase, a general questionnaire can be sent out to ascertain who amongst the respondents had at one time or other used the hospital services. Then, in the second stage, a comprehensive questionnaire may be sent to only these respondents to ascertain what they feel about the medical facilities in the hospitals. This is a two-phase or double sampling.

The main point of distinction between a multi-stage and a multi-phase sampling is that in the former each successive stage has a different unit of sample whereas in the latter the unit of sample remains unchanged though additional information is obtained from a sub-sample.

The main advantage of a multi-phase sampling is that it effects economy in time, money and effort. In our earlier example, if a detailed questionnaire is sent out to a large sample comprising individuals, they would not be able to provide the necessary information. Second, more time will be required. Finally, it will be far more expensive to carry out the survey, especially when personal interviews are involved.

Replicated Sampling

Replicated sampling implies a sample design in which "two or more sub-samples are drawn and processed completely independent of each other."[10] It was first introduced by Mahalnobis[11] in 1936, who used the term inter-penetrating sub-samples.

In replicated sampling, several random sub-samples are selected from the population instead of one full sample. All the sub-samples have the same design and each one of them is a self-contained sample of the population. For example, take the case of a random sample of 100 households. This sample may be divided into, say, 10 equal sub-samples to be assigned to 10 interviewers. Thus, each interviewer may be required to collect information from 10 households.

A replicated sample is particularly chosen on account of the convenience it affords in the calculation of standard error. In many complex sample designs, the calculation of standard error becomes too laborious. This difficulty can be considerably reduced by selecting a replicated sample design. However, in modern times when computers are being increasingly used, the ease in calculating standard error has made it somewhat less important. Apart from this advantage, there are certain other advantages of replicated sampling. First, if the size of a sample is too large, it may be advisable to split it up into two or more sub-samples. One sub-sample may be used to get the advanced results of the survey. Second, replicated sampling can indicate the non-sampling errors.

> In cases where bias may arise from a controllable procedure (question sequence, interviewer bias, editor bias) each sub-sample can be wholly handled in one way—assigned to one interviewer or editor, or using one questionnaire sequence. A fairly simple variance analysis, comparing variance within and among sub-samples, can detect the presence of bias and its importance, again provided that the sub-samples were randomly selected from the total sample.[12]

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[10] Deming, W. Edwards, *Sample Design in Business Research*, New York, John Wiley and Sons, Inc., 1961, p. 87.

[11] *See*, Mahalnobis, P.C., "On Large Scale Sample Surveys" in *Philosophical Transactions*, 1944, pp. 329–451.

[12] Semon, Thomas T., "Basic Concepts" in *Handbook of Marketing Research* (Ed.: R. Ferber), New York, McGraw-Hill Book Company, 1974, pp. 2–226. Reprinted with permission from McGraw-Hill Book Company, New York.

However, replicated sampling would not be helpful in undertaking a detailed investigation of bias as the numbers in the separate sub-samples tend to be small. Further, such samples do not reveal any systematic errors that may be more or less common to all interviewers and the compensating errors which cancel each other out over an interviewer's assignment.[13]

Apart from the above limitations, replicated samples have other disadvantages. If personal interviews are to be conducted, replicated samples turn out to be costlier. Likewise, tabulation costs would be higher than in the case of a single large sample. Finally, replicated samples are more complex to administer.[14]

Sequential Sampling

In sequential sampling, a number of samples $n_1, n_2, n_3, \dots n_4$, are randomly drawn from the population. It is not at all necessary that each sample should be of the same size. Generally, the first sample is the largest, the second is smaller than the first, the third is smaller than the second, and so on.

A sequential sampling is resorted mainly to bring down the cost and hence the smallest possible sample is used. The desired statistics from first sample, n_1 are computed and evaluated. If these statistics do not satisfy the criteria laid down, a second sample is drawn. The results of the first and second samples are added and the statistics are recomputed. This process is continued until the specified criteria are satisfied. The criteria are usually a minimum significance level, a minimum cluster size, or a minimum confidence interval.

The main advantage of sequential sampling is that it obviates the need for determining a fixed sample size before the commencement of the survey.

Suppose a firm is to decide whether a new product is to be introduced in the market or not. It feels that if it is able to acquire 15 per cent market share in a country within a year, it should introduce the new product. Further, it feels that if a market share of 10 per cent in a few test markets is achieved, it would be possible to acquire a 15 per cent market share in the country, say, within a period of six months. Now, when the firm has undertaken test marketing, it actually achieved far more than 10 per cent, say, 20 per cent, of the market share and that too within three months of test marketing. The firm may be sure to achieve the 15 per cent national market share within one year even though it may not be possible for it to accurately forecast the test market share at the end of four months.

Master Samples

A master sample is one from which repeated sub-samples can be taken as and when required from the same area or population. This was first used in the United States when the US Master sample of agriculture was taken. In this sampling, the rural area of over 3000 US counties was divided into segments of about four farms each. "After selecting a systematic sample of 1/8 of the segments, the materials were duplicated and made available, with instruction, at low cost."[15]

The crucial point to note in respect of master samples is that "the actual sample for each new survey is not selected directly from the entire population, but from a frame of segments and dwellings that was selected earlier from the entire population."[16]

[13] Moser, C.A. and G. Kalton, op. cit., p. 126.

[14] Semon, Thomas T., op. cit., pp. 2–226.

[15] Kish, Leslie, op. cit., p. 478.

[16] Ibid., p. 478.

The utility of master samples is limited to a relatively short period for there may be changes in the population, which would distort the representative character of the master samples. In view of this, master samples should be relatively permanent, say, dwellings rather than individuals or households which frequently undergo changes on account of births, deaths and migration. The main advantage of master samples is that they can be expeditiously selected on account of their simplicity. Another advantage is that they are economical, because the same master frame is used for drawing samples for several surveys, as a result of which the cost incurred on the preparation of the master frame is spread over these surveys. Further, on account of this economy in each survey, one can initially spend more to create a good master frame. Thus, economy may lead to improved quality in the listing.

NON-PROBABILITY SAMPLE DESIGNS

Quota Sampling

Quota sampling is quite frequently used in marketing research. It involves the fixation of certain quotas, which are to be fulfilled by the interviewers.

Suppose in a certain territory we want to conduct a survey of households. Their total number is 2,00,000. It is required that a sample of 1 per cent, i.e. 2000 households are to be covered. We may fix certain controls which can be either independent or inter-related. These controls are shown in the following tables.

A sample of 2000 households has been chosen, subject to the condition that 1200 of these should be from rural areas and 800 from the urban areas of the territory. Likewise, of the 2000 households, the rich households should number 150, the middle class ones 650 and the remaining 1200 should be from the poor class. These are independent quota controls. The second table shows the inter-related quota controls. As can be seen, inter-related quota controls allow less freedom of selection of the units than that available in the case of independent controls.

Independent Controls			
Rurl	1200	Rich	150
Urban	800	Middle class	650
		Poor	1200
Total	2000	Total	2000

Inter-related Controls			
	Rural	Urban	Total
Rich	100	50	150
Middle class	400	250	650
Poor	700	500	1200
Total	1200	800	2000

There are certain advantages in both the schemes. Independent controls are much simpler, especially from the viewpoint of interviewers. They are also likely to be cheaper as interviewers may cover their quotas within a small geographical area. In view of this, independent controls may affect the representativeness of the quota sampling. Inter-related quota controls are more representative though such controls may involve more time and effort on the part of interviewers. Also, they may be costlier than independent quota controls.

In view of the non-random element of quota sampling, it has been severely criticised especially by statisticians, who consider it theoretically weak and unsound.

There are points both in favour of and against quota sampling. These[17] are given below.

Advantages of Quota Sampling

1. It is economical as travelling costs can be reduced. An interviewer need not travel all over a town to track down pre-selected respondents. However, if numerous controls are employed in a quota sample, it will become more expensive though it will have less selection bias.
2. It is administratively convenient. The labour of selecting a random sample can be avoided by using quota sampling. Also, the problem of non-contacts and call-backs can be dispensed with altogether.
3. When the field work is to be done quickly, perhaps in order to minimise memory errors, quota sampling is most appropriate and feasible.
4. It is independent of the existence of sampling frames. Wherever a suitable sampling frame is not available, quota sampling is perhaps the only choice available.

Limitations of Quota Sampling

1. Since quota sampling is not based on random selection, it is not possible to calculate estimates of standard errors for the sample results.
2. It may not be possible to get a 'representative' sample within the quota as the selection depends entirely on the mood and convenience of the interviewers.
3. Since too much latitude is given to the interviewers, the quality of work suffers if they are not competent.
4. It may be extremely difficult to supervise the control and field investigation under quota sampling.

Judgement Sampling

The main characteristic of judgement sampling is that units or elements in the population are purposively selected. It is because of this that judgement samples are also called purposive samples. Since the process of selection is not based on the random method, a judgement sample is considered to be non-probability sampling.

Occasionally it may be desirable to use judgement sampling. Thus, an expert may be asked to select a sample of 'representative' business firms. The reliability of such a sample would depend upon the judgement of the expert. The quota sample, discussed earlier, is in a way a judgement sample where the actual selection of units within the earlier fixed quota depends on the interviewer.

[17] Based on Moser, C.A. and G. Kalton, op. cit., pp. 133–137.

It may be noted that when a small sample of a few units is to be selected, a judgement sample may be more suitable as the errors of judgement are likely to be less than the random errors of a probability sample.[18] However, when a large sample is to be selected, the element of bias in the selection could be quite large in the case of a judgement sample. Further, it may be costlier than the random sampling.

Convenience Sampling

Convenience sampling, as the name implies, is based on the convenience of the researcher who is to select a sample. This type of sampling is also called accidental sampling as the respondents in the sample are included in it merely on account of their being available on the spot where the survey is in progress. Thus, a researcher may stand at a certain prominent point and interview all those or selected people who pass through that place. A survey based on such a sample of respondents may not be useful if the respondents are not representative of the population. It is not possible in convenience sampling to know the "representativeness" of the selected sample. As such, it introduces an unknown degree of bias in the estimate. In view of this major limitation, convenience sampling should be avoided as far as possible. It may however be more suitable in exploratory research, where the focus is on getting new ideas and insights into a given problem.

Snowball Sampling

In the initial stage of snowball sampling, sample units may or may not be selected by using probability methods. Subsequently, additional units are obtained on the basis of information given by initial sample units. Again, these units may provide other names to the researcher. In this way, the sample builds up as more and more names are covered by it. Let us take some examples.

A marketing research agency may use the telephone to contact some persons and ask them to give names of individuals who in their opinion are appropriate respondents for the concerned study. On getting those names, these respondents are included in the sample.

A survey is undertaken on a newly launched computer. Some persons are selected who may be well acquainted with this computer. These persons may suggest the knowledgeable persons in this field.

The need for snowball sampling arises because of the difficulty in identifying the respondents right in the beginning of the proposed research study.

Special Forms of Non-probability Sampling

Group Interview Sample

Apart from the foregoing non-probability designs, there are some special forms of non-probability sample designs. One such design is known as group interview sample, which is used in focus-group studies. Here, a small number of respondents are asked to meet at a particular place for the joint interview. The duration of such a focus-group interview is usually for a couple of hours.

This sample design is used in exploratory research when the researcher wants to know as to how respondents feel about a certain product or service. The use of such a design is quite helpful in formulating hypotheses.

A detailed discussion on focus-group interviewing is given in Chapter 13.

[18] Deming, W. Edwards., op. cit., p. 31.

Shopping Mall Intercept Samples

As the name implies, this sample design is used in shopping malls. Respondents are interviewed at certain specified locations in a shopping mall. This design is normally used in experimental studies where some type of comparison is involved. For example, when two or more product concepts are under comparison, such a sample design is used.

A point to note is that this design need not be confined to one shopping mall. In order to know the views of respondents belonging to different socio-economic status, respondents can be interviewed simultaneously in a number of shopping malls.

A major advantage of this sampling technique is that it needs far less time than the probability sampling. Further, it is much cheaper as the respondents are readily available in a limited area. One has not to cover long distances to interview respondents living in different localities. However, as the sample design is expedient, the question is as to how far the sample selected within shopping malls is representative of the population?

Controlled Panel Samples

This sample design, in a way, is highly controlled quota sampling. Here, organizations maintain very reliable information covering names, addresses, telephone numbers and other demographic characteristics of individuals/households in their files. The information relates to all those who are quite willing to be interviewed. This list is known as the 'panel' which normally has 1000 persons or households. For a given study, more than one panel can be used.

Panel samples are advantageous as they are cheap and easily available. Another advantage is that longitudinal studies can be undertaken to find out the change in say, consumption pattern of a product or service between two points of time.

Another advantage of panel samples is that they are very appropriate when a study is to be done in great detail. In the first phase, a large sample is used to identify the respondents having certain background such as education and experience. A small questionnaire is used for this purpose. Based on the responses received in the first place, a comprehensive questionnaire on the subject of enquiry is then sent to a small sample.

The main limitation of such samples is that it may be difficult to sustain the interest of individuals included in the panel for a long period. Many respondents on the panel may refuse to be interviewed twice or may give poor answers. In either case the quality of the survey will suffer. Another limiting factor in panel samples is that there may be bias on account of the continued participation in the panel. It is felt that the individual is conditioned to some extent by the fact that data on purchases are reported. In such a case the purchase behaviour of panel members may become different from others not covered by the panel. Furthermore, panel samples may turn out to be more expensive while locating the same sample of respondents after a lapse of, say, a year, when some of them might have migrated to other areas. This would involve travel costs in addition to being difficult.

Controlled panel samples have almost the same limitations as the quota sample has. As the responses are from those included in the panel, a pertinent question is how far these responses reflect the views of those who are not in the panel.

To sum up, these special forms of non-probability samples are all variants of quota sampling and convenience sampling. Although they suffer from certain limitations, they are frequently used in marketing research studies. This is mainly because the requisite information can be obtained quickly as well as cheaply with the help of such sample designs.

DETERMINING THE APPROPRIATE SAMPLING DESIGN[19]

After having discussed different types of probability and non-probability sample designs, we come to an important issue on sampling design. From amongst so many sampling designs, we have to decide which is the most appropriate. In this connection we have to consider several factors that will enable us to select the appropriate sampling design. These are briefly discussed below.

Research Objectives

A clear understanding of the research problem as well as its objectives will provide the initial guidelines for selecting the appropriate sampling design. In case the purpose of our research study is served by simple generalisation of the sample results to the target population, then our choice should be in favour of probability sampling design rather than a non-probability sampling design. Further, the type of research-exploratory, descriptive and causal will also influence the selection of the sampling design.

Degree of Accuracy

In case preliminary insight about the target population serves our purpose, then a non-probability sampling design will be the right choice. When we are interested in making predictions for the target population on the basis of sample results, then we must use some kind of probability sampling design.

Resources

While deciding the sampling design for a research study, the researcher has to ensure that sufficient financial resource is available. If this aspect is overlooked, he may find later, when the research is in progress, that it is not possible to adhere to the sampling design. This would distort the original design and adversely affect the quality of the research. When the funds are limited, it is advisable to prefer a non-probability sampling design

Time Frame

While starting a research project, a crucial factor to be considered is the availability of time. When the researcher has limited time, obviously he has to select a simple sample design. In case a comprehensive survey is planned, he must ensure sufficient time is available to complete the study and to ascertain the representativeness of the results.

Knowledge of the Target Population

Sometimes one finds that a list of population is not available. In such cases, it becomes necessary to undertake a short study to develop a sampling frame for the proposed study. But this can be possible if the researcher is clear as to who is in the target population.

[19] Based on Hair, Joseph F. (Jr), Robert P. Bush and David J. Ortinau: *Marketing Research*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005, pp. 342–44.

Scope of the Research

To a large extent, the choice of the sampling design will depend on the scope of the research study. In other words, whether it would be local, regional, national or international. When the geographical scope of the research project is vast, a more complex sampling design may be needed. When the geographic scope is limited, the sampling design such as simple random sampling or systematic random sampling design can be selected.

Statistical Analysis Needs

The selection of sampling design also depends on the nature and extent of statistical analysis being considered. When a non-probability sampling design is being used, the statistical analysis will be limited. Further, the question is how far the results can be generalised for the target population. This is because a detailed analysis is not possible. A number of statistical techniques are available which are applicable only when the probability sampling design is used.

CHARACTERISTICS OF A GOOD SAMPLE DESIGN

Kish[20] mentions that a good sample design requires the judicious balancing of four broad criteria—goal orientation, measurability, practicality and economy.

Goal Orientation

This suggests that a sample design "should be oriented to the research objectives, tailored to the survey design, and fitted to the survey conditions." If this is done, it should influence the choice of the population, the measurement as also the procedure of choosing a sample.

Measurability

A sample design should enable the computation of valid estimates of its sampling variability. Normally, this variability is expressed in the form of standard errors in surveys. However, this is possible only in the case of probability sampling. In non-probability samples, such as a quota sample, it is not possible to know the degree of precision of the survey results.

Practicality

This implies that the sample design can be followed properly in the survey, as envisaged earlier. It is necessary that complete, correct, practical and clear instructions should be given to the interviewer so that no mistakes are made in the selection of sampling units and the final selection in the field is not different from the original sample design. Practicality also refers to simplicity of the design, i.e. it should be capable of being understood and followed in actual operation of the field work.

Economy

Finally, economy implies that the objectives of the survey should be achieved with minimum cost and effort. Survey objectives are generally spelt out in terms of precision, i.e. the inverse of the

[20] Kish, Leslie, op. cit., pp. 23–26.

variance of survey estimates. For a given degree of precision, the sample design should give the minimum cost. Alternatively, for a given per unit cost, the sample design should achieve maximum precision (minimum variance).

It may be pointed out that these four criteria come into conflict with each other in most of the cases, and the researcher should carefully balance the conflicting criteria so that he is able to select a really good sample design. As there is no unique method or procedure by which one can select a good sample, one has to compare several sample designs that can be used in a survey. This means that one has to weigh the pros and cons, the strong and weak points of various sample designs in respect of these four criteria, before selecting the best possible one.

Summary

At the outset, the chapter has given the definitions of some basic terms used in sampling. Then the advantages and limitations of sampling have been mentioned. This is followed by a discussion on the steps involved in a sampling process. The distinction between probability and non-probability sample has been brought out. This is followed by a discussion on simple random sampling, systematic random sampling, and stratified random sampling.

The problem of estimation of the universe mean and the confidence interval with a stratified random sample has been discussed with illustrations. The major issues in stratified sampling, namely, bases of stratification, number of strata and sample sizes within strata have also been explained.

The discussion has concerned itself with a number of other sampling designs such as cluster sampling, multi-stage sampling, area sampling and multi-phase sampling. A comparison between stratified sampling and cluster sampling covering some aspects such as objective, sampling frame and selection of elements has been made. Some non-probability sample designs have been discussed. As regards quota sampling, its advantages and limitations have also been brought out. Further, some special forms of non-probability samples have been explained.

This is followed by guidelines for determining the appropriate sampling design. At the end, the characteristics of a good sample design, namely, goal orientation, measurability practicality and economy have been given.

Key Terms and Concepts

Population 175
Census 176
Sample 176
Sample Survey 176
Sampling Unit 176
Frame 176
Sampling Error 177
Biased sample 177
Sampling Process 178
Probability Sampling 182
Random Sampling 182
Systematic Sampling 184
Stratified Random Sampling 184
Cluster Sampling 189
Multi-stage Sampling 192
Area Sampling 193
Multi-Phase Sampling 193
Replicated Sampling 194
Sequential Sampling 195
Master Samples 195

Questions

1. Why is a sample survey preferred to a census enquiry?
2. Explain the following concepts:
   (i) Population
   (ii) Sampling frame
   (iii) Elements
   (iv) Stratum
   (v) Precision
3. Describe the various steps involved in the sampling process.
4. Distinguish between a probability sample and a non-probability sample.
5. Distinguish between a simple random sample and a systematic random sample.
6. Describe the procedure for selecting a simple random sample.
7. What are the relative advantages and disadvantages of systematic sampling as compared to simple random sampling?
8. What is a stratified random sample? How does it differ from a simple random sample?
9. What issues are involved in a stratified random sample?
10. Distinguish between a proportionate stratified sample and a disproportionate stratified sample.
11. Does the stratified sampling method give a more precise estimate of a population mean than the simple random sampling method? Why or why not?
12. What is a cluster sample? What are its advantages and limitations?
13. How does a cluster sample differ from a stratified sample? What are the similarities between the two?
14. What is a quota sample? Why is it a non-probability sample?
15. What are the advantages and limitations of quota sampling?
16. What is a multi-stage sample? How does it differ from a one-stage sample and a multi-phase sample?
17. Explain the following sample designs:
   (i) Area sample
   (ii) Judgement sample
   (iii) Convenience sample
   (iv) Replicated sample
   (v) Sequential sample
   (vi) Master sample
   (vii) Snowball sample
18. In the absence of an adequate and reliable sampling frame, what sample design/designs would you choose? Why?
19. What are the advatages and limitations of panel sample?
20. Differentiate betwen replicated sampling and sequential sampling.

21. What sample design would you select in each of the following?
    (i) A study to determine consumer reactions to a new brand of tea.
    (ii) A study to measure the audience watching a sponsored television programme.
    (iii) A survey of households in a city to determine the number of children eligible for primary education but not yet enrolled.
    (iv) A study to find out the household expenditure on clothing by various income groups.
22. What factors would you consider while choosing the appropriate sampling design?

12 Sample Size Decisions

Learning Objectives

After reading this chapter, you should be able to understand:

- Sampling distribution of the mean
- Main considerations for sample size decisions
- Stratified sample size
- Sample size and other factors
- Sample size decisions when estimating proportions
- Statistical efficiency
- Determining the size of non-probability samples

After having looked into major sample designs in the preceding chapter, we now turn to another important aspect of sampling, namely, the sample size. When a survey is undertaken and when it is not possible to cover the entire population, the marketing researcher has to answer a basic question—How larger should the sample be? We will focus our attention on this basic problem and discuss how decisions on sample size are taken.

DETERMINING THE SAMPLE SIZE

There are two basic approaches to the problems of sample size—**the ad hoc or practical approach** and **the statistical approach.** The former is widely used in marketing research.

Practical Method

According to this approach, a sample size of less than a few hundred units is not chosen. This is because when a field survey is undertaken, interviewers are appointed, trained and asked to conduct field investigations. Since all this would cost substantially, it would not be worth it for the marketing researcher if only a small sample is chosen. A survey confined to a relatively small number of units would mean a relatively high cost per interview. Another consideration in favour of selecting a reasonable size of sample is that it enables the researcher to test several hypotheses. This is especially true for samples in the sub-groups. Such hypotheses can be tested with a high degree of statistical significance when the sample size is reasonably large. Another practical consideration in case of a stratified sample is that the overall sample size is so fixed that the sample size within each stratum is not less than 30.[1] A common practice in this regard is to determine the sample size of each stratum first and then add up the samples of all the strata to obtain the overall sample size.

Statistical Principles

The second approach based on statistical principles is obviously scientific. A good researcher is expected to follow it rather than the rule-of-thumb approach. According to the statistical approach, the problem of sample size involves several aspects such as the type of sample design, the homogeneity in the population from which a sample is to be chosen and the availability of finance, personnel and time for the conduct of the field survey. In view of all these considerations, the question of sample size becomes difficult. Since a comprehensive discussion of all these aspects would need a good deal of space, only some basic principles for determining sample size are discussed.

However, before this is done, it is necessary to have some idea of sampling distribution, which forms the basis for any problem on sample size.

SAMPLING DISTRIBUTION OF THE MEAN

According to the central limit theorem, the various arithmetic means of a large number of random samples of the same size will form a normal distribution. If an arithmetic mean of all possible sample means is calculated, it will coincide with the population mean. To illustrate this point, let us take a simple example:

Suppose there are six persons A, B, C, D, E and F constituting the population. Each one of them has some money. Assume that A has rupee one, B rupees two, and so on. Then, the population mean and standard deviation will be as follows:

Table 12.1

Identity of persons	Amount (X)	X^2
A	1	1
B	2	4
C	3	9
D	4	16
E	5	25
F	6	36
	21	91

$$\mu = \text{Rs } \frac{21}{6} = \text{Rs } 3.5$$

[1] In Statistics, a sample size of 30 is regarded as the point between a large and a small sample. A large sample within each stratum will enable the testing of hypotheses with a considerable level of confidence.

$$\sigma \sqrt{\frac{1}{N} S (X - \mu)^2} = \sqrt{\frac{SX^2}{N} - \left(\frac{SX}{N}\right)^2}$$

$$= \sqrt{\frac{91}{6} - \left(\frac{21}{6}\right)^2} = \sqrt{15.1667 - 12.2500}$$

= Rs 1.71 approx.

Suppose two persons are selected as a sample. The number of possible size 2 that can be selected is:

$$\binom{N}{n} = \binom{6}{2} = \frac{6!}{2!4!}$$

$$= \frac{6 \times 5 \times 4 \times 3 \times 2 \times 1}{2 \times 1 \times 4 \times 3 \times 2 \times 1}$$ 15 (Total number of samples without replacement)

Table 12.2 gives all the 15 samples along with their respective means.

Table 12.2

S. No.	Sample	Sample Mean
1	A, B	1.5
2	A, C	2.0
3	A, D	2.5
4	A, E	3.0
5	A, F	3.5
6	B, C	2.5
7	B, D	3.0
8	B, E	3.5
9	B, F	4.0
10	C, D	3.5
11	C, E	4.0
12	C, F	4.5
13	D, E	4.5
14	D, F	5.0
15	E, F	5.5

Table 12.3 shows the distribution of sample means, as also some other calculations.

Table 12.3

Sample Mean	Frequency	Deviation from assumed mean = 4	d ÷ 0.5	fd	d^2	fd^2
1.5	1	– 2.5	– 5	– 5	25	25
2.0	1	– 2.0	– 4	– 4	16	16
2.5	2	– 1.5	– 3	– 6	9	18
3.0	2	– 1.0	– 2	– 4	4	8
3.5	3	– 0.5	– 1	– 3	1	3
4.0	2	0	0	0	0	0
4.5	2	0.5	1	2	1	2
5.0	1	1.0	2	2	4	4
5.5	1	1.5	3	3	9	9
	15			– 22	69	85
				+ 7		
				– 15		

$$\bar{X} = \text{A} + \frac{\Sigma f d}{n} \times \text{C}$$

$$= 4.0 + \left(\frac{-15}{15} \times 0.5\right)$$

$$= \text{Rs } 3.5$$

$$\sigma_{\bar{x}} = \sqrt{\frac{\Sigma f d^2}{n} - \left(\frac{\Sigma f d}{n}\right)^2} \times \text{C}$$

$$= \sqrt{\frac{85}{15} - \left(\frac{-15}{15}\right)^2} \times 0.5$$

$$= \sqrt{5.6667 - 1} \times 0.5$$

$$= 2.16 \times 0.5$$

$$= \text{Rs } 1.08$$

It will be seen that standard deviation of the population, as arrived at in Table 12.1, is 1.71, while the standard deviation (called standard error) of the sample distribution as given in Table 12.3 is 1.08. There is a certain relationship between the two. This is best explained by the following formula:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \cdot \sqrt{\frac{N-n}{N-1}}$$

where $\sigma_{\bar{x}}$ = standard error of the sample distribution

σ = standard deviation of the population

n = sample size

N = Number of units in the population

Applying the different values in the above formula,

$$\sigma_{\bar{x}} = \frac{1.71}{\sqrt{2}} \cdot \sqrt{\frac{6-2}{6-1}}$$

$$= \frac{1.71}{1.41} \cdot \sqrt{0.8}$$

$$= \frac{1.71 \times 0.89}{1.41}$$

$$= 1.08 \text{ (same as obtained earlier)}$$

The term $\sqrt{\frac{N-n}{N-1}}$ is called the finite population correction (fpc).

It may be noted that in case of an infinite population, the term $\frac{N-n}{N-1}$ approaches 1.00 and hence the finite population correction also approaches 1.00. In such a case, the formula becomes $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$. In the case of sampling with replacement, there is an infinite population and as such, the reduced version of the formula may be used. In other cases too, if the sample is relatively too small vis-à-vis the population, fpc need not be used as it will approach 1. In other words, when N is large relative to n, the formula $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$ may be used. The question is: how to decide that N is relatively larger than n? Different people may take different values but the general practice is to use this formula (which excludes the correction factor) when n is less than 5 per cent of N.

Characteristics of the Distribution of Sample Means

1. Although the population shows a rectangular distribution, the distribution of sample means shows a symmetrical distribution and has only one mode. i.e. it is unimodal.
2. The mean of the sample distribution coincides with the mean of the population. In the example given above, the population mean is Rs 3.5 (Table 12.1) and the mean of the distribution of the sample means too happens to be Rs 3.5 (Table 12.3).
3. The standard deviation of the population, and the standard deviation of the sample means, $\sigma_{\bar{x}}$ are related, as is indicated by the formula given earlier. If the finite population correction is to be ignored, then the standard deviation of the distribution of sample means $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$.

It may be noted that σ (Table 12.3) was 1.08 whereas σ (Table 12.1) was 1.71. In other words, the standard deviation of the sample means turns out to be smaller than that of the population. Further, it may be noted that the former tends to be smaller as the sample size, n, increases. This is because of the fact that as the sample size increases, the mean of the sample distribution tends to be closer to the population mean which, in turn, makes the scatter of the sample means narrower.

Since the formula for the relationship between the standard deviation of the population and the standard error of the sample is $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$, we find that $n = \frac{\sigma^2}{\sigma_{\bar{X}^2}}$, ignoring the finite population correction. Thus, to determine n, the size of the sample, both the numerator and the denominator should be known to us.

MAIN CONSIDERATIONS FOR SAMPLE SIZE DECISIONS

There are three considerations required to be checked when determining the sample size necessary to estimate the population mean. These are

1. The extent of error or imprecision allowed
2. The degree of confidence desired in the estimate
3. Estimate of the standard deviation of the population

The first two considerations involve the judgement of the researcher. The third consideration is the responsibility of the researcher. Sometimes, estimates of standard deviation are available, from earlier studies. Even when standard deviation is not available, it can be calculated from the summary tables containing the data. However, if this too is not possible, the researcher may choose a small sample from which the standard deviation is calculated. He then uses the sample standard deviation as an estimate of the population standard deviation and then determines the final sample size. The initial sample need not be discarded afterwards and can be used as a part of the final sample. However, some additional time is needed to carry out this exercise.

We may consider the problem of determining sample size in two different situations, namely when the standard deviation of the population is known and when it is unknown.

Determination of Sample Size when Standard Deviation is Known

Extent of Error

The first consideration relates to the extent of error allowed. This is indicated by the standard error (i.e. the standard deviation of the sample means). The researcher himself has to decide the magnitude of the standard error that he can tolerate. Although this is a difficult question, it is necessary to fix the limit of the standard error beyond which it should not exceed. The fixation of standard error should not be confined to overall results but should also be applied to various sub-groups. One way is to first determine the size of each sub-group on the basis of a given degree of precision. The total of the size of each sub-group could then be taken as the overall size of the sample, though it may turn out to be too large and on considerations of time and money, it may not be acceptable to the researcher.

The Degree of Confidence

A second consideration is the degree of confidence that the researcher wants to have in the results of the study. In case he wants to be 100 per cent confident of the results, he is left with no option but to cover the entire population. However, as this is often not possible on account of cost, time and other constraints, the researcher should be satisfied with less then 100 per cent confidence. Normally, three confidence levels, namely, 99 per cent, 95 per cent and 90 per cent are used. When a 99 per cent confidence level is used, it implies that there is a risk of only 1 per cent of the true population statistic falling outside the range indicated by the confidence interval. In the case of a 95 per cent confidence level, such a risk is of 5 per cent and in the case of 90 per cent confidence level, it is of 10 per cent. In marketing research studies, the most frequently used norm is the 5 per cent confidence level.

It should be noted that there is a trade off between the degree of precision and the degree of confidence. For a given size of a sample, one can specify one of these two but not both of them at the same time. To illustrate this point, let us assume that in a survey of households in a certain territory, the average income per household has turned out to be Rs 1000 per month. As this is a point estimate, it is not associated with any bounds of error and, therefore, it is regarded as a precise estimate. At the same time, such an estimate is likely to be wrong, i.e. one can associate a very low level of confidence with it. In contrast, if we say that the average monthly income per household varies from Rs 500 to Rs 2500, we are associating a very high degree of confidence in this estimate, although it tends to be far less precise than the earlier one. An estimate of this type, having a very wide range, will not be of much help to the researcher.

The foregoing basic considerations involved in determining the sample size can be better understood with the help of some examples. We have earlier seen the sampling distribution of sample means. According to the Central Limit Theorem, the distribution of sample means will be normal regardless of the distribution of population. Figure 12.1 gives the normal distribution.

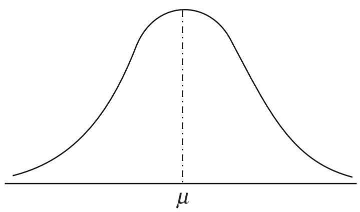

Fig. 12.1 Sampling Distribution of Sample Means

Let us first take the case where the population variance is known. Suppose in our previous example of average monthly income per household we find that the standard deviation is Rs 100. Further, we suppose that the estimate is within ± Rs 40 of the true population mean. This means that the total precision is 80 and half precision is 40. We shall use the latter value as we shall work out the calculations on the basis of one-half of the curve. In this way, certain calculations can be simplified as we know that the population mean μ divides the normal curve into two equal halves.

Another point that needs to be decided relates to the degree of confidence in the result that one would like to have. Suppose that this degree of confidence is 95.4 per cent which would imply that Z is 2.

The formula to determine the size of n is:

$$n = \frac{Z^2\sigma^2}{E^2}$$

where E = the maximum error allowed; $Z = 2$ and σ is 100.

Hence

$$n = \frac{(2)^2\,(100)^2}{(40)^2}$$

or $$= \frac{4 \times 10000}{1600}$$

$\therefore$ $$n = 25$$

This calculation gives the sample size as 25. This indicates that when the standard deviation of population is Rs 100 and the extent of precision is Rs 40, a sample of 25 households needs to be chosen.

Let us take a few more examples, making certain variations in the original values. Suppose that we are interested in making out our estimate twice as precise as the earlier one, then E becomes 20 instead of 40. Taking confidence level as 95.4 per cent thus, $Z = 2$ and standard deviation as 100, as in the earlier case, and applying the formula

$$n = \frac{Z^2\sigma^2}{E^2}$$

or $$= \frac{(2)^2\,(100)^2}{(20)^2}$$

or $$= \frac{4 \times 10000}{400}$$

$$= 100$$

We find that the value of n now arrived at is 100, i.e., four times of the original value. In other words, when precision is doubled, the value of n increases four times. This result can be generalised as follows: When the precision is increased by a factor x, sample size increases by a factor x^2.

Let us now see what happens to the sample size n if the degree of confidence undergoes a change. Suppose that the degree of confidence is 99.7 per cent instead of 95.4 per cent, then Z is equal to 3. Thus

$$n = \frac{Z^2\sigma^2}{E^2}$$

or $$= \frac{(3)^2\,(100)^2}{(40)^2}$$

or $$= \frac{9 \times 10000}{1600}$$

$$= 56.25$$

If Z is reduced to 1, then

$$n = \frac{Z^2\sigma^2}{E^2}$$

or $$n = \frac{(1)^2\ (100)^2}{(40)^2}$$

or $$= \frac{1 \times 10000}{1600}$$

$\therefore$ $$= 6.25$$

Notice the changes in the value of n.

In the first case, when Z is increased from 2 to 3, there is an increase of 3/2 times in its value. When Z is increased 3/2 times, the value of n increass $\frac{3}{2} \times \frac{3}{2} = \frac{9}{4}$ times as $25 \times \frac{9}{4} = \frac{225}{4} = 56.25$. Likewise, when the value of Z is reduced from 2 to 1, there is a fall in its value by 1/2. When Z is reduced by 1/2, the value of n reduces to $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$ th of its original vale $n = 25 \times \frac{1}{4} = 6.25$. To generalise the above results, when Z is increased by a certain factor y, sample size increases by a factor y^2.

When Standard Deviation of Population is Unknown

So far the discussion was confined to such cases where standard deviation of the population was known. Many a time, the standard deviation is not known. In such cases too, the method followed is the same except that an estimate of the population standard deviation in place of its previously known value is taken. Sometimes, the researcher may undertake a pilot survey to ascertain the standard deviation. If this is not possible, the researcher may have to use some alternative approach. As we know, the entire area under the normal curve falls within $\mu \pm 3\sigma$. This means that we should have some idea of the range of variation, i.e., the difference between the highest item and the lowest item. This range needs to be divided by six in order to get an estimate of the standard deviation.

Suppose in our previous example, the minimum monthly income amongst households is Rs 500 and the maximum is Rs 2000. This gives a range of Rs 1500 which divided by 6 yields a figure of 250. This is the estimated value of σ. Taking other values as earlier, the sample size can be determined as shown below.

$$= \frac{Z^2\sigma^2}{E^2}$$

or $$= \frac{(2)^2\ (250)^2}{(40)^2}$$

or $$= \frac{4 \times 62500}{1600}$$

$\therefore$ $$= 156.25$$

This shows that a sample of 156 household should be taken.

Suppose a sample of 156 households gives a sample mean $\bar{X}$ = 1000, and a sample standard deviation $\hat{S}$ = 200, then the confidence interval would be $\bar{X} \pm Z_{s\bar{x}}$

or $$1000 \pm 2\frac{\hat{S}}{\sqrt{n}}$$

or $$1000 \pm 2\frac{200}{\sqrt{156}}$$

or $$1000 \pm \frac{400}{12.5}$$

or $$1000 \pm 32$$

or $$968 \le \mu \le 1032$$

This shows the precision as ± 32 as against ± 40 in the earlier example. Thus the interval has become narrower than earlier envisaged. This is because the sample standard deviation (200) is less than the estimated population standard deviation (250) in the earlier example. In other words, as the population standard deviation was over-estimated as judged by the sample standard deviation, the confidence interval became narrower. Conversely, if the population standard deviation turns out to be under-estimated vis-a-vis sample standard deviation, the confidence interval will become wider.

Relative Precision

So far the discussion was concerned with the basis of absolute precision measured in terms of specific units. We now introduce another dimension, namely, the relative precision. It can be defined as the extent of precision relative to level. Suppose the mean is 200 and a relative precision of 10 per cent is aimed at. This would mean a confidence interval from 180 to 220. In case the mean is 100, the confidence interval will be from 90 to 110.

When applying relative precision instead of absolute precision, the usual formula $n = \frac{Z^2\sigma^2}{E^2}$ is transformed to

$$n = \frac{Z^2}{r^2}\left(\frac{\sigma}{\mu}\right)^2 \text{ where } r \text{ is the relative precision}$$

This can be written as $(z^2/r^2)\,C^2$, where C is the coefficient of variation.

In the above form of the formula, it is necessary to have values of three variables namely, z, r and C. Since Z relates to the desired level of significance, it will be known. So also r will be known as it indicates the level of precision which has to be decided in advance. It is only C that is not known and which needs to be estimated. The researcher has to very carefully use his judgement regarding the magnitude of the population mean and the population standard deviation. If there are some earlier studies available for his guidance, he should draw upon them in order to make his judgement as realistic as possible. It may be noted that if the coefficient of variation C turns out to be higher than that actually given by the ratio of the sample standard deviation to the sample mean, then this would show that the sample size should have been larger and *vice versa*.

STRATIFIED SAMPLE SIZE

Our discussion so far was in relation to simple random sampling. We now turn to determining sample size when the sample to be chosen is a stratified random sample. It may be recalled that the purpose of choosing a stratified sample is to reduce costs for a given level of precision or to increase precision for a given cost of conducting the survey. We shall consider both proportionate and disproportionate stratified samples.

Proportionate Stratified Sample

The proportionate stratified sample implies that the sampling fraction is proportionate to the population in each stratum. The formula to determine the sample size for estimating the population mean μ is

$$n = \frac{z^2}{E^2} \sum w_i \check{\sigma}_i 2$$

where w_i = weight of stratum $i = N_i/N$

$\hat{\sigma}_i^2$ = estimated variance of stratum i

E = tolerable error

Z = confidence coefficient

Let us take an example to illustrate the application of the above formula.

Suppose we have the following data pertaining to consumption of sample households in three strata—rich, middle class and poor.

Table 12.4

Income stratum	Sample S.D.	Size of stratum	Weight
Rich Class	70	1000	0.1
Middle Class	60	3000	0.3
Poor Class	40	6000	0.6

Assuming a tolerable error of Rs 10 and a confidence level of 95 percent (Z = 1.96), and applying the above formula, we would get

$$n = \frac{(1.96)^2}{(10)^2} \Sigma\, [(0.1)\,(70)^2] + [(0.3)\,(60)^2] + [(0.6)\,(40)^2]$$

$$= \frac{(3.8416)\,(490 + 1080 + 960)}{100}$$

$$= \frac{3.8416 \times 2530}{100}$$

$$= \frac{9719.248}{100}$$

$$= 97.19248 \text{ or } 97 \text{ approx.}$$

Having obtained the overall sample size of 97, we may now allocate sample size to each of the three strata on the basis of their relative size. In other words, sample size 97 is to be apportioned in the ratio of 1:3:6 to rich, middle and poor class respectively. On this basis the stratum sample size would be 10, 29 and 58, respectively.

It may be mentioned that when the researcher is estimating the overall mean and when he has the only information on the number of units in each stratum, then he should prefer the proportionate stratified sample.

Disproportionate Stratified Sampling

In disproportionate stratified sampling, samples in the strata are not proportionate to the strata sizes. Such a sample is preferable when the standard deviation of the observations in each stratum is known. When a couple of strata show a large portion of the overall standard error, then this sample becomes more efficient.

The formula used for determining the sample size in case of disproportionate stratified sampling is as follows

$$n = \frac{z^2}{E^2} \left(\sum w_i \hat{\sigma}_i\right)^2$$

Mark the difference between this formula and the one given earlier. The difference lies in the second term.

Applying the values as given in the earlier Table 12.4, we would get

$$n = \frac{(1.96)^2}{(10)^2} [(0.1 \times 70) + (0.3 \times 60)] + [(0.6 \times 40]^2$$

$$= \frac{3.8416}{100} [7 + 18 + 24]^2$$

$$= \frac{3.8416}{100} (49)^2 = \frac{3.8416 \times 2401}{100} = 92 \text{ rounded}$$

It will be seen that the overall sample size has now reduced from 97 to 92. However, the optimum sample allocation in each stratum can be achieved by using the following formula for each stratum.

$$n_i = \frac{N_i \hat{\sigma}_i}{\sum_{i=1}^{k} (N_i \hat{\sigma}_i)} (n)$$

Table 12.5 summarizes the calculations obtained on the basis of the above formula.

Table 12.5 Allocation of Sample Size to each Stratum

i	N_i	$\hat{\sigma}_i$ (Rs)	$N_i\hat{\sigma}_i$	$\frac{N_i\hat{\sigma}_i}{\sum(N_i\hat{\sigma}_i)}$	n	n_i
1.	1000	70	70000	0.14	92	13
2.	3000	60	180000	0.37	92	34
3.	6000	40	240000	0.49	92	45
			490000			

The last column of Table 12.5 gives the optimum sample sizes of 13, 34 and 45 for stratum 1,2 and 3 respectively. These sample sizes have been arrived at by multiplying the figures given in the preceding two colums of Table 12.5. Table 12.6 presents the sample sizes for each stratum obtained by two types of stratified samples.

Table 12.6 Sample Size

Stratum	PSRS	DSRS
1	10	13
2	29	34
3	58	45
	97	**92**

At this stage, one may ask whether the optimum allocation of sample size to strata under disproportionate stratified sampling is worth while? To answer this question, one has to compare the standard errors of each of the two types of sampling.

In order to calculate the standard error for disproportionate stratified sampling, the following formula is to be used

$$\sigma_{\bar{x}sr} = \sqrt{\frac{\left(\sum_{i=1}^{k} W_i\hat{\sigma}_i\right)}{\sum_{i=1}^{ks} n_i}}$$

Where $\sigma_{\bar{x}sr}$ = standard error of the mean.

Applying the values in the above formula, we get

$$\sigma_{\bar{x}sr} = \sqrt{\frac{[(0.1\times 70)+(0.3\times 60)+(0.6\times 40)]^2}{92}}$$

$$= \sqrt{\frac{(7+18+24)^2}{92}}$$

$$= \sqrt{\frac{2401}{92}} = \sqrt{26.0978} = 5.1086$$

The standard error of the mean in case of proportionate stratified sample can be calculated by the following formula:

$$\sigma_{\bar{x}sr} = \sqrt{\sum_{i=1}^{k} \frac{W_i \sigma_i^2}{n_i}}$$

Applying the values obtained earlier when sample size was to be determined.

$$\sigma_{\bar{x}sr} = \sqrt{\frac{(490 + 1080 + 960)}{97}}$$

$$= \sqrt{\frac{2530}{97}} = \sqrt{26.08} = 5.1071$$

Thus, we find that standard error for PSRS was 5.1071 as against 5.1086 for DSRS. The difference between the two standard errors is very marginal. The point to note is that in the disproportionate stratified sample we get almost the same precision with a smaller sample size (92) as compared to the proportionate stratified sample (97). Normally, taking the same degree of precision, the sample size will be larger in simple random sampling as compared to proportionate sampling while the sample size in the latter will be larger than the disproportionate sample. Alternatively, given the same sample size, the precision will be least in simple random sample and highest in disproportionate sampling while it will be between the two in proportionate sampling.

SAMPLE SIZE AND OTHER FACTORS

It should be noted that a marketing research study is usually a compromise between technical compliance and practical limitations faced by researcher. Some of these constraints which influence sample size are discussed here.

Several Objectives

A marketing research study is seldom conducted to estimate a single parameter. Generally several objectives are involved in a single study. Now, a sample size may vary from one objective to another on account of the expected variance. It is not necessary to go through the process of determining the sample for all objectives. The general approach is to choose a few crucial questions on the basis of which the sample size is determined. The researcher should especially include objectives that are likely to have greater variability as their inclusion will be more crucial for sample size.

Suppose that in a study three parameters are to be estimated each with a 95 per cent confidence level and within desired precision. The sample size required has been determined as 400 units, 800 units and 250 units, respectively. The most conservative approach in such a case would be to select a sample of 800 units, which is the largest. However, if the second parameter, where sample size required i.e. 800 is not crucial, it is advisable not to choose a sample of 800 units. Taking a sample of this size would involve additional expenditure which could be saved. In such a case, a sample size of 400 would be most appropriate. Thus, the marketing researcher should be guided by the relative importance of the parameters and the one which is most crucial should be taken into consideration. The sample size should then be determined for the desired precision and confidence with respect to that parameter. The sample size thus determined should be applicable to the entire study, covering all the parameters.

In our preceding example, if a sample of 800 is chosen, then the degree of confidence as also precision will be higher than the desired degrees, as envisaged earlier. Conversely, if a lower sample size say, 250 units is chosen, then in case of the other two parameters, the degrees of confidence and precision would be lower than the corresponding values envisaged earlier. The researchers have to exercise their judgement very carefully in such cases.

Cost Constraints

Another major factor that influences sample size is the cost involved in drawing the sample and undertaking the survey on the basis of the sample chosen. This does not mean that a company having plenty of finance should go in for a large sample. Availability of large funds should not be a criterion for increasing the sample size. These funds can be better utilized elsewhere.

When a firm finds that the study will cost too much, an alternative before it is to increase the size of the allowable error. A lower degree of precision would need a lower sample size than envisaged earlier. There could be several combinations of the extent of confidence and precision which can be thought of by the firm. It has to choose one of these feasible combinations keeping in mind the financial resources at its disposal. It is possible that reducing the degree of confidence or precision or both may undermine the utility of the study so much so that it may even drop the idea of conducting the field survey.

Time Constraints

At times, management wants prompt results on the basis of a proposed marketing research study. It fears that delay in getting the findings of the study will be hardly useful in decision-making. In such a situation, the researcher has to keep in mind the time factor. Accordingly the sample size should be so limited that the marketing research report can be completed within the stipulated time.

Nature of Data Analysis

Another factor that may affect the sample size is the nature of data analysis planned for the proposed study. If the research needs only univariate analysis, the sample size is determined on the basis of criteria explained earlier in this chapter. This means that the relationship between sample size and desired precision on one variable is to be determined. In case the research study involves two or more variables, i.e. bivariate and multivariate study, the study requires different sample sizes so that valid estimates of population parameters can be made. In general, as the number of parameters increases, the requirement of sample size also increases. However, there may be some multivariate studies, which may not require a large sample size.

SAMPLE SIZE DECISIONS WHEN ESTIMATING PROPORTIONS

The foregoing discussion was carried out in relation to sample size for estimating mean values. At times, it is the proportion of population with a particular attribute that becomes more relevant to the marketing researcher than the mean value. *For example*, one may be more interested in knowing the proportion of households having a monthly income of, say, Rs 1000 and less or Rs 2500 and above rather than in knowing the average income of the households.

The formula for the standard error of a proportion p based on a simple random sample of size n is

$$S.E.\,(p) = \sqrt{\frac{\pi\,(1-\pi)}{n}}$$

where π is the proportion of units with a particular attribute.

The above formula can be transformed as follows:

$$[S.E.\,(p)]^2 = \frac{\pi\,(1-\pi)}{n}$$

or

$$\frac{1}{n} = \frac{[S.E.\,(p)]^2}{\pi\,(1-\pi)}$$

By inverting the above, we get

$$n = \frac{\pi\,(1-\pi)}{[S.E.\,(p)]^2}$$

The above formula can also be written as

$$n = \frac{Z^2\,[\pi\,(1-\pi)]}{(E)^2}$$

Let us take an example.

Suppose we are interested in estimating the proportion of households having a television set. We believe that this figure is about 20 per cent. Further, we decide that a standard error should not be more than 8 per cent. We now apply the earlier formula, taking the confidence level of 95.4 per cent (thus, $Z = 2$):

$$n = \frac{Z^2\,[\pi\,(1-\pi)]}{(E)^2}$$

$$= \frac{Z^2\,(0.2 \times 0.8)}{(0.08)^2}$$

$$= 100$$

This gives the sample size of 100 households. This could be regarded as the desirable sample provided that the population is relatively large. If, however, population is only 900 households, then the revised sample size can be worked out as follow:

$$n' = \frac{n}{1+\dfrac{n}{N}}$$

$$= \frac{100}{1+\dfrac{100}{900}}$$

$$= \frac{100}{\dfrac{1000}{900}}$$

$$= 90$$

This shows that a sample size of 90 households should be taken instead of 100 households.

From the formla

$$n = \frac{\pi (1-\pi)}{[S.E.(p)]^2}$$

it should be clear that the value of $\pi(1 - \pi)$ would influence the size of n. The smaller is this value, the smaller will be the sample size required for a given standard error. It may also be noted that n will be at a maximum when $\pi(1 - \pi)$ is at a maximum. When $\pi = 1/2$, $\pi(1 - \pi)$ is at a maximum. This also shows that if a small standard error is to be preferred, then a relatively large sample size is required.

Another point that needs to be emphasised is that in the initial stage when an estimate of π is made, it may not be right. Let us take an example. Suppose the proportion of households earning Rs 1000 or less per month has been estimated as 0.4.

This means that

$$n = \frac{Z^2 [\pi (1-\pi)]}{(E)^2}$$

$$= \frac{(Z)^2 (40 \times 60)}{(0.08)^2}$$ (on the assumption that the allowable error is not more than 8 percent)

$$= \frac{4 \times 0.4 \times 0.6}{0.0064}$$

$$= 150$$

Suppose that when the survey is undertaken and the 150 sampled households are contacted, the sample proportion p turns out to be 0.03. With this revised proportion, the standard error is determined

$$SE.(p) = \sqrt{\frac{p(1-p)}{n}}$$

$$= \sqrt{\frac{0.30 \times 0.70}{150}}$$

$$= 0.037$$

and the confidence interval will then be

$$p \pm Z\,Sp = 0.30 \pm 2\,(0.037)$$

$$0.226 \leq \pi\, 0.337$$

The interval is narrower than desired as the sample proportion (0.03) turned out to be less than the population (0.40).

Relative Precision

As was discussed earlier, while determining sample size when estimating means, here too the same approach is applicable in respect of relative precision. The term 'relative precision' signifies that the size of the interval will be within a certain per cent of the value, regardless of its level. *For* *example*, if the sample proportion is 0.4 and if the relative precision is to be within ± 10 per cent, then the interval would be 0.36 to 0.44.

STATISTICAL EFFICIENCY[2]

The term 'efficiency' or 'statistical efficiency' is frequently used in discussions of sampling. A sample design is considered statistically more efficient than another if its standard error of the mean is smaller, given the same sample size. Conversely, a more efficient sample design will yield as precise a result as an alternative sample design but with a smaller sample. Thus, efficiency implies a comparison of two or more sample designs. Symboically,

$$E_A = \frac{\hat{\sigma}_\mu}{\hat{\sigma}_A} \cdot 100$$

where E_A = the statistical efficiency of sampling design A, expressed as a pecentage

$\hat{\sigma}_\mu$ = the standard error of the appropriate statistic, e.g., mean, produced by an unrestricted single-stage sample of size n

$\hat{\sigma}_A$ = the standard error of the appropriate statistic, produced by sampling design A of size n.

If the degree of precision required is specified in advance, regardless of the sample design, then the relative size of the sample required would indicate efficiency. Symbolically,

$$E_A = \frac{n_\mu}{n_A} \cdot 100$$

where E_A = the efficiency of sampling design A, based on relative sample size and expressed as a percentage

n_A = the size of the sample, using sampling design A

n_u = the size of the sample, using the unrestricted single-stage sampling design

It may be noted that when a comparison is made of standard errors of the mean of different sample designs requiring the same rupee expenditure, it will indicate relative economic efficiency. In other words, economic efficiency is measured in terms of the precision of results per rupee of cost. Marketing researchers are generally concerned with economic efficiency of sample designs and aim at obtaining maximum efficiency of this type.

Population Size and Sample Size

We have discussed earlier in detail how to determine sample size. An important point worth noting is that in all our calculations, the size of the population has not entered into the calculation of the size of sample. This is indeed very surprising but it is really so. We may slightly modify this statement and say that the population size has no direct effect on the sample size.

[2] Based on Wentz, Walter B., *Marketing Research: Management, Method, and Cases*, New York, Harper and Row Publishers, 1979, pp. 225–226.

Suppose we want to know the mean height of the students in a university. If the height is the same in each case, then only one student is sufficient to provide the mean height of the entire universe i.e. all students enrolled in the university. The point to note is that variability of the characteristic in the population is important and not the size of the population. The greater the variability of a given characteristic in the population, greater would be the sample size with some specified level of precision. This can be further elaborated with the help of the formula used for determining the sample size. The formula is: $n = (Z^2 \sigma^2)/E^2$ with absolute precision and $n = (Z^2/r^2)\, C^2$ with relative precision, where r is the specified relative precision and C is the coefficient of variation. It becomes obvious that with higher variability i.e. σ^2, size of n will be larger.

In other words, it can be said that population size does not directly affect the sample size but only indirectly through its impact on variability. When the population size is large, it is quite possible that its variability too is high. Likewise, smaller the population size, the variability is likely to be lower.

Coming to the determination of sample size when estimating proportion, we find that the determining factor is the estimated proportion of the population having the characteristic under consideration. When the estimated population proportion is closer to 0.5, the sample will be larger. When the proportion is 0.5, it shows the greatest variability and the sample required will be the largest. This is because one-half of the population is having the characteristic and the other half of the population does not have that characteristic.

As was mentioned in the beginning, there would be a slight modification in our earlier statement that sample size is not based on the size of the population. This is based on the finite population correction (fpc). We have seen in our earlier examples that when sample is small relative to the population, the fpc is not used. When the sample is large relative to population size (i.e., more than 5 percent of the population), the finite limits of the population constrain the sample size, for whih the fpc $\sqrt{\dfrac{N-n}{N-1}}$ is used in the formula $\sigma_{\bar{x}} = \sigma / \sqrt{n}$

The use of fpc reduces the sample size. For example, it the population has 500 elements and the calculation of sample size arrived at is 40, which is more than 5 percent of the population, then there is a need to take less than 40 elements. The required sample size can be calculated as

$$\begin{aligned} n' &= nN / (N + n - 1) \\ &= (40 \times 500) / (500 + 40 - 1) \\ &= 2000/539 \\ &= 37 \end{aligned}$$

Thus, when N is 500 and n is 40, only 37 sample elements are required.

Determining Sample Size for other Probability Sample Designs

The preceding discussion on determination of sample size related to simple random and stratified sample designs. The question may be asked: what about other probability sample designs such as systematic, cluster, area and multi-stage sample designs?

As regards other sample designs, it should be noted that the general approach as was followed in simple random sample design remains the same. However, the formula for calculating the standard errors differ. As the sample design becomes more elaborate, the formula too becomes more complex and difficult. This is on account of the fact that the standard error for such a design is partially a function of the standard deviation (or proportion) of each stratum or cluster included in it. These observations are in respect of the overall sample size. Once an overall sample size has been determined, it has to be allocated among the strata and clusters. This allocation further adds to the existing complexity.

DETERMINING THE SIZE OF NON-PROBABILITY SAMPLES

The preceding discussion was in respect of probability samples. However, non-probability samples are used, perhaps more frequently, in marketing research than probability samples. The question is—How should the size of a non-probability sample be determined? In this case, there is no theoretical basis for estimating sampling error. We have seen how important the concept of sampling error is in determining size when the sample is based on probability.

Generally, two approaches are followed in respect of non-probability samples. One approach is to determine the size as if it were a probability sample. Another approach is to take as large a sample as possible within the constraints of time and money. For example, if a sum of Rs 50,000 has been earmarked for a research project, the estimated fixed costs of sampling and the non-sampling costs are Rs 30,000 and sampling costs are Rs 25 per element, the sample size (n)should be $\frac{\text{Rs } 50{,}000 - \text{Rs } 30{,}000}{\text{Rs } 25}$ = 800. There are two limitations of this approach. It fails to take into consideration the difference in value of information of the sample of 800 as compared to that of other sample sizes. Second, unlike the probability sample, it usually fails to consider tradeoffs between sampling and non-sampling errors.

Summary

This chapter has dealt with statistical principles involved in determining sample size. To facilitate the reader in understanding these principles, sampling distribution of the mean, which forms the basis for any problem on sample size, has been discussed with the help of a numerical example. Its characteristics have also been explained.

The three major considerations relevant in determining sample size:

1. The extent of error or imprecision allowed 2. The degree of confidence desired in the estimate 3.Estimate of the standard deviation of the population, have been discussed with illustrations. The discussion is in two parts: determination of sample size (a) when standard deviation of the population is known, and (b) when standard deviation of the population is unknown.

The chapter has introduced another dimension, namely, the relative precision. This is followed by a discussion on stratified sample size. As sometimes a compromise between technical compliance and practical limitations becomes necessary, some other factors relevant in determining sample size have been briefly discussed. While a good deal of this chapter is devoted to the problem of determining sample size for estimating means, some discussion has also been given on determining sample size when estimating proportions. Towards the end, the concept of statistical efficiency has been explained. Finally, the problem of sample size of non-probability samples has also been looked into.

Key Terms and Concepts

Questions

1. What is meant by distribution of sample means? What are its characteristics?
2. What specifications are necessary for determining the size of a simple random sample to estimate the population mean?
3. What is the finite population correction? When is it used?
4. Distinguish between (i) a point estimate of the mean, and (ii) an interval estimate of the mean.
5. What is a confidence coefficient?
6. Describe the procedure for determining sample size for estimating a population mean when the population variation is unknown.
7. What is the difference between absolute precision and relative precision in the estimation of a population mean?
8. How would you decide sample size when estimating proportions?
9. How does relative precision differ from absolute precision in the estimation of a population proportion?
10. Bring out clearly the difference between degree of precision and degree of confidence.
11. Should a larger sample be selected when the standard deviation of population tends to be larger? Why or Why not?
12. "A larger sample does not necessarily mean that it is a representative sample." Comment.
13. How would you determine sample size for a field survey which has several objectives?
14. You have been asked to select a simple random sample from a population of 20,000 sales invoices to estimate the average amount per invoice. Suppose that the standard deviation of the population is Rs 500. Determine the sample size required if the allowable error is Rs 100 and the confidence coefficient at 95 percent. You may ignore the finite population correction factor.
15. Suppose in question 14, the standard deviation of the population is Rs 1000 and the allowable error is Rs 200, determine the sample size.

16. Suppose an estimate of the proportion of sales invoices having an amount of Rs 500 or more is to be made. The allowable error is 0.10 (10 percentage points), the confidence level is 95% and the estimate of the population proportion is 0.40 (40%). Determine the sample size required on the basis of the above data.
17. What do you understand by ''statistical efficiency'' in the context of sampling? How would you measure it?
18. "Population size is not relevant while determining sample size." Comment.
19. Describe the procedure that you would follow to determine the following :
    (i) A systematic random sampling of 100 students at your university
    (ii) A convenience sampling of 50 persons at a shopping mall
    (iii) A stratified random sampling comprising
    100 rich class
    3000 middle class
    6000 poor class
20. A mobile phone company is interested in determining the heavy uses of mobile phones (airtime). Which sampling design would be most appropriate in this case? Why?

13 Interviewing

Learning Objectives

After reading this chapter, you should be able to understand:

- The conditions for a successful interview
- The interviewer's task
- The interviewing errors
- Selection of interviewers
- Training of interviewers
- Supervision of interviewers
- Interviews for qualitative research

Having looked into the designing of questionnaires, scaling techniques and major aspects in sampling in some of the preceding chapters, we now turn to an important aspect of the field survey, namely, interviewing. It is one of the most difficult tasks in marketing research and yet it has not received adequate attention. It is difficult because it requires a rare combination of intelligence, initiative and tact on the part of interviewers so that they can get the desired information from the unknown respondents.

THE CONDITIONS FOR A SUCCESSFUL INTERVIEW

An interview is a purposeful conversation between the interviewer and the respondent aimed at eliciting certain information from the latter. Though this appears to be a simple task, in reality, it is not so. It is necessary that certain conditions are fulfilled in order to ensure its successful completion. These conditions are explained below.

Availability of Information with the Respondent

First, the respondent must have the information which is sought by the interviewer. It may well be that the respondent had the information but due to the passage of time, he has now forgotten it. Alternately, he might have repressed it due to some emotional stress.

Cognition

Second, the respondent should understand what is required and expected of him. He should be in a position to decide what information he should give, how much he should give and in what manner he should give it. The interviewer should ensure that the respondent understands his role when he is interviewed. Whenever the respondent's answer to a question is incomplete or irrelevant, the interviewer should again explain it clearly or probe further to get the necessary details.

Motivation

Finally, the respondent should feel motivated to answer questions accurately. He should be cooperative right from the beginning to the end of the interview. At the same time, he should realise the seriousness of the interview and give correct answers.

An interview is in fact an interaction of the interviewer and the respondent. Unless they are cooperative and talk on the same wavelength, the interview cannot be successful. Much responsibility, therefore, falls on the interviewer to remove any distrust and misgiving on the part of the respondent at the beginning of an interview, as also his confusion in answering questions as the interview proceeds.

A number of errors do creep in on account of the interviewer, which are termed as interviewer bias. This aspect is discussed later in the chapter.

THE INTERVIEWER'S TASK[1]

The interviewer's task has four aspects: **(i) Locating sample members, (ii) Obtaining interviews, (iii) Asking questions,** and **(iv) Recording the answers.** The amount of time spent on these aspects will vary on account of such factors as the nature of the inquiry, the type of sample, the extent of the respondent's cooperation and length of the questionnaire. The time spent by interviewers on actual interviewing is much less than what is generally imagined. Sudman[2] found that contrary to general expectation, interviewers spend only one-third of their time on actual interviewing and two-thirds on other aspects of their task.

Locating the Respondents

In probability sampling, the interviewer cannot choose his respondents on his own. He has to approach only those persons who have been selected in the sample. This fixes a responsibility on the interviewer to find the sample members. In area sampling, where maps are used, the interviewer has to concern himself with either listing dwellings or segmenting within selected blocks. This needs great care as a casual handling of the job may leave some dwellings unlisted. From these listed dwellings, a sample is chosen and the interviewer has to call on the sample members. Sometimes he may have to call back when the members are not available or unable to spare time on the first call.

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[1] This section draws heavily on the ideas contained in Moser, C.A. and G. Kalton, *Survey Methods in Social Investigation*, London, Heinemann Educational Books Ltd., (Second edition), 1979, pp. 273–281.

[2] Sudman, S., (1) "Time Allocation in Survey Interviewing and in other Field Occupations" in *Public Opinion Quarterly*, Vol. 29, 1965, pp. 638–648; and (2) "Reducing the Cost of Surveys", National Opinion Research Centre, *Monograph in Social Research*, No. 10, Aldine, Chicago.

Obtaining the Interview

Having located the respondent, the interviewer has to initiate the interview. He may have to show his identity and authorisation letter/card of his organization. After this, it is necessary to inform the respondent about the purpose of the survey, to impress upon him how his response will be helpful for the survey and to convince him of the need for his cooperation. While he should fully justify to the respondent the reasons for the information sought, he need not be too much apologetic about it. He should also give some idea about what is expected to emerge from such a survey and to whom the results may be of interest. He should refrain from overstating or inflating the importance of the survey.

Initially, when the interview proceeds, the respondent is usually reserved. In such a case, the interviewer should be very patient and courteous while persuading the respondent lest he may be forced to abandon the interview altogether. Such a situation is, no doubt, challenging but if handled carefully, it will give added self-confidence to the interviewer. He should assure the respondent that his answers will be kept confidential and that his identity will not be disclosed. He should also point out that the interview is not a test nor is it intended to educate the respondent. What is important at the beginning is that the interviewer establishes a rapport with the respondent. He has to put the respondent at ease so that he does not have any reservations while talking to the interviewer. The more free and frank the respondent is in answering questions, the better will be the interview. The interviewer must be careful not to assume an air of superiority. This is necessary to ensure the respondent does not put off the interviewing.

Asking the Questions

Having initiated the interview, the interviewer must ask the necessary questions. In the case of a structured questionnaire, he has to ask the questions in the same phraseology and sequence as contained in the questionnaire. He has to ensure that whatever is asked, is understood by the respondent in the sense in which it is intended. He has also to ensure that he understands what the respondent says. He has to be extremely careful not to influence the respondent by his own ideas and prejudices. It has been rightly said that

> …the interviewer's function is neither that of an educator nor missionary, but that of an impartial observer of public opinion as he finds it. No matter how much he may privately disagree with the attitudes he encounters, it is not his business to enlighten or convert but to listen and understand.[3]

If he directly or indirectly influences the respondent by his ideas and opinions, the answers of the respondent will not reflect his own ideas and opinions. The interviewer should not emphasise a particular word or part of the question as it could be suggestive to the respondent. Particularly when a question has more than one alternative answer, the interviewer should not, by the manner of asking or by the tone in which it is asked, suggest that he prefers one particular alternative to the remaining ones. In short, he must maintain neutrality and objectivity throughout the interview process.

[3] Manual for Interviewers used by the Division of Special Surveys, Bureau of Agricultural Economics, US Department of Agriculture, cited by Lorie, James H. and Harry V. Robberts, *Basic Methods of Marketing Research*, New York, McGraw-Hill Book Company, Inc., 1951, p. 352.

During the course of the interview, in addition to asking questions, the interviewer must satisfy himself that the answers given by the respondent are adequate. The symptoms of inadequate response, as given by Kahn and Cannell[4] are: partial response, non-response, irrelevant response, inaccurate response and the verbalised response problem. While the first four symptoms are self-explanatory, the last one needs some explanation. At times the respondent explains to the interviewer why he is unable to answer the question. He might not have understood the question or he does not possess the information sought, or he thinks that the question is irrelevant or inappropriate. In all such cases the interviewer should gently probe further to get the necessary information. It may be difficult at times to develop supplementary questions on the spur of the moment. This apart, the phrasing of a supplementary question in a particular manner may introduce an element of interviewer-bias. On the other hand, no single supplementary question will be suitable in all possible situations. It is difficult to lay down any rigid guidelines in this regard. However, one important measure that can be taken is to provide adequate training to interviewers with a set of standard techniques that should be used by them for handling inadequate responses.

Recording the Responses

Recording the responses is the last aspect of the interviewing task. Except when mail questionnaires are sent out, or a panel survey is undertaken in which the respondents are requested to keep diary records, the recording of answers is done by the interviewers themselves.

The interviewer has to record the answers honestly, as they are obtained from the respondent. In no case should he add or delete something on his own. In the case of open-ended questions, he is expected to be more careful in recording the answers otherwise he is likely to forget or miss some part. If answers are improperly or partially recorded in the hope that when the interviewer returns to his organization, he will write them in full, he may find that he is unable to recollect all the answers. This is likely to pose a serious problem at the time of the editing of the questionnaire or the tabulation of data.

While closing the interview, the interviewer should thank the respondent for his cooperation in the survey and for the time that he has spent in providing the answers. He should close the interview on a friendly note so that in exceptional cases when some crucial additional information is needed, he can approach the respondent again. However, the interviewer should avoid approaching the respondent again as far as possible as this would take more time and enhance the total cost of the survey.

THE INTERVIEWING ERRORS

Although the researcher may have taken sufficient care in the recruitment and training of interviewers before they are deputed for interviews, there are likely to be certain errors which arise while interviewing.

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4 Kahn, Robert L. and Charles F. Cannell, *The Dynamics of Interviewing*, New York, John Wiley and Sons, Inc., 1957.

First, errors may arise if the interviewer is unable to establish a proper rapport[5] with the respondent. If the rapport is too weak, the respondent may give answers half-heartedly or give incorrect replies. On the other hand, if the rapport is too strong, it may obsess the respondent on account of excessive influence of the interviewer. This too would not help in obtaining accurate responses. Both these situations have to be avoided and a reasonable rapport between the interviewer and the respondent is to be established, as was pointed out earlier.

Errors in interviewing may also arise if the interviewer has deliberately or inadvertently not followed the instructions. *For example*, he might not have explained the background and purpose of the survey to the respondent or he might have done so vaguely, as a result of which the answers received may not be accurate.

Further, if the interviewer gives undue emphasis to a particular word or a part of the question, it might be suggestive to the respondent. This too would be a source of an interviewing error.

Interviewing demands much patience on the part of both interviewers and respondents. If the interviewer omits any questions in haste, the answers will not be complete. This will cause an error of omission. Besides, when the response to a question is inconsistent with that of an earlier one, it means that one of the responses is wrong. The interviewer is expected to identify such inconsistencies when he comes across them during the course of the interview itself. He should then further probe or ask an additional question to clarify the situation.

Finally, the interviewer may commit some error in the recording of responses. As was mentioned earlier, he should record answers as given by the respondent without adding or deleting anything.

Several studies have been conducted to find out interviewer effects in marketing research. Boyd and Westfall[6] have conducted an extensive research of the literature on interviewer bias. One of their main findings shows that interviewers are a major source of error in marketing field studies and that little is known about the magnitude of such errors under varying conditions. In a subsequent study[7] they observe that despite the need for research in a large number of areas dealing with interviewer bias, extremely limited research has been done in this field. Some more work has been done since then. In the field of social surveys, Sudman and Bradburn[8] analysed the results of a large number of surveys. One of their findings is that the use of self-administered questionnaires reduces not only the amount of interviewer time but also provides a better indication of the respondent's real feelings than personal interviews, under certain conditions.

In a more recent study, Mckenzie[9] has investigated interviewer effects in marketing research. As the author has put it: "This survey afforded the opportunity to measure interviewer effects on a

[5] It may be interesting to note that the term "rapport" has been used to convey different meanings. Some refer to it as creating respondent motivation, while others view it mainly as generating free and frank answers. Still others *see* rapport as harmonious relations or friendliness. We have used rapport to mean a good sense of understanding between the interviewer and the respondent. For details, reference may be made to Goudy, Wills J. and Harry R. Potter, "Interview Rapport: Demise of a Concept" in *Public Opinion Quarterly*, Winter, 1975–76, published by Columbia University Press, pp. 529–543.

[6] Boyd, Harper W. Jr. and Ralph Westfall, (1) "Interviewers as a Source of Error in Survey" in *Journal of Marketing*, Vol. 19, April 1955, pp. 311–324; and (2) "Interviewer Bias Revisited" in *Journal of Marketing Research*, Vol. 2, February 1965, pp. 58–63.

[7] Boyd, Harper W. Jr. and Ralph Westfall, "Interviewer Bias Once More Revisited" in *Journal of Marketing Research*, Vol. 7, May 1970, pp. 249–253.

[8] Sudman, S. and N.M. Bradburn, *Response Effects in Surveys*, Chicago, Aldine Publishing Company, 1974.

[9] Mckenzie, J.R., "An Investigation into Interviewer Effects in Market Research" in *Journal of Marketing Research*, Vol. 14, August 1977, pp. 330–363.

variety of long or involved questions, where they might be expected to be greatest; emphasis is on effects due to interviewer respondent interaction rather than selective non-response." As the scope of this book does not allow us to go into the technical details of the survey, we only mention some of the conclusions of the study. One of these showed that interviewer differences accounted for more than 10 per cent of the basic random sampling variance. Where a large number of interviews per interviewer are carried out, such differences would be a major source of additional variance. Another conclusion showed that for several questions, there were sizeable interviewer differences. These questions were mostly either of a repetitive type or involved possible difficulty in interpretation. Another conclusion showed that there was a certain relationship between the respondents' replies and the interviewers' own answers to the survey questions. All the same, the authors could not find any evidence for causal inference from this relationship. These are some of the conclusions reached in the study.

To sum up, we may say that the best way to reduce interviewer bias or effect still continues to be the improvement of interviewer selection, training, supervision and increasing the respondent's motivation to cooperate. We shall deal with the first three aspects in the subsequent sections.

SELECTION OF INTERVIEWERS

It has been recognised in all quarters that the success of any enterprise depends largely on the quality of manpower employed. This applies all the more in the case of surveys where the interviewers are to collect data from different respondents.

To begin with, we should know what are the major characteristics which an interviewer should possess. ***First***, as interviewing is a tiresome job involving strenuous field work for long hours, the interviewer should be in good health. ***Second***, he should be an extrovert. Any person who is very reserved will not enjoy meeting respondents and talking with them, and would perhaps fail miserably in canvassing the questionnaire. As such, a person should be sociable and inclined to contact strangers whom he has not met earlier. ***Third***, he should be well-dressed and possess a pleasing personality. Many a time appearance coupled with good manners decides whether the respondent will cooperate with the interviewer or not. ***Fourth***, the knowledge of the local or regional language must be possessed by the interviewer. In a vast country like India where so many different languages are spoken, it becomes necessary to recruit those interviewers who are proficient in the local or regional language. ***Fifth***, an interviewer must be educated and well-qualified to conduct the interview. *For example*, in the case of a highly technical survey, a person who knows the technicalities of the subject should be appointed. ***Sixth***, as wide discrepancies in the class or status of the interviewer and respondent inhibit certain types of responses, these should be avoided as far as possible. ***Finally***, an interviewer must be capable of communicating with the respondent. The major problem that arises in field investigation is that of a lack of communication. The interviewer should be communicative so that the respondent can easily understand what he wants.

TRAINING OF INTERVIEWERS

Before the interviewers are sent out for collecting data, it is necessary that they should be given some training. In case the subject of enquiry is of a very general nature, the training need not be very elaborate. The interviewers should be given some guidance regarding how they should conduct the interviews. However, if the inquiry is technical, the technical aspects should be fully explained and the necessary literature should be given to them so that they can familiarise themselves with the subject matter. The duration and content of training will vary from survey to survey. Even so, normally, training of 2 to 4 weeks may be considered sufficient. The content of training must be decided carefully.

Initial Training

It may be necessary to provide two types of training—initial training and training for individual studies. Soon after the appointment of the interviewer, initial training may be given which should familiarise him with the relevance of marketing research and the role of interviewers in marketing research studies. General aspects such as locating the respondents, obtaining interviews, asking questions, recording responses and closing interviews, problems of non-response, etc. should be covered fully. The entire training should not be in the form of classroom lectures and discussions. A part of it should be practical—the interviewer should be asked to accompany and observe a supervisor who actually conducts the interview. In the next visit, the interviewer may be asked to initiate and conduct the interview in the presence of the supervisor. Later on, the supervisor should comment on his interview, pointing out specific mistakes committed and suggesting improvements. Finally, the interviewer should be sent out on his own. Each recorded interview should be discussed by the supervisor, indicating its deficiencies. Such a training will go a long way in improving the competence of interviewer.

Training for Individual Studies

In addition to initial training, it is necessary that training for individual studies should be given. The purpose of the research study should be explained. If a consulting firm is undertaking research for an outside firm, it is desirable to inform the interviewers as to which is the sponsoring organization and to give them some background information about it. Further, if the study involves any technical aspects, these must be clearly explained to the interviewers.

In case of studies using area sampling, the interviewer is required to exercise great care in locating the sample respondents. Specific instructions must be given to the interviewers so that the job can be done efficiently. It may further improve the quality of interviewing if interviewers are issued written instructions with respect to a particular survey. In case of doubt, they can refer to them and resolve the difficulty on their own. Finally, certain hypothetical problem-situations should be covered in a specific study and explanations given as to how such problems can be handled if they occur at the time of interviewing.

SUPERVISION OF INTERVIEWERS

In conducting a survey, it is necessary to organise it on the right lines and to ensure its timely completion. The role of supervisors is important in this respect.

A supervisor's work should include:[10]

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[10] Andrews, Lee, "Interviewers: Recruiting, Selecting, Training and Supervising" in *Handbook of Marketing Research,* op. cit., pp. 2–130. Reprinted with permission from the McGraw-Hill Book Company, New York.

1. Gathering and training interviewers on the fundamentals of interviewing, including application forms.
2. Alerting and briefing interviewers for a particular job.
3. Allocating territory, in some cases requiring map work of a fairly detailed nature.
4. Carefully studying the first day's work, and correcting errors.
5. Editing all work.
6. Validating some of the reports (10 per cent or whatever percentage is required).
7. Keeping careful production records.
8. Reviewing time sheets.
9. Rendering a detailed bill for the work.

From this list it is evident that a supervisor's task involves several functions, which remain the same whether he is a full-time employee of a company or an independent functionary.

To minimise the chances of interviewer cheating, supervisors may visit the places, without any prior intimation, where the interviewer is expected to be present. Such sudden inspection visits by supervisors would alert all the interviewers and would prevent them from filling in the questionnaires without contacting the respondents. Apart from this, questionnaires filled in by the interviewer unaided by the respondent, are frequently self-disclosures in the sense that they contain rather unusual or inconsistent answers. Supervisors have to cross check such questionnaires very carefully so that they may detect the fraud. Thus, they can compare the data recorded by a particular interviewer with those recorded by other interviewers. If his data are very different from those of others, then two possibilities exist. *First*, the interviewer may have deliberately entered wrong data or he may not even have visited the respondent. *Second*, the resopondents assigned to him may be different from the rest of the population. In either case, the supervisor has to closely look into the problem. Further, to minimise interviewer cheating, it may be desirable to boost up the interviewer's morale and offer him a reasonable compensation for his work. If he is poorly paid, then he is unlikely to work hard and may be tempted to cut short interviews. In addition, he may be given an assurance that if his work is found quite satisfactory, he will be sought in the next survey or his services may be retained in the organization.

Apart from these measures, two methods[11] may be used to ascertain and control cheating. The first is the re-interview method which implies that a sample of respondents covered by each interviewer may be interviewed again. This method is helpful not only in checking whether the interviewer has followed sampling instructions but also whether the respondent was really interviewed and whether the information collected in the first interview was accurate. The main limitation of this method is that it is expensive. Besides, it is time-consuming.

The second method is the post-card check. Instead of holding re-interviews of selected respondents, a post-card is sent to them to find out whether the interview was held. The method is unable to check the quality of interviews though it will reveal if they were not held. No doubt, this method is much cheaper. This advantage is offset to a certain extent on account of the failure of the respondents to send back the post-cards. This method too is time-consuming. Further, sometimes these cards are likely to reach persons other than the respondents and when these are sent back, the supervisor may receive inaccurate information. Wherever it is possible to contact the respondent over the telephone, the supervisor should use it to find out whether the interview was really held.

[11] Based on Lorie, James H. and Harry V. Roberts, op. cit., p. 399.

Perhaps the more important job of a supervisor is to evaluate the interview itself rather than to ascertain whether it was conducted or not. One way is to conduct a re-interview, but the method is both time-consuming and expensive as was mentioned earlier. Another method is to evaluate the filled-in questionnaire. The supervisor should read through the questionnaire carefully to detect inconsistencies and inaccuracies. Sometimes one may not be able to detect these shortcomings. However, certain checks can be used. For instance, the supervisor may select a few important questions where the interviewer was particularly required to follow instructions, the non-compliance of which would be reflected in the responses. A check of this type may be helpful in evaluating the quality of the interviewer's work, though it is not complete by itself. Again, such a check may sometimes reveal that the instructions themselves were deficient.

Another method is to use free response questions in which the interviewer verbatim records the answers given by the respondent. A close perusal of such answers helps the supervisor to find out whether the interviewer has adhered to the instructions given. The method is subjective but it can be helpful in evaluating the quality of the interviewer's work as revealed by selected parts of filled-in questionnaires.

There are other methods for evaluating the interviewer's performance. One method is by assigning comparable interviewing tasks to interviewers and then comparing their performance relative to each other. Another method is that of direct observation, though it may not be possible always for the supervisor to accompany every interviewer. In addition, it is very expensive, though, at the time of initial training, the method can be followed. Yet another method is to invite comments from the interviewers on the work done by them, problems encountered in the field and measures taken by them to collect information. The supervisor may be able to identify interviewers having greater initiative, intelligence and who are hardworking.

NON-RESPONSE[12]

Before we move on to discuss the techniques used in qualitative research, a major topic affecting the qualitative process is non response error. The term 'non-response error' represents a failure to obtain information from the respondents of the population that were selected for the sample.

During the course of any survey, it is a common experience that the response to the interview is not complete. In other words, a failure to obtain information from the respondents of the population selected for the sample gives rise to non-response error. It is the difference between those who respond to a survey and those who do not. Since non-response error is one of the most serious sources of error confronting the researcher, a standard definition of response rate has been developed by the Council of American Survey Research Organisation (CASRO). The definition is:

$$\text{Response rate} = \frac{\text{No. of completed interviews with responding units}}{\text{No. of eligible responding units in the sample}}$$

The next question in this respect is what causes non-response in interview process. The two main sources of non-response bias are not-at-homes and refusels. In case the research study is based on personal interviews or telephone survey the problem of not-at-homes is most likely to arise. However, when the research study is based on mail survey, the problem of not-at-home does not

[12] Based on Churchill, Gilbert A-Jr. and Dawn Iacobucci, Marketing Research, Thomson Asia Pte Ltd, Singapore, 2004, pp. 528 – 535.

exist. At the same time, if a questionnaire is despatched at a wrong postal or e-mail address, there would be non-response from the respondents.

NOT-AT-HOMES

In order to ensure that the surrey covers a good deal of information, it is necessary to reduce the incidence of not-at-homes. A few suggestions can be made in this respect. First, the interviewer should contact the respondent again preferably at a different time. If this too fails, he should fix up in advance the date and time in consultation with the respondent. In this case, the interview will not be unusual. The problem of not-at-homes would depend, to a large extent, on how the interviewer handles it. A well trained and experienced interviewer would handle it effectively and efficiently.

In this respect, we may give another measure, which is very useful, by which the performance of interviewers can be compared and evaluated. This is the contact rate (k) given below:

$$K = \frac{\text{No. of eligible sample units contacted}}{\text{Total no. of eligible sample units approached}}$$

It can be seen that a high contact rate would show the effectiveness of the interviewer. On the basis of contact rate interviewers can be compared. In those cases where this rate is low, interviewers may be asked about it. Again, this will enable the researcher to take some remedial measures.

REFUSALS

In almost every research study based on interviews, there will be some respondents who refuse to participate. Here, one may find that certain types of people may be unwilling to answer the questions. For example, females, persons having lower incomes and retired and old people would be reluctant to cooperate in a survey. Further, very busy people or those who are extremely tired or sick too would normally refuse to participate. Even the subject of research may have some effect on the refusal rate. When the respondents are least interested in a subject of research or when highly sensitive information is being sought, there will be more refusals. There is yet another factor influencing the participation of respondents. This relates to the interviewer himself. If the interviewer approaches the respondent with pleasing manners and is articulate in explaining some points of the questionnaire including the significance of the research, then the respondent will be quite willing to participate.

INTERVIEWS FOR QUALITATIVE RESEARCH

So far the discussion was confined to formal interviewing involving direct questioning to get the necessary information from the respondents. However, there are certain problems or situations when direct questioning of respondents does not help the interviewer. Respondents are either unwilling to give the information sought or unable to provide it. In such cases, other techniques, which are generally referred to as qualitative research, are used. Qualitative research is mainly useful in understanding the consumer behaviour and attitudes. It probes rather than counts. As such it is impressionistic rather than conclusive. It comprises three major techniques—depth interviews, focus group interviews and projective techniques. A brief discussion of these techniques is given below.

Depth Interview

So far we have discussed the direct and structured interview. When an interview is held without the aid of a structured questionnaire, the interviewer has freedom in conducting it in the manner he desires. Such interviews are not subject to a well-defined and rigid procedure and are known as informal interviews. They are more appropriate in case of 'sensitive' issues which may require more probing.

> Largely as a result of the influence of clinical interviewing and anthropological field work, a varied assortment of interviews have been developed in which neither the exact questions the interviewer asks nor the responses the subject is permitted to make are predetermined. Such interviews take various forms and go under various names—the 'focused' interview, the 'clinical' interview, the 'depth' interview, the 'non-directive' interview, etc.[13]

When a researcher is interested in in-depth investigation of perceptions, attitudes or motivations of the respondents, a formal or structured interview will not be suitable. For this purpose, an unstructured interview, which is more flexible, is used. On account of this flexibility, such interviews enable the interviewer to bring out "the affective and value-laden aspects" of the respondent's answers. Such interviews are helpful in understanding the beliefs, feelings and attitudes of respondents in their personal and social contexts.

In depth interviewing,[14] a procedure similar to that used by a psychiatrist, is followed. A person trained in the techniques of probing conducts such an interview. He does not have a formal questionnaire with him. He asks such questions as are appropriate and in an order developed during the interview. He keenly observes and records subtle reactions of the respondent. The questions which centre around the product or problem involved are largely indirect.

The technique of depth interview has certain **advantages**. *First*, it is able to discover hidden motivations which really determine consumer behaviour. Through data obtained in depth interviewing, the interviewer may discover the strength of a new appeal. As a result of such a finding, an altogether different approach to marketing problems can be made. *Second*, depth interviewing may lead to the development of a motivational pattern with respect to a particular brand or other action under investigation. *Finally*, it provides a strong stimulus to the insight of the interviewer. It has been noticed that the major contribution in marketing research has been made by the 'clinical insight' of the researchers using this technique rather than by those conducting structured interviews.

As against the foregoing strengths of the depth interviewing, it has certain **weaknesses** or **limitations**. *First*, it does not provide a systematic structure for interpretation of the information obtained. *Second*, the information obtained is non-quantifiable and is based on human judgement. There is thus too much of subjectivity. This means that different results will be obtained by different people even though the situation is the same. *Finally*, it needs far more vigilance and training on the part of the interviewer, since depth interviews are normally conducted by untrained and incompetent interviewers. This may give rise to several inaccuracies in the information obtained.

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[13] Selltiz, Claire, et al., *Research Methods in Social Relations*, London, Methuen and Company Ltd., 1962, p. 263.

[14] The discussion that follows is based on Brown, Lyndon O., "Principal Psychological Techniques in Motivational Research" in *Motivation and Market Behaviour*, (Eds: Robert Ferber and Hugh G. Wales), Homewood, Illinois, Richard D. Irwin, Inc., 1958, pp. 76–88.

Focus-Group Interviewing

***Concept*:**[15] In the focus group interviewing method, the interviewer collects a small number of representative consumers for discussion on a particular subject. The optimal size of a focus group is usually taken to be about eight people. Any number less than this is insufficient for the focus group. On the other hand, if the number is say, 10 or 12, it is regarded as too large. The larger the size of the group, the longer people have to wait for their turn.

Generally, the group selected is a relatively homogeneous one so that a meaningful discussion can take place. On the other hand it may be preferable to form a varied group so that diverse views on a particular topic are expressed. This will depend largely on the nature of the research problem.

Groups are formed in a number of ways. Sometimes telephone screening is used. Field workers may scout around in the neighbourhood for persons conforming to their requirements. Certain organisations, especially in the advanced Western countries, may have names and addresses of respondents conforming to certain characteristics, in their records.

Conducting the Interview

There is no one best way to conduct a focus interview. Sometimes a trained psychologist experienced in group interviewing techniques is approached to act as the discussion leader or moderator. Many a time, group interviews are conducted by persons who have gained considerable experience in handling such interviews though they may not be well-versed with the literature on successful discussion techniques.

To start a group interview in a reasonably sound manner, it is desirable that the moderator first explains the subject for discussion in his own words. He should initiate the discussion and allow the group interview to proceed spontaneously, without any intervention. However, when he feels that the group discussion has digressed from its theme, he should intervene and bring it back on the track. He may introduce certain stimuli, such as products, packages, pictures or advertisements, which may stimulate members of the group to participate in the discussion more actively. As has been observed:

> "The moderator is like a conductor, orchestrating an improvisation. The task calls for adeptness and awareness of what is going on, what people are doing and feeling. It means giving everyone a chance without taking dull roll calls."[16]

The entire group discussion is recorded on a tape recorder. Several groups are formed and the same procedure is followed in each case. Comparisons of discussions of these groups may enable the interviewer to get new ''insights'' into the subject discussed.

Advantages of Focus-Group Interviewing[17]

Following are a number of advantages of focus-group interviewing.

1. Group interview studies are often fast and cheap, A study based on three or four group interviews can be conducted in a very short period. When the researcher is subjected to time and cost constraints, group interviewing is especially useful.

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[15] Levy, Sidney J., "Focus Group Interviewing" in *Focus Group Interviews: A Reader* (Eds: James B. Higginbotham and Meith K. Cox), Chicago, American Marketing Association, 1979, pp. 34–42.

[16] Ibid.

[17] Based on Wells, William D.: "Group Interviewing" in *Handbook of Marketing Research*, pp. 2–133 to 2–135.

2. The group interview technique is appropriate for generating hypotheses more so in cases when the available information is scanty. This may be helpful to the researcher when other sources are inadequate to stimulate his thinking. Such interviews are regarded as "highly productive idea breeders."
3. This technique brings the respondent who supplies information and the client who uses it closer.
4. This technique is quite flexible, which is not the case when a structured questionnaire is used. Here, the interviewer listens, thinks, probes, explores, framing hunches and ideas as he proceeds. He is not an automatic, mechanical, wind-up questioner as a survey interviewer is.[18]
5. The group interviewing technique, like the individual depth interviewing, is appropriate to handle contingencies.
6. Respondents in a group interview stimulate one another. There is an interaction of ideas, attitudes, emotions and beliefs of the different members comprising the group. As a result of this interaction, the threshold for personal revelations is lowered in the focus-group interview. Also, interaction widens the base of discussion—many more ideas emerge than would be possible in the depth interview involving only two persons.
7. Finally, a group interview study often gives its findings not in the "form of mysterious symbols and dull tables" but in direct quotations in which people give their views at length. Thus, its findings emerge in a form which is fully understandable to the clients.

Disadvantages and Misuses of Focus-Group Interviewing[19]

1. Some of the advantages of the focus group technique also lead to misuses. *For example*, this technique may be used by a manager to support his pre-conceived notions.
2. The technique is used for too many things. It does not indicate how extensive the attitudes expressed by the participants are. The necessary follow-up using quantitative research is generally not conducted.
3. The data are not at all projectable. This is because the sample is generally inadequate and drawn purely on the basis of convenience.
4. Much of the results depend on the moderator. He has his own biases and limitations and the things that impress him may or may not be typical.
5. Another difficulty in focus-group interviewing is with respect to the recruitment of participants. This problem would arise when a large number of groups are to be formed.

Use of Projective Methods in Interviewing

Sometimes, to provide a stimulus to help generate a discussion in informal interviewing, certain projective methods are used. Such techniques are based on the principle of confronting an individual with a purposely ambiguous situation which he must interpret. The ambiguous situation may just be a word, an incomplete sentence, or a picture.[20] *For example*, when a respondent is shown a series

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[18] Ibid.

[19] Based on Bellenger, Danny N., Kenneth L. Bernhardt and Joe L. Goldstrucker: "Qualitative Research Techniques: Focus Group Interviews" in *Focus Group Interviews: A Reader*, (Eds: B. Higginbotham and Meith K. Cox), Chicago, American Marketing Association, 1979, pp. 13–33.

[20] Brown, Lyndon O., op. cit., pp. 76–85.

of pictures with ambiguous situations, he is supposed to invent a story which explains the pictures. The purpose of using such a projective method is to remove the inhibitions of the respondent as he thinks and answers in terms of other people rather than himself.

Such methods were first devised by psychologists and psychiatrists concerned with the diagnosis and treatment of patients suffering from emotional disorders. They are used to find a comprehensive picture of the individual's personality structure, his emotional needs, his conflicts, etc.[21]

Projective Techniques

Projective techniques provide either verbal or visual stimuli with the objective to encourage the respondent to reveal his hidden feelings and attitudes without his being aware of doing so. There are a number of projective techniques. Here, only a few of them are briefly discussed.

Word Association Test

This test is sometimes called free word association test. In this test, the respondent is given a single word and asked to say whatever words come to his mind without any delay. The respondent is given a series of words, one after the other, and his immediate reaction is sought. It is believed that such a test provokes the respondent to come out with a meaningful response.

Responses can be classified in more than one way: (i) on the basis of frequency with which a particular word has been given as a response; (ii) on the basis of the interval of time before response is made (hesitation); and (iii) on the basis of failure of respondents to come out with any response (blocking). Word association tests are particularly useful in selecting brand names and in advertising to ascertain its effectiveness. In the latter case, a test is given to the same panel of consumers both before and after an advertisement.

Sentence Completion Test

Sentence completion test is similar to the word association test. The respondent is subjected to some pressure to give spontaneous replies. It is believed that it would reveal attitudes which otherwise respondents may be reluctant to disclose.

Sentence completion test, as the name implies, involves the use of an incomplete sentence which the respondent is asked to complete immediately. The sentence should be short and simple so that the response may also be in a few words. While some respondents may be in a position to give considered replies even in the shortest possible time, the sentence completion tests are considered to be quite reliable and, as such, they are frequently used in marketing research.

Thematic Apperception Test (TAT)

Thematic apperception test consists of 30 pictures plus one blank card. The maximum number of pictures used with any respondent is 20, usually administered in two sessions, ten each time.

Before using the TAT, the respondent is told that the test is of imagination and that there is no right or wrong response. The pictures are shown to the respondent one at a time and he is asked (i) to describe what is happening and the feelings of characters shown in the picture; (ii) to tell what he feels has led up the scene; and (iii) to tell what the outcome will be. The test assumes that the

[21] Sellitz, Claire, et al., *op. cit.*, p. 281.

responses to these questions based upon ambiguous pictures reveal personal feelings and experiences of the respondent. Interpretation of TAT should be done by experienced specialists in this line.

Story Completion Test

This test is a logical development of the sentence completion test. Here, the respondent is given the opening sentence or sentences describing a certain situation. He is asked to narrate the story as he imagines. It is believed that the respondent while developing the story gives out his own psychological reactions.

Cartoons (Blank Balloons)

Another device that is used in projective techniques is the cartoon or blank balloon. It involves the use of a cartoon showing two persons talking in a particular setting. The comments of one person are shown in a speech balloon while the other speech balloon pertaining to the second person is kept empty. The respondent is asked to give the reply the second person would have given. Since the respondent thinks that he is a different person not involved in the cartoon, he would not feel any hesitation in giving out his reaction to that situation. He might give his own reaction without being aware that he is doing so. It may be noted that responses in such tests should be confined to a few words. These tests are used in a number of marketing problems such as packaging, quality of services, etc.

Advantages and Disadvantages of Projective Techniques

After having described different types of projective techniques, we now turn to their advantages and disadvantages.

Advantages

A major advantage of projective techniques is that they can help to uncover information not available through direct questioning. Even in focus groups and depth interviews, respondents may be unwilling to respond, especially if they know the purpose of the study. In such situations, projective techniques are able to elicit responses.

Another advantage of projective techniques is that they can be extremely helpful in the beginning of a research study when the researcher is not clear as to how be should proceed. It is in such exploratory stages of research, projective techniques can help him in getting new ideas for further perusal. In this way, these techniques can help him in generating hypotheses for further testing.

The results of projective techniques can also be used directly for decision making. However, on account of being complex, such techniques should not be used naively.

Disadvantages

These are a number of disadvantages of projective techniques. To begin with, as they are highly complex, they require highly trained interviewers and interpreters. As a result, studies based on projective techniques are very expensive. This means that the sample size has to be restricted. In view of this, sampling error is likely to be substantial.

Further, non-response in projective techniques may be more serious as compared to depth interviews. Some of the projective techniques require the respondents to engage in behaviour that may be very strange to them. This is particularly true in respect of role playing.

Another disadvantage of projective techniques is that it may suffer from the interpreter bias. The responses to all except the word association techniques are open ended. Different interpreters may reach different conclusions pertaining the same response.

In view of these disadvantages, responses need to be edited, coded and tabulated with great care. This suggests that projective techniques are more suitable for exploratory research as compared to descriptive or causal research.

While concluding our discussion on projective techniques, it may be mentioned that despite criticism on account of their subjectivity in interpretation, they are now increasingly being used in marketing research. With the help of various projective techniques, it should be possible to study people's motives, emotions, values, attitudes, and needs by somehow getting them to project these internal states on to external objects. This potent idea is behind projective devices of all kinds.

Kerlinger further goes on to say that one of the basic principles of projective techniques is that the more unstructured and ambiguous a stimulus, the more a subject is expected to project his emotions, needs, motives, attitudes, and values.

No doubt, they are the most imaginative and significant tools in psychology, but on account of their lack of objectivity, people have questioned whether they should be used in scientific research. However, a detailed discussion of projective techniques is beyond the scope of this book.

Summary

An important aspect of the field survey is interviewing. It is one of the most difficult tasks in marketing research. The chapter has specified the conditions for a successful interview. This is followed by a discussion on the interviewer's task which consists of four aspects: (i) locating sample members, (ii) obtaining interviews, (iii) asking questions, and (iv) recording the responses.

As there are likely to be certain errors in interviewing, sources of such errors have been identified. It has been emphasised that the best way to reduce the interviewer's bias is through improvement of interviewer selection, training, supervision and by increasing the respondent's motivation to cooperate. All these aspects have been discussed in detail.

This is followed by a discussion on 'non-response' errors which are caused by two factors: (1) respondents who are not-at-home and (2) respondents who refuse to participate. In this connection, response rate and contact rate have been discussed. There is a brief discussion on how non-response errors can be reduced, emphasising the training, experience and skill of the interviewer.

Subsequently, the chapter enters the realm of qualitative research. Here the concepts of depth interview and focus group interview along with their advantages and disadvantages have been dealt with. Finally, a number of projective techniques used in qualitative research have been described.

Key Terms and Concepts

Questions

1. What conditions are necessary for a successful interview?
2. What are the different aspects of the interviewer's task?
3. If you have to conduct interviews in a field survey, describe how you would establish a rapport with respondents.
4. "The interviewer's function is neither that of an educator nor of a missionary, but that of an impartial observer of public opinion as he finds it." Comment.
5. What is meant by interviewing errors?
6. In which of the two interviews—personal or telephonic, is the interviewer bias more serious? How can it be reduced in these two types of interviews?
7. What tasks is a supervisor supposed to perform?
8. What methods would you use to minimise interview cheating?
9. What is an informal interview?
10. When is an informal interview necessary?
11. What is a depth interview?
12. What is a focus - group interview?
13. What are the advantages and disadvantages of a focus - group interview?
14. What projective methods are used in interviewing?
15. Suppose that the response rate in a mail survey is extremely poor. What steps would you take to improve it?
16. "The success of an interview depends on the way an interview is conducted." Comment.
17. How would you measure response rate for personal interviews?
18. How would you deal with 'not-at-homes' and 'refusals' in a survey?

CASE STUDY 1

HEALTHCARE COMPANY

A healthcare company was set up in 2003 in Navi Mumbai with a view to provide quality medical service to the residents at an affordable price. Having completed over two years of its existence, the management wants to have a feedback from those who have availed its services. The purpose of seeking such a feedback is to know shortcomings in its various activities so that necessary corrective steps can be taken.

It would like to have the opinion of the patients under each of the following:

(a) Accessibility
(b) Service Orientation
(c) Doctors
(d) Nurses and Technicians
(e) Room-Usage Experience
(f) General

Questions

Assume that the company has approached you for this exercise and you are asked to prepare a questionnaire covering the different medical services mentioned above.

1. Which type of scale would be most appropriate here? Design the questionnaire in conformity with the scale that you would use.
2. Which survey method would you choose? Justify your choice.

CASE STUDY 2

A FIVE-STAR HOTEL

The management of a leading Five-Star Hotel in Delhi is keen to know how its customers view its services so that necessary improvements can be made. It has designed the following questionnaire which is handed over to persons while leaving the hotel with the request that it should be filled in and mailed to the management promptly.

Questionnaire

	Strongly agree	Agree	Disagree	Strongly disagree	Don't know
1. The hotel staff is courteous.					
2. The hotel is kept very clean and tidy.					
3. The food served is of good quality.					
4. Variety of food is readily available.					
5. Good quality drinks too are available.					
6. The dining hall is well arranged with comfortable seats.					
7. In case of a query from patrons, it is immediately attended to.					
8. Toilets are clean and tidy.					
9. Facility for table reservation is promptly available.					
10. The parking space for vehicles is adequate.					

Questions

1. Do you think that the method used for acquiring information from patrons is appropriate? Why or why not?
2. What type of scale is this?
3. Are there any gaps in the information sought? If so, specify.
4. How would you overcome the problem of non-response?

CASE STUDY 3

A CONSUMER PANEL STUDY

Some time back, a study was done on the market media by the consumer panel. The details of the methodology used by it are given below.

1. The chosen method involved paper diaries to be filled in by housewives on product purchasing, TV viewing and cinema-going.
2. The panel sample of middle-upper class housewives was confined to the four metropolitan cities, viz. Mumbai, Kolkata, Delhi and Chennai, regarded as the key areas for advertising and marketing of branded products. Over 750 housewives were recruited in each of the four cities, making a total reporting sample of 3000.
3. Prior to recruitment, an establishment survey of 5000 households in each city was set up to determine the household characteristics on which to base the panel. The panel was then matched with the universe in terms of household income and age of the housewife.
4. The purchase diary covered approximately 25 product fields. The media diary covered TV viewing of the housewife on a 15-minute basis on the two national channels and cinema going.

Questions

1. Critically examine the methodology of the above case study.
2. How would you ensure the maintenance of panel continuity?
3. What, in general, are the major limitations of a panel study?

CASE STUDY 4

THE CAR MARKET

The Indian passenger car market has been growing very fast. Several new models have already come in the market and quite a few are expected to be introduced shortly. While this shows that there is a lot of potential for the passenger car market, the car manufacturer is seldom fully aware of the extent of satisfaction of car owners.

An existing car manufacturing company is, therefore, interested to know the profile of the car owners, the types of cars owned by them and the level of their satisfaction with the cars they use presently.

Questions

1. Discuss the concept of 'consumer satisfaction'.
2. Identify the parameters that should be relevant in ascertaining its level.
3. Having selected the parameters, how would you arrive at an 'overall' level of consumer satisfaction?

CASE STUDY 5

LIFE STYLE OF INDIAN YOUTH

On account of educational advancement, increasing popularity of television and changing business environment, Indian youth, especially in urban areas, seem to be more informed as to what is happening around them as compared to youth in the countryside. They are no longer passive and docile as earlier. In many cases, they play a major role in deciding what to purchase for the family.

Thinking that as the Indian youth are now quite assertive and confident, having their say in market almost always, *Descent Wear*, a company having a chain of retail outlets in major cities of the country, wants to know about their life style. *Descent Wear* wants to sponsor a survey covering Delhi and Mumbai. The objective of the survey is to know more about the educational level, career preferences, participation in games and cultural activities, relationship with parents and teachers, pocket money and TV viewing of Indian youth.

Questions

1. Develop an itemized scale covering a good number of items. Apart from developing the scale, indicate what sample design and sample size you would take.
2. How would you analyse the data and arrive at an overall life style with the break-up into properly specified categories?
3. Do you think that the survey should be confined to retail outlets of Descent Wear? Why or why not?

CASE STUDY 6

WELCOMGROUP HOTELS

The Welcomgroup owns a chain of 20 hotels located in different parts of the country. In recent years, it has been expanding the chain by setting up new hotels.

When there were only a few hotels, the Managing Director of the Welcomgroup used to personally visit them with a view to ensuring that they provided high quality food and service to their patrons. But now he finds that with so many hotels it is extremely difficult to personally visit each and every hotel. At the same time, he needs some mechanism to ensure that hotels of the chain continue to provide high quality service.

The Managing Director has discussed this problem with some senior officials of the company. As a result of this discussion, he feels that:

Option 1: A suitable questionnaire may be designed and the same may be given to guests during their stay in the hotels. They may be requested to return the filled-in questionnaire at the reception counter while leaving the hotels.

Option 2: A suitable questionnaire may be designed and the same may be posted to their homes soon after they have reached there with the request that these be returned, duly filled in, by post.

Option 3: A trained interviewer may be appointed on a temporary basis. He could visit different hotels without giving any prior intimation of his visits. In each hotel he visits, he may personally interview selected guests and seek their opinion on the quality of food and service in that hotel and their suggestions, if any, for improvement.

Option 4: The services of a marketing research firm may be hired. It may be asked to conduct a suitable study based on, say, telephone interviews of a random sample of guests from each hotel and to submit its report to the Managing Director.

Question

Discuss the relative merits of these options. Indicate which one you would adopt if you were the Managing Director.

CASE STUDY 7

CONSUMER SATISFACTION

A company is engaged in the manufacture of washing machines and a few other products. But, the former accounts for a sizeable proportion of its total production. Of late, the company has been finding it increasingly difficult to maintain its competitiveness on account of the availability of washing machines of a number of companies within the affordable price range. There are 17 brands which together are offering 88 models.

The top management of this company has considered the problem of increasing competition and declining sales. It is of the opinion that a survey should be conducted to ascertain the customer satisfaction in respect of its washing machines. However, before undertaking a detailed survey, it would like to be clear on the concept of consumer satisfaction.

Questions

1. How would you identify parameters which can effectively measure consumer satisfaction?
2. Construct a suitable scale using the parameters identified in Question 1.

CASE STUDY 8

ATTITUDE TOWARDS ADVERTISING

You have been asked to ascertain the attitude of people towards advertising, whether favourable or unfavourable, in the medium-sized city where you live. The study should indicate whether heterogeneous groups differ significantly or otherwise in their attitudes towards advertising.

The proposed study has to be carried out in two parts. Part I will involve the construction of a suitable scale for measuring attitudes of people. Part II will examine some hypotheses and conclude whether they are accepted or rejected. The hypotheses will concern the differences in attitude of the two groups towards advertising. For this purpose, you may think of groups in terms of male and female, young and old, educated and uneducated, and rich and poor.

Questions

1. What type of study is this?
2. How would you develop a suitable scale for the proposed study?
3. Which scale would be most appropriate and why?
4. What would be the limitations of such a study?

CASE STUDY 9

A THREE-STAR HOTEL

A three-star hotel located in Delhi has been experiencing a decline in its occupancy during the past one year. The management has recently reviewed the problem and is seriously considering to attract business executives as also to provide adequate facilities for holding business conferences, workshops, etc.

Since this would involve some renovation of the existing building in addition to new furniture and equipment, the management wants to be cautious in undertaking such an expenditure.

Since its inception several years ago, the hotel has been maintaining a complete record of its guests. When a person visits the hotel for the first time, details such as his name, age, sex, permanent address, purpose of visit and duration of stay along with dates are entered on a card. All subsequent visits along with the duration of stay are dated and recorded on the same card.

The guest file has expanded tremendously containing over 8000 cards. The management wants to make use of this readily available information along with any additional information necessary in this regard.

Questions

Assuming that the management has entrusted you with this job, answer the following questions:

1. Specify the statistical universe implicit in the management's choice of the sample.
2. If a sample is to be drawn from the guest file, describe the procedure you would adopt in each of the following sample designs:
   (i) Simple random sampling
   (ii) Systematic random sampling
   (iii) Stratified random sampling
   (iv) Cluster sampling
3. Which one of these sampling designs would you select and why?
4. Specify the nature of data that you would collect from the sample respondents.

CASE STUDY 10

OPENING A GYM

Shri Nath has just retired from the Government of India's service. All through his life, he was very particular about his health. He used to devote at least one hour every morning on physical exercises which included a set of acrobic exercises as well as some selected yogic aasans and pranayam.

Soon after his retirement, Shri Nath thought to take up some activity which would keep him engaged and, at the same time, give him some additional income.

This apart, he wanted to take up such an activity which would be useful to the society. After a good deal of serious thinking, Shri Nath finally decided to set up a gymnasium in Jaipur where he had been living for the past two decades.

Before setting up the gym, Shri Nath would have to be very clear about the place for the gym, people who would like to use this facility and other related issues. He has decided to seek professional advice in this regard.

Question

Shri Nath has approached you being a marketing researcher, to provide him with the required information. You have decided to conduct a survey. Prepare a sampling plan. Be sure to designate a population definition, a sampling frame, a sampling procedure and a method for determining the accuracy of the results.

CASE STUDY 11

A SURVEY OF SHOPPERS

A huge Departmental Store was set up in Jaipur about a year ago. The proprietor of this store wanted to know about the shoppers. For this purpose, he decided to conduct a survey of shoppers. He sought the assistance of a marketing research agency which developed a questionnaire as given below.

SHOPPERS' SURVEY

This questionnaire has been designed to collect useful information to serve you better. You are requested to cooperate with us. Please fill in the questionnaire and hand it over to the Manager of this store. Thank you for your cooperation.

1. Male _______ Female.
2. Age
3. Address __________________
   ____
   ____
4. Annual Income
5. How often do you visit here?
   Weekly ______ Monthly ______
6. Do you shop on some special occasions? If yes, specify them.
7. Do you enjoy shopping here?
   Yes ______ No ______
8. Do you get all things here that you require?
   Yes ______ No ______
9. How do you find the staff working in the Store?
   Extremely helpful ____ Quite helpful ____ Somewhat helpful ____ Not so helpful ____ Not at all helpful ____.
10. In general, how much time you spend per shopping trip?
11. In case you have any suggestion to make, please feel free to write it below:
    ____
    ____
    ____

Questions

1. What response errors may arise if this questionnaire is used?
2. Evaluate this survey and the questionnaire used as decisional research.
3. Improve upon this questionnaire to obtain better and more information about the shoppers' behaviour.

CASE STUDY 12

ATM SERVICE

A public sector bank started the ATM service to its customers a couple of years ago. The bank is not satisfied with the volume of business that was being done through ATM.

In this connection, the bank is interested to know:

1. Were the customers not sufficiently familiar with the ATM service?
2. Was the ATM service not properly promoted to the existing customers?
3. Did the bank not care to attract new customers
4. Had the bank failed to top the right people among the existing customers or the prospective customers?
5. Was the attractiveness of the ATM service over estimated?

In order to seek proper answer to each of the above questions, the bank decided to conduct a general purpose survey, which should give information on the following:

1. Demographic characteristics of the ATM card users.
2. Their usage habits with the cards.
3. Their attitude about the ATM cards and the system.
4. Any other suggestion that the ATM card holders may like to make.

Questions:

1. Design a questionnaire to collect the above information.
2. Which one of the following sample designs you would choose and why?
   Simple random sampling, stratified sampling, systematic sampling and quota sampling.
3. Do you think that the information to be received from the survey would cover all the four points mentioned above?

CASE STUDY 13

COSMETICS (INDIA) LIMITED*

Cosmetics (India) Limited is a company manufacturing several cosmetic products. It is interested to know the attitude of consumers towards cosmetic products in general and its own products in particular. In addition, it would like to know the amount of expenditure incurred on different items of cosmetics by households. It feels that such information would be extremely helpful in improving its existing products as also in bringing new products into the market.

The marketing manager of Cosmetics (India) Limited has approached you to help him in the preparation of a sampling plan in this connection.

Question

Prepare a sampling plan. You should ensure that it (a) specifies a population, (b) indicates a sampling frame, (c) describes a sampling procedure, and (d) explains a method for ascertaining how accurate the survey results are.

* Adapted from case 3-2 in Kinnear, Thomas C. and James R. Taylor, *Marketing Research-An Applied Approach*, Singapore, McGraw-Hill Book Company, 1983, p. 279.

CASE STUDY 14

SURVEY OF GRADUATING MANAGEMENT STUDENTS*

A management institute was set up five years ago. The Institute is a part of Rajasthan University, Jaipur. It provides a two-year full-time management course and at present its intake is of 50 students in the first year programme.

The Director of the Institute wants to know how the students who have completed their MBA study, feel about the institute, for this purpose, the institute has designed a questionnaire (given below).

Questionnaire

Please respond to the following statements on a five-point scale.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
(1)	(2)	(3)	(4)	(5)

Classes/Curriculum

1. I was satisfied with the papers covered in the MBA programme.
2. There was too much emphasis on theory, and practical aspects were hardly covered.
3. The quality of Teaching was good.
4. The material given to the students pertaining to their respective subjects was relevant and sufficient.
5. Participation in the group discussion was always encouraged.
6. There were sufficient options available to select electives.

Faculty

1. On the whole, the Institute has good teachers.
2. Whenever there is any difficulty, teachers were easily available to students outside the class.
3. Teachers were very good in communication and lectured with absorbing interest.
4. Too much emphasis was given on research rather than on the prescribed course of study.
5. The Institute always considered the evaluation forms filled by students and made changes, if necessary.
6. There was good interaction between the faculty and the students.

Library

1. The library is well-equipped with management books written by Indian and foreign authors.

* Adapted from Gilbert A. Churchill, Jr. and Dawn Iacobucci, *Marketing Research*, Thomson Asia Pte. Ltd., Singapore, 2004. Case 3.6, pp: 435–441.

2. A large number of magazine and periodicals are subscribed by the Institute.
3. Apart from management books and periodicals, there are popular books and periodicals of general interest.
4. The library staff is very cooperative and helpful to students.
5. The library remains open for long hours so that students may use it as per their convenience.

Computer Lab

1. The Institute has sufficient number of computers.
2. Students are encouraged to have their own Laptops at concessional rates.
3. The Computer Lab Incharge is very helpful when some problem is referred to him.

Placement of Students

1. The Institute has a full-time Placement Officer.
2. The number of companies visiting the Institute to hold campus interviews is gradually increasing each year.
3. All the graduating MBA students get placement.
4. Some students have more than one offer of job.
5. Placement officer is active and has good rapport with several companies.
6. Some students always turn down the job offer and prefer to start their own business.

Physical Facilities

1. The Institute seems to be in need of more spacious accommodation.
2. Classrooms have fans and are well ventilated.
3. There are also two seminar/conference rooms.
4. Adequate facilities are available in students' canteen.
5. A variety of items are available in the canteen.
6. The existing common room for students is too crowded.

You can use the space below to write on any aspect of management education that has not been covered above.

____
____
____
____

Others

Your name
Age
Have you already accepted a position?
Are you still in the process of interviewing?
Are you thinking of starting your own enterprise?
Are you interested to take up some research for a higher degree?
Are you interested to take up a teaching position?

Questions

1. Considering customer satisfaction as it applies to an academic institution, are there some other areas that may contribute to students' satisfaction with their education experience?
2. Can you suggest certain changes in the questionnaire so that the Management Institute is better equipped to target suitable areas? Identify such changes.
3. The questionnaire does not contain an open-ended question on strengths and weaknesses of the Institute. Should there be such an open-ended question?
   What, in general, are the advantages and disadvantages of open-ended questions?

CASE STUDY 15

DOCTORS' SATISFACTION SURVEY

A leading hospital located in Delhi is interested to know what the doctors feel about the quality of services available in the hospital. For this purpose, the Administration has designed a questionnaire. Doctors are requested to fill in the questionnaire assuring them their individual responses will not be seen by the Administration. It is only the collective responses will be looked into to ascertain areas where improvement is needed.

The Questionnaire

You are asked to respond each item on a 5-point scale: Highly satisfied (1), Satisfied (2), Somewhat satisfied (3), Not satisfied (4) and Not at all satisfied (5). Your responses should be in terms of 1, 2, 3, 4, or 5.

A. Operational/Clinical Areas

1. Inpatient Admitting.

a. Scheduling
b. Room assignments
c. Staff performance

2. Surgery/operating room

a. Scheduling
b. Anesthesia services
c. Staff performance

3. Radiology Department

a. Quality of services
b. Technologists' Support

B. Other Clinical Areas and Departments

1. Respiratory Care
2. Pharmacy
3. Inpatient Rehabilitation
4. Medical Records
5. Maternity
6. Dietatics

C. Administration

1. Hospital administration is interested in and receptive to the needs of the Medical Staff.
2. Receptive to the needs of Nursing Staff.
3. Adequate communication between the Administration Department & Medical Staff.
4. Private practice of doctors is allowed.

D. Opinion and Suggestions

1. What is the single greatest weakness of this hospital?
2. What is the single greatest strength of this hospital?
3. What suggestions you would make to improve your satisfaction with the hospital?

Questions

1. Evaluate the questionnaire suggesting improvements where necessary.
2. Do you think that personal administration of the questionnaires is called for in this study, or would you suggest any alternative method?
   Why or why not?

3

Data Processing Analysis and Reporting

14 Data Processing, Analysis and Estimation

Learning Objectives

After reading this chapter, you should be able to understand:

- Editing
- Coding
- Tabulation
- Computer Processing of Data
- Measures of Central Tendency
- Measures of Dispersion
- Estimation
- Finite Correction Factor

Once the data have been collected, the researcher has to process, analyse and interpret the same. In Chapter 8, it was emphasised that the researcher should exercise good care to ensure that reliable data are collected. All this effort, however, will be in vain if the collected data are not properly processed and analysed. Sufficient attention is often not given to these aspects, with the result that the quality of the report suffers. It is desirable to have a well thought out framework for the processing and analysis of data prior to their collection. Dummy tables should be prepared in order to illustrate the nature and extent of tabulation as also the comparisons of data that will be undertaken. At the same time, it may be noted that certain changes in such a framework may become necessary at a later stage. The researcher should not hesitate to introduce such changes as may be necessary to improve the quality of tabulation and analysis of data.

EDITING

The first task in data processing is the editing. It is the process by which data are prepared for subsequent coding. As it is a very subjective process, it is necessary that persons who are well-qualified and trained in the job of editing, should alone be entrusted with this responsibility.

Editing is the process of examining errors and omissions in the collected data and making necessary corrections in the same. This is desirable when there is some inconsistency in the response or responses as entered in the questionnaire or when it contains only a partial or a vague answer. A few examples will indicate how editing can be helpful.

1. The respondent has given answers which are inconsistent with each other. In such a case, the editor has to change one of the answers so as to make it consistent with the others. He has to use his judgement to decide which answer is correct so that the other one can be suitably changed.
2. The respondent has marked two answers instead of one for a particular question. In such a case, the editor has to carefully examine which of the two answers would be more accurate. Sometimes, when a decision cannot be made categorically, he may prefer to code 'no information' for that question.
3. The respondent has answered a question by checking one of the many possible categories contained in the questionnaire. In addition, the respondent has written some remarks in the margin. These remarks do not go well with the particular category marked by the respondent. The editor has to look into this and may have to change the category to better represent the remarks made by the respondent.
4. Sometimes the questionnaires contain imaginary and fictitious data. This may be due to cheating by the interviews who may fill in the entries in the questionnaire without actually interviewing the respondent. This may also happen in case of a mail questionnaire, where the respondent has given an arbitrary answer without exercising any care. If the responses indicate obvious inaccuracy, they may be either dropped or suitably modified if they are to be retained. The editor has to exercise his judgement in this regard.

In all cases where editorial corrections are to be made, it is necessary that these should be kept distinct from the changes made either by the respondent or by the interviewer. This can be ensured by the editor by using a different coloured pencil for editing the raw data.

Editing can be undertaken both at the time when the field survey is in progress and when it has been completed. In the former case, it is known as field editing. When the interviewer fills in the information at the time of the interview, he often uses several abbreviations due to the paucity of time. These need to be spelt out fully later. It is advisable for the interviewer to carefully look into the questionnaire at the earliest possible opportunity after the interview so that he can enter the proper responses or complete the partial answers.

Another type of editing is central editing, which is undertaken after the questionnaires have been received at the headquarters. As far as possible, a single editor should carry out this task so that consistency in editing can be ensured. However, in the case of large studies, this may not be physically possible. When two or more editors are entrusted with the task of editing, it is necessary that they are given uniform guidelines so that maximum possible consistency in their approaches can be attained. An alternative way would be to split the entire task into two or more parts so that each part of the work can be looked after by one single editor. In such a case, chances of inconsistencies pertaining to the responses of a particular part can be almost fully avoided.

An editor should be well-versed with the editing of questionnaires. It may be emphasised that editing a manuscript is different from the editing of a questionnaire or numeric data. People who are good at editing descriptive material may not be able to edit numeric data satisfactorily. Persons who are quite efficient in detecting flaws or errors in the data in just one glance should be entrusted with this job. Enumerators with long experience and having a special aptitude for editing of data should be given preference over others.

When the services of more than one editor are required, it is advisable to give each one explicit editing instructions in order to ensure consistency in the editing of data.

Before undertaking the coding, tabulating and analysis of responses contained in questionnaires, they should be checked for completeness, accuracy and uniformity.[1]

The first point to check is that questionnaires are complete and do not have any omissions or partial responses. Sometimes, the interviewer might have forgotten to record the answer. In such cases, it may be difficult to fill in the gap as the interviewer may be unable to recollect the answer given by the respondent. When several questions remain unanswered in a questionnaire, the whole questionnaire may have to be excluded. However, before doing so, all other alternatives should be exhausted and the questionnaire should be disposed of only if unavoidable.

The second point to check is that questionnaires contain accurate answers. The editor should look for inconsistent answers, which are sometimes so obvious that a little careful perusal may detect them. Such inconsistencies should be removed. Sometimes inaccuracies may be a result of the carelessness of the interviewer who may mark a wrong code or put the mark in such a way that it is not clear which of the two codes is intended. At times the respondent may give wrong or misleading answers deliberately. In all such cases the editor has to go over the answers carefully and try to remove the inconsistency in the best possible manner.

Finally, one should check whether the interviewers have interpreted questions and instructions uniformly. While going through the questionnaires filled in by different interviewers (or respondents in case of a mail questionnaire), the editor would be able to make out such inconsistencies.

In dealing with these three points—completeness, accuracy and uniformity, the editor should see that far too much time is not spent on trivial or relatively minor errors.

CODING

Coding is the procedure of classifying the answers to a question into meaningful categories. The symbols used to indicate these categories are called codes. Coding is necessary to carry out the subsequent operations of tabulating and analysing data. If coding is not done, it will not be possible to reduce a large number of heterogeneous responses into meaningful categories with the result that the analysis of data would be weak and ineffective, and without proper focus.

Coding involves **two steps**. The first step is to specify the different categories or classes into which the responses are to be classified. The second step is to allocate individual answers to different categories.

Code construction, as pointed out by Sidel,[2] is something of an art and the final categories reflect the tastes and interests of the individual researcher. All the same, it is desirable to follow some guidelines to ensure the utility and rationality of the code. One of the most important points in this respect is that the categories must be all inclusive and mutually exclusive. The 'all-inclusive' aspect can be taken care of by adding one or more such categories as 'other', 'no information' and 'none'. The other aspect is that categories must be 'mutually exclusive', i.e., they must not be overlapping and ambiguous. It should be possible to classify each response in one and only one category. However, this requirement, is often violated when more than one dimension is embodied

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[1] Based on Moser, C.A. and G. Kalton, *Survery Methods in Social Investigation*, London, Heinemann Educational Books Ltd., 1979, pp. 411–414.

[2] Sidel, Philip S., "Coding" in *Handbook of Marketing Research*, (Ed.: Robert Ferber) , *op. cit*., pp. 2–180.

in a single case.[3] To give an example, a person may, by occupation, be an industrial worker as well as unemployed. Here, two concepts or dimensions have been used. The first is the occupational category and the second is the current employment status. In such a case, there is apprehension that different categories or classes will not be mutually exclusive. It would, therefore, be advisable to use two category-sets, one for the occupations and the other for the current employment status.

There is no definite rule for the number of categories or classes that can be used. This will depend on the research problem as also the extent of analysis the researcher proposes to carry out.

In large surveys, where mostly structured questionnaires are used, the response categories are pre-determined and are contained in the questionnaires themselves. The categories are in the form of multiple-choice answers to the question. *For example*, the respondent may be asked: To which age group do you belong?: 15–30 years, 30–45 years, 45–60 years and 60+ years. Here, four distinct categories are indicated and the respondent is supposed to indicate by checking the category in which his age falls. It is obvious that in such a case the respondent himself chooses the category which is applicable to him.

The problem of coding is not so simple, especially in respect of an open-ended question. The response to such a question is in a descriptive form, in the words of the respondent himself. *For example*, the respondent may be asked—What is your opinion regarding the prohibition policy of the government? The respondent may give a lengthy answer indicating what he feels about this policy. In case of such responses, coding needs extra care in framing the possible categories in which various responses can be classified. Sometimes the interviewer himself decides the category in which a particular response to an open-ended question is to be included. He may first take down the entire response and then decide the category in which it should be included.

At times the questionnaires are wholly or partially pre-coded. The questionnaires contain a numeric code for each of the response categories.

Some examples of pre-coded questions are given below:

Questions	**Answers**	**Codes**
How often these days do you go to the cinema?	More than once a week	1
	Once a week	2
	Once a fortnight	3
	Once a month	4
	Three or four times a year	5
	Less often	6
	Never	7
Which type of wrist watch do you own?	Hand wound	1
	Automatic	2
	Electronic	3
Which of the following battery operated equipment	Torch	1
do you have in your family?	Transistor	2
	Others	3
	(specify)	

[3] *Ibid*., pp. 2–181.

A practice which is frequently followed is to edit and code the data simultaneously. These two operations are regarded as one operation which is looked after by one person. As has been rightly pointed out, although this may perhaps be the quickest and most efficient method, it may lead to the neglect of editing as the editor who is expected to code becomes just a coder.[4] In view of this, it may be advisable to get these jobs done by two persons. However, in such a case, coding by itself tends to be monotonous and boring but this perhaps cannot be helped.

TABULATION

Tabulation comprises sorting of the data into different categories and counting the number of cases that belong to each category. The simplest way to tabulate is to count the number of responses to one question. This is also called **univariate tabulation**. The analysis based on just one variable is obviously meagre. Where two or more variables are involved in tabulation, it is called **bivariate** or **multivariate tabulation**. In marketing research projects, generally both types of tabulation are used.

The tabulation may be done by hand or by machine or some part by hand and the other by machine. The number of tabulations will depend on the number of variables, while the number of responses to a question will depend on the sample size. If the number of variables in a survey is not large and the sample size is small, then tabulation by hand is preferable. On the other hand, when the number of variables involved is large as a result of which there may be several relationships and the sample size is large, it will be more appropriate to opt for machine tabulation.

Tabulation may be done by hand or by machine or some part by hand and the other by machine. The choice of the method of tabulation to be used depends on a number of factors such as the number of categories of data, the sample size, and the amount and kind of analysis to be performed. When a research study involves a small sample with a few categories and limited analysis, then hand tabulation is preferable. It would be a fast and less expensive method. In contrast, when the number of categories, the sample size, and the amount and complexity of analysis required increase, machine tabulation would be more appropriate.

In order to use machine tabulation, it is first necessary to translate data into machine language. Further, the data should be put in disks, magnetic tapes or paper tapes. No doubt, preparation of data for machine tabulation would be more costly and time-consuming. A major advantage of machine tabulation is that it provides more flexibility as well as more convenience in the manipulation of data. But these very benefits need that, careful planning prior to undertaking tabulation must have been done.

One-way Tabulation

A one-way table, from the first hand tally given earlier, is given as Table 14.1.

Table 14.1 shows both the absolute frequencies and the percentage of respondents. Although it may not be necessary to give percentages, it is a good practice to include them, as they facilitate comparisons. The researcher should ensure that percentage figures add up to 100. He has also to decide up to what decimal place percentages should be given. Generally, figures may be given to one decimal place. Rarely, if ever, do they need to be given to two decimal places. While such figures

[4] Casley, D.J. and D.A. Lury, *Data Collection in Developing Countries*, New York, Oxford University Press, 1982. p. 156.

would be more accurate, they would also be more confusing to the reader. The guiding principle in reporting percentages is that unless decimals serve a useful purpose, they should be avoided.

Sometimes only percentages are shown in the table and corresponding frequencies are omitted. In such cases, it is necessary to indicate the total number of cases on which the percentages are based.

Table 14.1 Movies seen by Sample Respondents

No. of movies seen per week	Number of respondents	Percentage of respondents
0	9	15
1	15	25
2	13	22
3	10	17
4	8	13
5	5	8
	60	100

Let us take an example to show how "Don't know" and "No answer" responses can be handled. The researcher can handle "don't know" responses in three differen ways:

1. "Don't knows" may be shown as separate catgory as in Table 14.2.
2. The researcher may allocate the "don't knows" among the other categories, proportionately. The assumption here is that "don't knows" are spread over in other categories in the same proportion as their responses other than "don't knows". This assumption may or may not be true.
3. The researcher may look into other information in the questionnaire where the "don't know" response has figured. At times, it may be possible for the researcher to infer from other information readily available with him or her. But this is not possible always.

Table 14.2 Percent of Respondents who Purchased Air Conditioners from Different Dealers

Dealer	Percentage of Respondents
A	22
B	18
C	12
D	15
E	7
All others	8
Don't know	18
	100
(Base 340 respondents)	

Cross Tabulation

It may often be necessary to tabulate responses to two or more questions simultaneously. Such tabulations are known as bivariate or multivariate tabulations, depending on whether two or more than two variables are involved.

In constructing cross classification tables, one has to first determine which data should be given primary emphasis and which should be given secondary emphasis. Data with primary emphasis are normally given in columns while those with secondary emphsis are shown in rows. This order is repeated for higher order table, i.e., those having three or more dimensions. This convention is almost invariably followed because it is easier to see data when figures follow one another in a column rather than in a row.

Table 14.3 is an example of cross-classification.

Table 14.3 Preference for Shopping Centres by Income Level of Households

Income Level	Shopping centres		Total no. of households
	A	B	
Up to Rs. 10000	100	200	300
Rs 10000 +	120	80	200
Total	220	280	500

Table 14.3 gives the break-up of respondent households, both by income level and by their preference for shopping centres. A table of this type is also known as contingency table. This is the simplest contingency table with two rows and two columns. The data contained in Table 14.3 pose an important question—Does the preference for shopping centres depend on the income level of houseolds? To answer this qustion, it is necessary to analysis the two variables simultaneously. Bivariate analysis is discussed in Chapter 16.

Data shown in Table 14.3 can be transformed into percentages and then these percentages alone can be shown or they can be shown side by side with the original data. The question in a two-way tabulation is: Which base should be used for 100 per cent, as the data may be percentaged in either direction? Percentages should be based on totals of rows or columns, whichever is relatively more important. One simple rule in this regard is the cause and effect rule. This rule states that the percentages should be computed in the direction of the causal factor.[5] Tables 14.4 and 14.5 give these data.

Table 14.4 Preference for Shopping Centres by Income Levels of Households (*Percentages*)

Income Level	Shopping Centres		Total
	A	B	
Up to Rs 10000	33	67	100
Rs 10000+	60	40	100

[5] For details *See* Zeisel, Hans, *Say it with Figures*, London, Routledge and Kegan Paul Ltd., 1958, p. 24.

Table 14.5 Income Levels and Preference for Shopping Centres (*Percentages*)

Income Level	Shopping Centres	
	A	B
Up to Rs 10000	45	71
Rs 10000 +	55	29
Total	100	100

In our example, income level appears to be the causative factor, which should influence the preference for shopping centres and not the other way round. Thus, the perentages should be computed in the direction of income level or across shopping centres. Table 14.4 presents these percentages and suggests that the choice of shopping centres is affected by the income level of households. This table indicates that 67 per cent of households in the lower income level prefer shopping centre *B* as against only 40 per cent of households in the higher income level. Further, 33 per cent of households in the lower income level prefer shopping centre *A* as compared to 60 per cent of households in the higher income level. It is apparent from Table 14.4 that there are marked differences in the choice of shopping centres on account of differences in household incomes.

Sometimes, the cause and effect rule leads to the conclusion that percentages might be computed in either direction. In such cases, the researcher has to use his discretion. It may also be noted that the cause and effect rule is not always applicable. It may be advisable in a particular problem to compute percentages in a certain direction, but the data might not permit the researcher to do this.[6]

While tabulating the data collected through qestionnaire, the researcher has to be careful in respect of some types of responses. Sometimes, the respondent has 'no answer' to a particular question or 'does not know' the answer. Such answers are even encountered in respect of dichotomous and multiple-choice questions. Such responses cannot be ignored. The researcher should include them in the tabulation. But before that, it should be ensured that these responses are coded in the normal manner.

Problem of Handling Multiple Responses to Multiple-Choice Questions

Sometimes, multiple-choice questions allow respondents to give more than one response. Here, the tabulation problem is very different from what we have discussed above. When there is more than one response to a question, the percentage of responses will not add to 100 per cent. Such responses can be handled in more than one way. The researcher has to look into this aspect carefully and come to a decision which seems to be most appropriate.

Percentages

It is known to everyone that the general purpose of using percentages is to serve as a relative measure. In other words, they are used to compare the relative size of two or more numbers. However, in using percentages, two problems generally arise: (1) In which direction the percentages should be computed? and (2) How the percentage change should be interpeted?

[6] Ibid., pp. 24–39.

Let us first focus on the first problem. Taking Table 14.3 which shows a two-way classification, the question is which base should be used for 100 per cent, as the data may be presented in either direction? Percentages should be based on totals of rows or columns, whichever is relatively more important. One simple rule in this regard is the cause and effect rule. This rule states that the percentages should be computed in the direction of the causal factor. Tables 14.4 and 14.5 give these data.

The second problem that arises while using percentages in cross tabulations is how to measure differences in percentages. There are mainly three ways for measuring percentage change. These are:

1. The absolute differences in percentages
2. The relative differences in percentages
3. The percentage of possible change in percentages

Let us illustrate this with the help of Table 14.6.

Table 14.6 Percentage Change

Persons	**Before**	**After**
Test group	30	55
Control group	20	35

There are two groups—test group and the control group. A company has launched a vigorous advertising campaign. Prior to the advertising campaign, the test group and the control group accounted for 30 per cent and 20 per cent of its total sales. After the advertising campaign, they accounted for 55 per cent and 35 per cent respectively.

(1) First, we find that the absolute differences in the test group ws 55 – 30 = 25 per cent as against control group 35 – 20 = 15 per cent.

(2) The relative difference in percentage was

Test group $[(55 - 30)/30] \times 100 = 83.3\%$

Control group $[(35 - 20)/20] \times 100 = 75.0\%$

(3) The percentage of possible change in percentages for the test group is computed by first noting that the maximum percentage point increase could have occurred is 100 – 30 = 70 points. The increase actually registered is 55 – 30 = 25 percentage points, or 100 (25/70) = 35.7% of the maximum possible. In the control group the corresponding figure would be 100 (15/80) = 18.75%.

It will be seen that in all the three methods, the test group has indicated a greater change as compared to the control group. However, in some cases one may find the results are not so much consistent.

It should also be evident that the absolute difference method is quite simple. The relative difference method may be misleading especially when the base for computing the percentage change is quite small. The percentage of possible difference is rather a complex method. However, in some studies, all the three methods are used as they emphasise different aspects of the relationship.

Bivariate cross tabulation is frequently used in marketing research to analyse variables at all levels of measurement. The following reasons* show why cross tabulation is so popular:

1. They provide a means of data display and analysis that is clearly interpretable even to the less statistically inclined researcher or manager.

* Lawrence F. Feick, "Analysing Marketing Research Data with Association Models", *Journal of Marketing Research*, 21, (November 1984), p. 376.

2. A series of bivariate tabulations provides insights into complex marketing phenomena that might be lost in a single multivariate analysis.

3. The clarity of interpretation affords a more readily constructed link between market research and market action.

4. Consideration of bivariate cross tabulations may lessen the problems of sparse cell values, which can plague the interpretation of discrete multivariate analysis.

The entities being cross-classified are often called units of association. Usually, they will be people, objects, or events. The cross-tabulation, at its simplest, consists of a simple count of the number of entities that fall into each of the possible categories of the corss-classification.

However, we usually want to do more than show the raw frequency data. At the very least, row or column percentages (or both) are usually computed. Indeed, most computerized tabulation programmes perform this step on a routine basis.

At times, one finds it difficult to know which is a causal factor or independent variable in a cross-tabulation. In other words, the relationship is not clear between the two variables. In such cases, introduction of third variable may bring out clarity in the relationship of the first two variables.

Another point to note is that, sometimes there is a temptation to run several cross-tabulations of variables that are not logically related. The researcher should avoid such spurious cross-tabulations. Further, if one thinks that some interesting relationship between a dependent and an independent variable is likely to emerge, it is advisable to use a chi-square analysis. This will clearly indicate whether the observed differences are statistically significant.

COMPUTER PROCESSING OF DATA

On account of the rapid use of computers in varied spheres it is said that human civilisation has entered the second industrial revolution. "The first industrial revolution freed man's muscles; the second is freeing his mind for more challenging pursuits."[7] However, processing of data by computers may not always be economically beneficial. It is, therefore, necessary to know when computers should be used.

In the processing of data, computers may be used most efficiently if the processing operations have one or more of the following characteristics.[8]

1. *Large Volume of Input*: When a large amount of data needs to be processed, computer processing may turn out to be more economical as compared to other methods of data processing.
2. *Repetition of Project*: When repetitive projects are undertaken by an organistion,the use of the computer for processing data is advisable. In such cases too, computer processing will generally be cheaper than its use in individual projects.
3. *Desired and Necessary Greater Speed in Processing*: When information is needed in a limited time, manual processing of data should be given up in favour of computer processing because of its unbeatable speed.

[7] Cutler, Donald I., Introduction to Computer Programming, Englewood Cliffs New Jersey, Prentice-Hall, Inc., 1964, p.7.

[8] Based on Sanders, Donald H., Computers in Business : An Introduction, Tokyo, McGraw-Hill Kogakusha Ltd., 1975 (International Student Edition), pp. 24-25.

4. *Desired and Necessary Greater Accuracy*: There are likely to be mistakes in data processing by manual methods. Computer processing will be more accurate provided sufficient care has been exercised in planning the task.
5. *Processing Comlexities that Require Electronic Help*: When a number of interacting variables are involved in the data, computer will be most appropriate. Certain analytical tools such as linear programming, business simulation, factor analysis and discriminant analysis generally require the use of a computer.

It may be pointed out that data processing is generally not given sufficient and advanced attention in research investigations. This results in poor quality of data and poor interpretation. It is desirable to have a careful planning regarding how data processing will be done, preferably at any early stage. In fact, the pre-testing of a questionnaire can be very helpful in detrmining the suitable code categories for the different responses. Designing of data forms is equally important.

It may be emphasised that data processing can turn out to be both time consuming and expensive if sufficient and timely attention is not given to its various aspects. Above all, sound common sense coupled with experience is needed in ensuring the processing of data accurately.

After the collected data have been processed, it is necessary that these data are analysed. As there are several statistical techniques available to do this, the researher has to decide which of them he will use. In fact, a decision in this respect is called for even before the data collection has begun so that those techniques can be used properly. We now discuss measures of central tendency.

MEASURES OF CENTRAL TENDENCY

The principal measures of central tendency are the arithmetic mean, the median and the mode.

The arithmetic mean should be used in case of intervalled or ratio-scaled data. It is obtained by adding all the observations and dividing the sum by the number of observations. In case of a frequency distribution, the arithmetic mean is obtained by the following steps: (i) the mid-point of each class interval or category is multiplied by the number of observations (called frequencies) in that class, ii)the resultant values are summed up, and (iii) the total thus obtained is divided by the total number of observations.

Symbolically,

$$\bar{X} = \frac{\sum_{i=1}^{h} f_i\, x_i}{n}$$

where $\bar{X}$ = the sample mean
f_i = the frequency of the ith class
x_i = the mid-point of the ith class
h = the number of classes
n = the total number of observations in the sample

For a population mean, the formula is:

$$\mu = \frac{\sum_{i=1}^{h} f_i\, x_i}{N}$$

where, the Greek letter μ = the mean of the population

N = the total number of observations in a population.

The mid-point is a good approximation of the true mean of the class. This is based on the assumption that the values are distributed fairly evenly throughout the interval. When a large number of frequencies occur, this assumption is usually acceptable.

A short-cut method by taking arbitrary mean is followed. The formula for calculation of the arithmetic mean by the short-cut method is as given below:

$$\bar{X} = A + \frac{\sum_{i=1}^{h} f_i\, d_i}{n} \times C$$

where A = arbitrary or assumed mean
f_i = the frequency of the ith class
d_i = deviation from the arbitrary or assumed mean
C = common factor (or size of the class interval)

Some of the important characteristics of the arithmetic mean are:

1. The sum of the deviations of the individual items from the arithmetic mean is always zero. This means $\Sigma (X - \bar{X}) = 0$, where X is the value of an item and $\bar{X}$ is the arithmetic average. Since the sum of the deviations in the positive direction is equal to the sum of the deviations in the negative direction, the arithmetic average is regarded as a measure of centrality.
2. The sum of the squared deviations of the individual items from the arithmetic mean is always minimum. In other words, the sum of the squared deviations taken from any value other than the arithmetic mean will be higher.
3. As the arithmetic mean is based on all the items in a series, a change in the value of any item will lead to a change in the value of the arithmetic mean.
4. In the case of a highly skewed distribution, the arithmetic mean may get distorted on account of a few items with extreme values. In such a case, it may cease to be the representative characteristic of the distribution.

The median is the measure of the central item when all the items in a series are arranged either in ascending or descending order of magnitude. Thus, in an ungrouped frequency distribution if the n values are arranged in ascending or descending order or magnitude, the median is the middle value if n is odd. When n is even, the median is the mean of the two middle values. For a grouped series, the median is calculated by linear interpolation with the help of the following formula:

$$M = l_1 + \frac{l_2 - l_1}{f}\,(m - c)$$

where

M = the median
l_1 = the lower limit of the class in which the median lies
l_2 = the upper limit of the class in which the median lies
f = the frequency of the class in which the median lies
m = the middle item or $n/2$
c = the cumulative frequency of the class preceding the one in which the median lies.

Some of the important characteristics of the median are:

1. Unlike the arithmetic mean, the median can be computed from open-ended distributions. This is because it is located in the median class interval which would not be an open-end class.

2. The median can also be determined graphically whereas the arithmetic mean cannot be ascertained in this manner.
3. As it is not influenced by the extreme values, it is preferred in case of a distribution having extreme values.
4. In case of the qualitative data where items are not counted or measured but are scored or ranked, it is the most appropriate measure of central tendency.

The mode is another measure of location of a frequency distribution. It is the value at the point around which the items are most heavily concentrated. In case of grouped series, it is determined by the following formula:

$$\text{Mode} = l_1 + \frac{f_1 - f_0}{(f_1 - f_0) - (f_1 - f_2)} \times i$$

where l_1 = the lower value of the class in which the mode lies
f_1 = the frequency of the class in which the mode lies
f_0 = the frequency of the class preceding the modal class
f_2 = the frequency of the class succeeding the modal class
i = the class interval of the modal class.

Some of the important characteristics of the mode are:

1. It can be applied to both qualitative and quantitative distribution.
2. It remains unaffected by the extreme values in the distribution.
3. It can be ascertined in an open-ended distribution.

MEASURES OF DISPERSION

So far the discussion was confined to the measures of central tendency. Although these measures are useful, they alone are not sufficient as they give a very inadequate description of the sample data. This is because the measures of central tendency are not concerned with the variability in a distribution. For this purpose, some other measures are used. These measures are the range, the mean deviation, the standard deviation and the variance and they indicate how the data are spread out. As the last two of these measures are frequently used, the discussion below is confined to them.

The formula for calculating the standard deviation in case of an array of data is

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(X_i - \mu)^2}{N}}$$

where σ = standard deviation
X_i = the value of the ith observation
μ = the mean
N = the total number of observations

The formula for the standard deviation computed from data in a frequency distribution is

$$\sigma = \sqrt{\frac{\sum_{i=1}^{h} f_i(X_i - \mu)^2}{N}}$$

where f_i = the frequency of the ith class
X_i = the mid-point of the ith class
h = the number of classes

and all the other symbols are the same as in the previous formula.

The variance is the square of the standard deviation and is calculated by the same formula with the square-root sign removed.

When the two series given in different units of measurement are to be compared, the standard deviation will not be suitable. In such a case the coefficient of variation is computed for each series. The formula for the coefficient of variation is

$$C = \frac{\sigma}{\mu}$$

where C is the coefficient of variation, σ is the standard deviation and μ is the arithmetic mean. Since σ and μ are both measured in the same units, their ratio σ/μ is a pure number and does not have any unit of measurement. A comparison of the two coefficients of variation will indicate which of the two series having different units of measurement, has greater variability.

UNIVARIATE ANALYSIS

We discuss here the analysis of data involving a single variable. These analytical methods would usually suffice to solve the problem being investigated. However, more advanced techniques are needed when one attempts to analyse into greater depth and probes into the causes responsible for a certain phenomenon.

Estimation

Statistical estimation involves the estimation of parameters for a population from a sample. This can be illustrated best by examples. Suppose a department store is interested in setting up a branch in the suburbs of a metropolitan city and would like it to be situated in a locality where the average income of the inhabitants is more than the national average. It will be too expensive, apart from being extremely time consuming, to contact each household in that locality to find out its income and then to compute the average income of households. In such a case, a sample of households is chosen. These households are contacted and the sample average income is computed. This sample average is then taken as an estimate of the average income of households in that locality.

Apart from knowing the average household income in the locality, the department store may be interested in knowing the variability of the incomes. This would give it some idea of the price range of the products it should sell. Since it does not know the dispersion in the household incomes in the population, it may use the sample standard deviation instead.

In both these examples, a sample value has been used as an estimate of the population parameter. In the first example, the sample mean is used as an estimator of the population mean μ. In the second example, the sample standard deviation is used as an estimator of the population standard deviation.

A point estimate is a single number estimate and is the simplest to calculate. However, it will be only by chance that such a point estimate will be the same as the population parameter. This is because a number of samples of a given size can be drawn from the same population and these samples will give different point estimates of a true population parameter. This poses a problem as to how one can ensure a good estimator.[9]

Interval Estimates

An interval estimate consists of two values between which the true population value lies with some stated level of significance. Thus an interval estimate of a parameter (say, the population mean μ) may be $a < \mu < b$ where a and b are the lower and upper points obtained from the sample observations. At times it may be desirable to use an interval estimate rather than a point estimate. For example, it may be more useful to say that there is a 90 per cent probability that the average income of households in a certain territory lies between Rs. 6,000 and 12,000 per annum than to state that it is estimated to be Rs. 10,000 per annum. This is because we can never be sure that an estimate of a parameter is correct, as different samples from the same population would yield different values of a parameter. It is, therefore, desirable that we state an interval estimate in such a way that it is a fair bet that the parameter lies between the two values. These values are also called confidence limits. This section describes how such intervals or confidence limits are constructed.

Interval Estimate of the mean

An interval estimate with a specified level of confidence is obtained from an interval formed by the two points,

$$\bar{X} - Z\,\sigma_{\bar{x}} = \text{lower point, and}$$

$$\bar{X} + Z\,\sigma_{\bar{x}} = \text{upper point}$$

where $\bar{X}$ is the mean of the sample, Z represents the number of standard errors for the specified confidence level and $\sigma_{\bar{x}}$ is the size of the standard error. When applied to the sampling distribution of the mean, the term standard error is used instead of standard deviation. It is customary to refer to the number of standard errors by a common term from the normal curve. We can say that a confidence level of 68.2 percent is obtained when $Z = 1$, 95.4 percent when $Z = 2$ and 99.8 percent when $Z = 3$. Each Z value indicates a specified level of confidence because the means of that percentage of samples that could be taken would lie between the lower and upper points of the interval formed by that particular Z value.

As mentioned in Chapter 11, there is a relationship between the population standard deviation and the sample standard error. This relationship is shown by the following formula:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

Thus, we may substitute $\sigma_{\bar{x}}$ the standard error of the mean, by $\sigma/\sqrt{n}$. That is to say, the population standard deviation is to be divided by the square root of the sample size.

We may now rewrite the lower point and the upper point as

$$\bar{X} - Z\,\frac{\sigma}{\sqrt{n}} = \text{lower point, and}$$

$$\bar{X} + Z\,\frac{\sigma}{\sqrt{n}} = \text{upper point}$$

[9] A discussion on criteria of a good estimator and methods for determining it can be found in most of the standard textbooks on Statistics.

The value of Z would vary depending upon how much confidence we want to have for our interval estimate. We know from the normal area table that when $Z = 1.96$, it corresponds to a probability of 0.975. We may, therefore, write the interval estimate as

$$P\left(\bar{X} - 1.96\frac{\sigma}{\sqrt{n}} < \mu < \bar{X} + 1.96\frac{\sigma}{\sqrt{n}}\right) = 0.95$$

Let $\bar{X} - 1.96\dfrac{\sigma}{\sqrt{n}} = a$ and $\bar{X} + 1.96\dfrac{\sigma}{\sqrt{n}} = b$,

then $P(a < \mu < b) = 0.95$

This means that there are 95 chances out of 100 that the $\bar{X}$ will be between $\mu - 1.96\dfrac{\sigma}{\sqrt{n}}$ and $\mu + 1.96\dfrac{\sigma}{\sqrt{n}}$, given that μ is the true value of the population mean.

This may be further illustrated with the help of a few examples.

Example 1

A random sample of 100 firms was taken to find out the average sale per customer. The sample mean was found to be Rs. 300 and the standard deviation Rs. 100. Construct an interval estimate of the population mean with a confidence level of 95.44 percent.

Lower point as indicated earlier is

$$\bar{X} - Z\,\sigma_{\bar{x}}$$

$$\sigma_{\bar{x}} = \frac{S}{\sqrt{n}}$$

where S is the estimate of the standard deviation.

Thus,

$$\bar{X} - Z\,\sigma_{\bar{x}} = \text{Rs } 300 - 2\left(\frac{100}{10}\right)$$

$$= \text{Rs } 300 - 20$$

$$= \text{Rs } 280$$

Upper point as indicated earlier is

$$\bar{X} + Z\,\sigma_{\bar{x}} = \text{Rs } 300 + 2\left(\frac{100}{10}\right)$$

$$= \text{Rs } 320$$

This can also be written as Rs 300 ± Rs 20. This shows that the population mean lies between Rs. 280 and Rs 320. We are 95.44 per cent confident that the population mean μ lies in this interval.

Example 2

In the previous example, suppose we are interested in having an interval estimate with a higher confidence level, say, 99.8 per cent. The corresponding value of Z is 3. Using the same data as given in Example 1 and taking Z = 3, we find

$$a < \mu < b$$

$$\bar{X} - Z\,\sigma_{\bar{x}} < \mu < \bar{X} + Z\,\sigma_{\bar{x}}$$

$$300 - 3\left(\frac{100}{10}\right) < \mu < 300 + 3\left(\frac{100}{10}\right)$$

$$300 - 30 < \mu < 300 + 30$$

$$270 < \mu < 330$$

In other words, the population mean lies between Rs. 270 and Rs. 330 and we are almost 100 per cent confident that it is so. Note that the interval between the lower and the upper points has widened as the level of confidence has increased. Conversely, if we reduce the level of confidence, we shall find that the interval between the two points has narrowed down.

Example 3

A restaurant is interested in knowing the average amount a customer spends for lunch. A random sample of 64 customers is taken and the sample mean $\bar{X}$ is found to be Rs. 36 and $\sigma = 2$. Find out an interval estimate with a confidence level of 95 per cent.

First of all, we obtain the value of Z corresponding to 95 per cent confidence level. From the normal area table we find that the value of Z is 1.96.

Now, $a < \mu < b$

or $\bar{X} - Z\,\sigma_{\bar{x}} < \mu < \bar{X} + Z\,\sigma_{\bar{x}}$

or $36 - 1.96\,\dfrac{2}{\sqrt{64}} < \mu < 36 + 1.96\,\dfrac{2}{\sqrt{64}}$

or $36 - \dfrac{1.96}{4} < \mu < 36 + \dfrac{1.96}{4}$

or $36 - 0.49 < \mu < 36 + 0.49$

or $35.51 < \mu < 36.49$

We have assumed that σ is known. When σ is not known, we may have to use an estimate of σ and then find the confidence interval. In marketing research, more often than not, one will find that the population standard deviation is not known. The standard deviation of the sample is used as a substitute for the population standard deviation. The formula for estimating the standard error is

$$S_{\bar{x}} = \frac{S}{\sqrt{n}}$$

It may be emphasised that when the normal distribution or Z distribution is used as an approximation to the distribution of sample means, the sample size should be large. In other words the central limit theorem applies only as n gets large. Generally, when n is not less than 30, the normal distribution is used. When the sample size is less than 30, the sampling distribution is no longer normal. In such a case, the t distribution is used in place of the normal distribution. The t distribution involves the use of degrees of freedom which, for a given sample size, are $n - 1$. Thus, the degrees of freedom for a sample size of 15 will be $15 - 1 = 14$. The t value for a 95 per cent confidence level with a sample size of 15 (i.e., 14 degrees of freedom) is 2.145. This value is used for a 95 per cent confidence level, as described earlier.

Example 4

A firm has appointed a large number of dealers all over the country to sell its bicycles. It is interested in knowing the average sales per dealer. A random sample of 25 dealers is chosen for this purpose. The sample mean is Rs. 30,000 and the sample standard deviation is Rs. 10,000. Construct an interval estimate with 95 per cent confidence.

$$\sigma_{\bar{x}} \text{ can be estimated by } \frac{S}{\sqrt{n}}$$

where S = sample standard deviation

n = number of observations

$$\sigma_{\bar{x}} = \frac{S}{\sqrt{n}} = \frac{\text{Rs. }10000}{\sqrt{25}} = \text{Rs. } 2000$$

From the t-table, the value of t for 25 – 1 = 24 degrees of freedom and corresponding to 95 per cent confidence level is 2.064. Interval estimation can now be calculated as follows:

$$\bar{X} - (t)(\sigma_{\bar{x}}) \text{ to } \bar{X} + (t)(\sigma_{\bar{x}})$$

= Rs. 30,000 – (2.064) (Rs. 2000)

to Rs. 30,000 + (2.064) (Rs. 2000)

= Rs. 30,000 – Rs. 4128 to Rs. 30,000 + Rs. 4128

= Rs. 25,872 to 34,128

We are 95 per cent confident that the interval estimate Rs. 25,872 to Rs. 34,128 contains the population mean.

Interval Estimate of a Proportion

So far the discussion was confined to interval estimates of the population mean. In this section, we discuss interval estimate of a population proportion.

The theory is identical to that used for constructing a confidence interval for the population mean. The procedure used for constructing interval estimates of proportions is, therefore, similar to that used for means.

First, the estimated standard error of the proportion, σ_p is determined. Then the interval estimate is constructed around the sample proportion such that

$$p - Z\sigma_p = \text{lower point, and}$$

$$p + Z\sigma_p = \text{upper point}$$

where Z indicates the number of standard errors for the desired confidence level.

In case of a simple random sample where the population proportion is known, the standard error of the proportion is obtained by the following formula

$$\sigma_P = \sqrt{\frac{P(1-P)}{n}}$$

where P is the proportion of items in the sample having a given characteristic, and n is the sample size. When the population proportion is not known, it can be estimated from the sample proportion

p and the estimated standard error, $\hat{\sigma}_p$, calculated from the following formula:

$$\hat{\sigma}_p = \sqrt{\frac{p(1-p)}{n}}$$

Example 5

Suppose that a simple random sample of 400 families shows that 120 families own a television set and 280 do not. In other words, 30 per cent of families own a television set. We have to construct a confidence interval with 95 per cent confidence.

$$\hat{\sigma}_p = \sqrt{\frac{p(1-p)}{n}}$$

$$= \sqrt{\frac{(30)(100-30)}{400}}\ \%$$

$$= \sqrt{\frac{30 \times 70}{400}}\ \%$$

$$= 2.3\%$$

The 95 per cent confidence interval would be

$$\text{p} \pm z\sigma_p = 30 \pm 1.96\ (2.3\%)$$

$$= 30 \pm 4.5\%$$

$$= 25.5\% \text{ to } 34.5\%$$

Thus, one would be 95 per cent confident that the true percentage of television ownership lies between 25.5 and 34.5 per cent of the population.

Example 6

A firm manufacturing steel furniture desired to estimate the proportion of the population that uses its product. In a sample of 100 families, it is found that 20 families use its product. Estimate the proportion of the population using steel furniture of the firm, assuming the confidence level of 90 per cent.

1. Determine the proportion using steel furniture produced by the firm

$$p = \frac{20}{100} = 0.2$$

2. Determine the estimated standard error

$$\hat{\sigma}_p = \sqrt{\frac{p(1-p)}{n}}$$

$$= \sqrt{\frac{(0.2)(8.0)}{100}}$$

$$= 0.04$$

3. The value of Z corresponding to 90 per cent confidence level from the normal area curve is 1.64.
4. Construct the interval estimate

$$p \pm Z\hat{\sigma}_p$$

$$= 0.2 \pm 1.64\ (0.04)$$

$$= 0.2 \pm .0656$$

$$= 0.1344 \text{ to } 0.2656$$

$$= 13.44\% \text{ to } 26.56\%$$

On the basis of these calculations, we conclude that 13.44 per cent to 26.56 per cent of the population used the steel furniture manufactured by the firm. We are 90 per cent confident that the true population percentage lies within this interval.

If we wish to be more confident, say 99 per cent, of the interval estimate, then the calculations would be

$$p \pm Z\hat{\sigma}_p$$

$$= 0.2 \pm 2.57\ (0.04)$$

$$= 0.2 \pm 0.1028$$

$$= 0.0972 \text{ to } 0.3028$$

$$= 9.72\% \text{ to } 30.28\%$$

Note that the interval estimate has widened as the confidence level has increased. If we are willing to be less than 90 per cent confident, then the interval estimate would be smaller.

Finite Correction Factor

The relationship $\sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$ is valid when a sample is drawn from an infinite population. When the population is finite, a correction factor $\sqrt{\dfrac{N-n}{N-1}}$ (as was mentioned in Chapter 11) is introduced and the relationship becomes

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \cdot \sqrt{\frac{N-n}{N-1}}$$

It can be seen that when the sample size is extremely small relative to the population, the correction factor approaches 1. However, when a sample forms a sizeable proportion of the population, the correction factor assumes significance. Generally, when the sample size is more than 5 per cent of the population, the finite population correction factor is used.

Example 7

A sample survey was conducted in a town by a marketing consultancy firm to estimate the average annual expenditure on woollens. The total number of families in the town was 6000 of which a sample of 400 was chosen. The average amount spent on woollens per annum by the sample families was Rs. 400 and the standard deviation was Rs. 100. Construct an interval estimate of the true average expenditure on woollens with 95 per cent confidence.

$$\sigma_{\bar{x}} = \frac{\sigma_{\bar{x}}}{\sqrt{n}} \cdot \sqrt{\frac{N-n}{N-1}} = \frac{100}{\sqrt{400}} \cdot \sqrt{\frac{6000-400}{6000-1}}$$

$$= 5 \cdot \sqrt{\frac{5600}{5999}} = 5 \times 0.9662 = 4.83$$

$$\bar{X} - Z\sigma_{\bar{x}} < \mu < \bar{X} + Z\sigma_{\bar{x}}$$

$$= 400 - (1.96)\,(4.83) < \mu < 400 + (1.96)\,(4.83)$$

$$= 400 - 9.47 < \mu < 400 + 9.47$$

$$= \text{Rs. } 390.53 < \mu < \text{Rs. } 409.47$$

We conclude that the average expenditure on woollens is between Rs. 390.53 and Rs. 409.47. We are 95 per cent confident that this interval contains the true average.

To sum up, the size of the interval estimate depends upon three factors. The first is the confidence level. If we are keen to be more confident that the interval estimate will include the true population mean, then the interval between the lower and the upper points will be wider and vice versa. The second is the population standard deviation. A wide variation in the population will result in a larger interval estimate of the population mean. If, on the contrary, there is a high degree of homogeneity in the population, then the interval estimate will be smaller. The third is the sample size. As the sample size increases, the magnitude of the sampling error declines. This will make the interval estimate smaller.

Summary

It is desirable to have a well thought out framework and analysis of data prior to their collection. The first task in data processing is editing. A few examples as to how editing can be helpful have been given. What the editor should check in the data has also been indicated.

The chapter then explains the term ‘coding’ and its importance. It emphasizes that categories made from the data should be ‘all-inclusive’ and mutually exclusive. This is followed by a discussion on tabulation, which comprises sorting the data into different categories and counting the number of cases belonging to each category. Tabulation may be done by hand or by machine or some part by hand and the other by machine. When hand tabulation or machine tabulation needs to be used, has also been explained. Further, one-way tabulation and cross-tabulation have been discussed.

The problem of handling multiple responses to multiple-choice questions has also been discussed. This is followed by brief discussion on measures of central tendency and dispersion. The later part of the chapter has been devoted to statistical estimation. A number of examples have been given to explain how interval estimates can be calculated, covering both the mean and the proportion. Finally, the chapter explains the concept of ‘finite population correction factor’ and it indicates when it needs to be used.

Key Terms and Concepts

Editing 265
Coding 267
Tabulation 269
Cross Tabulation 271
Measures of Central Tendency 275
Measures of Dispersion 277
Univariate Analysis 278
Estimation 278
Interval Estimates 279
Finite Correction Factor 284

Questions

1. What is meant by data processing?
2. What are the steps involved in data processing?
3. What is the purpose of editing?
4. What is the difference between a field edit and a central-office edit?
5. What is coding?
6. Describe the principles that should be borne in mind while classifying data into categories.
7. What checks would you make before questionnaires are subjected to tabulation?
8. What are the relative advantages and disadvantages of manual tabulation and machine tabulation?
9. Distinguish between a one-way tabulation and a cross-tabulation, giving suitable illustrations.
10. What is the problem faced by the researcher regarding the cross-tabulation analysis?
11. Prepare a two-way tabulation using:
    (i) Income level and ownership of television sets.
    (ii) Age-group of population and its preference for movies.
    (iii) Use of a newly introduced drug and treatment of cancer.
12. When should computers be used for data processing?
13. "The suitability of data-processing methods depends on the volume of data to be processed." Comment.
14. What are the measures of central tendency?
15. What are the characteristics of the arithmetic mean?
16. What are the characteristics of the median?
17. What are the characteristics of the mode?
18. What is a standard deviation?
19. What is a coefficient of variation?
20. What is a univariate analysis?

21. What is meant by statistical estimation?
22. Distinguish between a point estimate and an interval estimate.
23. Mention the factors on which the size of an interval estimate depends.
24. A company, which manufactures biscuits, is interested in knowing the average sales of its dealers. It decides to use last year's sales effected by them. A sample of 500 out of a total number of 5000 dealers has been taken. On the basis of the information collected from the sample, the company has estimated the sample mean of Rs. 50,000 and standard deviation of Rs. 1500. What is the interval estimate of average sale of biscuits if 95 per cent confidence is desired?
25. A firm manufacturing ceiling fans desires to estimate the proportion of the population that uses its fans. A sample of 500 families was selected and a survey was conducted covering these families. The survey revealed that 30 per cent of families used its ceiling fans. Assuming the confidence level of 99 per cent, estimate the proportion of families using the ceiling fans manufactured by the firm.
26. Suppose in question No. 25 the confidence level is 90 per cent instead of 99 per cent, construct the interval estimate of the proportion of families using the ceiling fans of the firm.
27. How would you determine whether income or education had the greater effect on the consumption of product X ?
28. Describe the proceduce that you would follow for investigating the hypotheses using cross tabulation analysis.
    (i) The consumption of Product X depends on a person's income.
    (ii) The consumption of Product X depends on a person's education.
    (iii) The consumption of Product X depends on both.

15 Testing Hypotheses

Learning Objectives

After reading this chapter, you should be able to understand:

- Concept of Hypothesis
- Precedure in Hypothesis Testing
- Two Types of Errors in Hypothesis testing
- Hypothesis Testing in Respect of Interval Data
- Test of Differences between Two Proportions and Independent Samples
- Non-parametric Tests.

Having looked into the estimation of unknown population parameters in the preceding chapter, we now turn to a related subject, i.e., testing hypotheses. It may be noted that there are several statistical techniques used in hypothesis testing. All these techniques are not discussed here but this chapter deals with some of the more frequently used ones. Before discussing the application of these techniques, we should first understand the concept of hypothesis and the steps involved in testing it.

CONCEPT OF HYPOTHESIS

A hypothesis is a proposition which the researcher wants to verify. It may be mentioned that while a hypothesis is useful, it is not always necessary. Many a time, the researcher is interested in collecting and analysing data, indicating the main characteristics without a hypothesis excepting the one which he may suggest incidentally during the course of his study. However, in a problem-oriented research, it is necessary to formulate a hypothesis or hypotheses in as clear terms as possible. In such research, hypotheses are generally concerned with the causes of a certain phenomenon or a relationship between two or more variables under investigation.

PROCEDURE IN HYPOTHESIS TESTING

A number of steps are involved in testing a hypothesis:

1. Formulate a hypothesis
2. Set up a suitable significance level
3. Choose a test criterion
4. Compute
5. Make decisions.

These steps are discussed below.

Formulate a Hypothesis

The conventional approach to hypothesis testing is to set up two hypotheses instead of one in such a way that if one hypothesis is true, the other is false. Alternatively, if one hypothesis is false or rejected, then the other is true or accepted. These two hypotheses are:

(i) Null hypothesis, and

(ii) Alternative hypothesis

The term "null" means nothing or invalid. Let us assume that the average income of the population is Rs 9000. Since we have assumed that the population has an average income of Rs 9000, this is our null hypothesis. We may write it as

$$H_0 : \mu = \text{Rs } 9000$$

where H_0 is the null hypothesis. The alternative hypothesis is $H_A : \mu \neq \text{Rs } 9000$

The rejection of the null hypothesis will show that the average income of the population is not Rs 9000. This implies that some other hypothesis is accepted. This other hypothesis is called the alternative hypothesis. It may be noted that there can be two or more alternative hypotheses though only one alternative hypothesis can be tested at one time against the null hypothesis.

Set up a Suitable Significance Level

Having formulated the hypothesis, the next step is to test its validity at a certain level of significance. The confidence with which a null hypothesis is rejected or accepted depends upon the significance level used for the purpose. A significance level of, say 5 per cent, means that in the long run, the risk of making the wrong decision is about 5 per cent. The researcher is likely to be wrong in accepting a false hypothesis or in rejecting a true hypothesis in 5 out of 100 occasions. A significance level of, say 1 per cent, implies that the researcher is running the risk of being wrong in accepting or rejecting the hypothesis in 1 out of every 100 occasions. Thus, a 1 per cent, significance level provides greater confidence to the decision than a 5 per cent significance level.

Select Test Criterion

The next step in hypothesis testing is the selection of an appropriate statistical technique as a test criterion. There are many techniques from which one is to be chosen. For example, when the hypothesis pertains to a large sample (30 or more), the *Z*-test implying normal distribution is used. When a sample is small (less than 30), the use of the *Z*-test will be inappropriate. Instead, the *t*-test will be more suitable. The test criteria which are frequently used in hypothesis testing are *Z*, *t*, *F* and χ^2.

As the selection of a proper test is crucial, the researcher has to be careful in selecting the one which is most appropriate. His choice should depend on a number of considerations such as number (one or more) of variables involved, the type of data (ratio, interval, ordinal or nominal), the size of the sample (large or small), and whether the samples are independent or related.

Compute

After having selected the statistical technique to verify the hypothesis, the next step is the performance of various computations, necessary for the application of that particular test. These computations include the testing statistic as also its standard error.

Make Decisions

The last step in hypothesis testing is to draw a statistical decision, involving the acceptance or rejection of the null hypothesis. This will depend on whether the computed value of the test criterion falls in the region of acceptance or in the region of rejection at a given level of significance. It may be noted that the statement rejecting the hypothesis is much stronger than the statement accepting the hypothesis. It is much easier to prove something false than to prove it true. Thus, when the researcher says that the null hypothesis is not rejected, he does not categorically say that it is true.

TWO TYPES OF ERRORS IN HYPOTHESIS TESTING

At this stage, it is worthwhile to know that when a hypothesis is tested, there are four possibilities:

1. The hypothesis is true but our test leads to its rejection.
2. The hypothesis is false but our test leads to its acceptance.
3. The hypothesis is true and our test leads to its acceptance.
4. The hypothesis is false and our test leads to its rejection.

Of these four possibilities, the first two lead to an erroneous decisions. The first possibility leads to a Type I error and the second possibility leads to a Type II error. This can be shown as follows:

Table 15.1 Types of Errors in Hypothesis Testing

Decision	State of nature	
	H_0 is true (S_1)	H_0 is false (S_2)
Accept H_0 (A_1)	Correct decision	Type II error (β)
Reject H_0 (A_2)	Type I error (α)	Correct decision

Table 15.1 indicates that one of the two conditions (states of nature) exists in the population, i.e., either the null hypothesis is true or it is false. Similarly, there are two decision alternatives: Accept the null hypothesis or reject the null hypothesis. Thus, two decisions and two states of nature result into four possibilities.

In any hypothesis testing the researcher runs the risk of committing Type I and Type II errors. In case we are interested in reducing the risk of committing a Type I error, then we should reduce the size of the rejection region or level of significance, indicated in Table 15.1 by α. When $\alpha = 0.10$, it means that a true hypothesis will be accepted in 90 out of every 100 occasions. Thus, there is a risk of rejecting a true hypothesis in 10 out of every 100 occasions. To reduce this risk, we may choose $\alpha = 0.01$, which implies that we are prepared to take 1 per cent risk. That is, the probability of rejecting a true hypothesis is merely 1 per cent instead of 10 per cent as in the previous case.

It may be noted that the choice of a level of significance involves a compromise between two kinds of risk. A reduction in the probability of committing a Type I error increases the risk of committing a Type II error, i.e., the probability of accepting a null hypothesis when it is false, increases. On the other hand, if we choose a significance level ($\alpha = 0.05$) of 5 per cent as compared to 1 per cent, it implies that we are taking a greater risk of committing a Type I error, though this would reduce the risk of committing a Type II error. An increase in the sample size is the only way to reduce the risk of committing both types of errors.

Table 15.2 Example of Type I and Type II Errors

Decision	State of nature	
	H_0 is true (Product fails)	**H_0 is false (Product succeeds)**
Do not introduce the product (A_1)	Correct decision	Type II error (β)
Introduce the product (A_2)	Type I error (α)	Correct decision

Let us give a hypothetical example to understand Type I and Type II errors. A business firm wants to introduce another product in the market. Thus, it has to choose one of the two decisions, i.e., not to introduce the product or to introduce it. Now, the states of nature are two, namely, the failure of the product and the success of the product. The firm thus runs the risk of a wrong decision in two ways. It does not introduce the product though it would have succeeded had it been introduced. This is a Type II (β) error. The second risk is that the product is introduced but does not succeed. This type of risk is denoted by a Type I (α) error as shown in Table 15.2.

Another example of Type I (α) and Type II (β) error is presented as follows: Suppose a marketing company has salesmen with varying capabilities. On the basis of certain criteria, it has grouped them into two categories: good salesmen and poor salesmen. Thus, w_1 is the state of nature where the firm has good salesmen and w_2 is the state of nature where it has poor salesmen. The firm proposes to give meritorious rewards to encourage good salesmen. In such a case, the two actions A_1 and A_2 would denote whether a reward is given and not given, respectively. This can be shown schematically as follows:

Table 15.3 Additional Example of Type I and Type II Errors

Action	State of natue	
	w_1, Good salesmen	w_2, Poor salesmen
A_1, Reward is given	Correct decision	Incorrect decision, β error
A_2, Reward is not given	Incorrect decision, α error	Correct decision

When the firm has failed to give the reward to a good salesman, it has made the α error. On the other hand, when it has given the reward to a poor salesman, it has made the β error.

In the foregoing example, we have taken w_1 to represent good salesmen, w_2 as poor salesmen, A_1 as reward given and A_2 as reward not given. Suppose we interchange these classifications. Assume that A_1 stands for "reward is not given", A_2 for "reward is given", w_1 for "poor salesmen" and w_2 for "good salesmen". In such a case, the table will take the following form:

Table 15.4 Change in Decision Errors

Action	State of nature	
	w_1, Poor salesmen	w_2, Good salesmen
A_1, Reward is not given	Correct decision	Incorrect decision, β error
A_2, Reward is given	Incorrect decision, α error	Correct decision

It becomes evident from Table 15.4 that α and β errors have reversed themselves. This shows that the α error and β error will depend on how the researcher selects w_1, w_2, A_1 and A_2. Conventionally speaking, α is taken as the one which the researcher wants to avoid in particular and accordingly, he chooses w_1, w_2, A_1, and A_2. In the above example, one has to decide which is the more serious error—the reward is not given to a good salesman or reward is given to a poor salesman. If we think that no good salesman should remain unrewarded, then we shall be guided by the pattern shown in Table 15.3.

Parametric and Non-parametric Tests

There are two types of tests—parametric and non-parametric. The parametric tests assume that parameters such as mean, standard deviation, etc., exist and are used in testing a hypothesis. The underlying assumption in such tests is that the source of data is normally distributed. In some cases the population may not have a normal distribution. But as in research studies sample is most frequently used and as the sample distribution is very close to normal distribution, parametric tests are used. The parametric tests that are commonly used are: (a) **Z-test;** (b) **t-test;** and (c) **F-test.** These tests are more powerful than the non-parametric tests.

In this chapter we will discuss first parametric tests and then some non-parametric tests.

Figure 15.1 shows both parametric and non-parametric hypothesis tests.

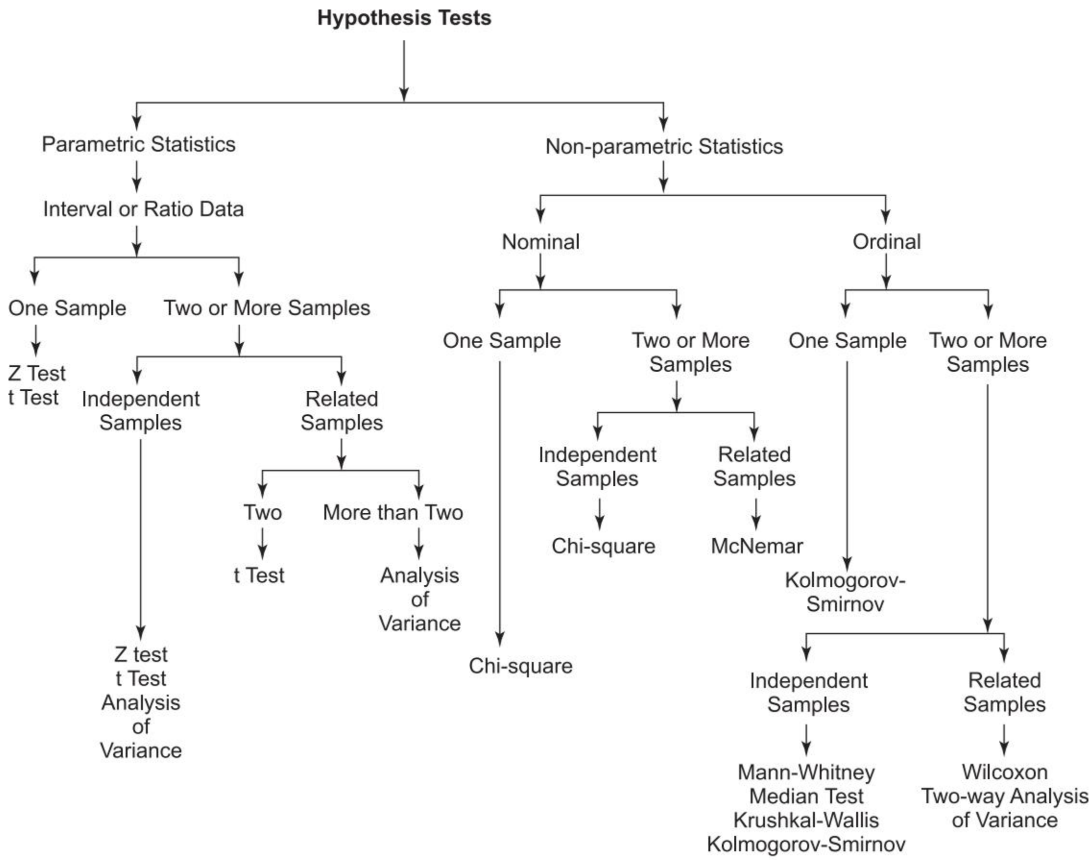

Fig. 15.1 Hypothesis Testing: Parametric and Non-Parametric

PARAMETRIC TESTS

HYPOTHESIS TESTING IN RESPECT OF INTERVAL DATA

Test of a Sample Mean, One Sample: $n \geq 30$

While discussing statistical estimation in the preceding chapter, the normal distribution was used. In hypothesis testing too, the standard normal distribution is used. This is the normal distribution which has been adjusted in a certain manner.

It may be recalled that in case of a normal distribution of sample mens ($\bar{x}$) with mean μ and standard deviation σ $\sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$, if we subtract the mean of the population, μ, from each sample mean, $\bar{x}$, then the mean of the resultant distribution will be zero. Further if $\bar{x} - \mu$ is divided by $\sigma_{\bar{x}}$, then the resultant distribution will have a mean zero and a standard deviation 1. This transformed normal distribution, i.e., $\dfrac{\bar{x} - \mu}{\sigma_{\bar{x}}}$ is known as the standard normal distribution. It is this distribution which is used for testing hypotheses.

A few examples using the standard normal distribution, i.e., $Z = \dfrac{\bar{x} - \mu}{\sigma_{\bar{x}}}$ are as follows:

Let us first take an example of a one-tail test. A characteristic of this test is that the alternative hypothesis is one-sided. For example, if $H_0 : \mu = 50$, then $H_1 : \mu > 50$. It can as well be $H_1: \mu < 50$. When $H_1 : \mu > 50$, it is the right-tail test and when $H_1 : \mu < 50$ it is the left-tail test. Whether a test is to be right or left-tail will depend upon the problem on hand.

Another characteristic of the one-sided test is that the alternative hypothesis is not a single alternative but includes a series of alternatives. For example, when we write null hypothesis, $H_0 : \mu = 60$ (say) and alternative hypothesis, $H_1 : \mu > 60$, what we imply is that there are alternative hypotheses as

$$\begin{aligned} H_1 : \mu &= 61 \\ \mu &= 62 \\ \mu &= 63 \\ &\cdots \\ &\cdots \end{aligned}$$

Such an alternative hypothesis is called a composite hypothesis. This chapter contains both types of examples—one-tail test and two-tail test.

Example 1

A company manufacturing automobile tyres finds that tyre-life is normally distributed with a mean of 40,000 km and standard deviation of 3,000 km. It is believed that a change in the production process will result in a better product and the company has developed a new tyre. A sample of 64 new tyres has been selected. The company has found that the mean life of these new tyres is 41,200 km. Can it be concluded that the new tyre is significantly better than the old one?

In a problem of this type, we are interested in testing whether or not there has been an increase in the mean life of tyres. In other words, we would like to test whether the mean life of new tyres has increased beyond 40,000 km.

The various steps in testing the hypothesis are outlined below:

1. Null hypothesis and alternative hypothesis are:

$$H_0 : \mu = 40{,}000 \text{ km}$$

$$H_1 : \mu > 40{,}000 \text{ km}$$

2. The significance level is taken as 0.05. That is, in 5 out of every 100 occasions, there is a risk of being wrong in accepting or rejecting the hypothesis.
3. The test criterion, as mentioned earlier, is the Z test.
4. Computations: Substituting the value of standard deviation $\sigma = 3{,}000$ km in the formla

$$= \frac{\sigma}{\sqrt{n}}$$

$$= \frac{3{,}000}{\sqrt{64}}$$

$$= 375$$

$$Z = \frac{\bar{x} - \mu}{\sigma_{\bar{x}}}$$

$$= \frac{41{,}200 - 40{,}000}{375}$$

$$= 3.2$$

5. Decision: At 0.05 level of significance, the critical (table) value of $Z = \pm\ 1.64$.

As can be seen from Fig. 15.2, the computed value of $Z = 3.2$ falls in the rejection region. Thus, we reject the null hypothesis that $\mu = 40{,}000$ kms. That is, the alternative hypothesis that $\mu > 40{,}000$ km is accepted. We, therefore, conclude that the new tyre is significantly better than the old one.

In the above example, the value of *N*, that is, population size is not given. It is assumed that sample size *n* is very small relative to the population size *N* and, therefore, the finite population correction factor is not used.

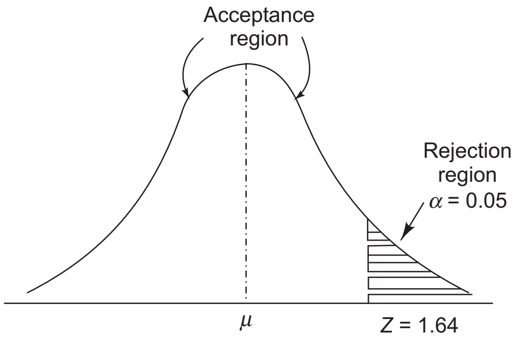

Fig. 15.2 Test of Hypothesis

$H_0 : \mu = 40{,}000$ km (Right-tail test)

Example 2

An insurance agent has claimed that the average age of policy-holders who insure through him is less than the average for all agents, which is 32 years. A random sample of 100 policy-holders who had insured through him gave an average age of 30 years. Assuming a standard error of 5 years, do you think that his claim is justifiable? Use α at 5% level of significance to test the claim.

The null hypothesis, $H_0 : \mu = 32$ years and the alternative hypothesis $H_1 : \mu < 32$ years.

$$Z = \frac{\overline{X} - \mu}{\sigma_{\bar{x}}}$$

$$= \frac{30 - 32}{5}$$

$$= -\ 0.4$$

We are interested in testing whether or not the insurance agent's claim of average age of policy-holders who insure through him is justified. Thus, it is a left-tail test as the alternative hypothesis $\mu < 32$ years.

At $\alpha = 0.05$ level of significance, the critical value of Z is -1.64 for a one-tail test. The computed value of $Z = -0.4$ falls in the acceptance region, as shown in Fig. 15.3. Thus, we accept the null hypothesis and conclude that the claim made by the insurance agent is not justifiable.

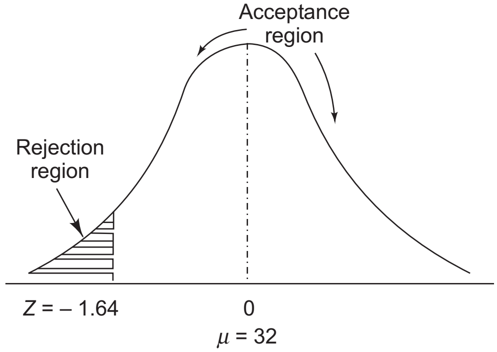

Fig. 15.3 Test of Hypothesis

$H_0 : \mu = 32$ years

Hypothesis Testing when n < 30

The Z-test used earlier is based on the assumption that the sampling distribution of the mean is a normal distribution. This is applicable when the sample is large, i.e., 30 or more. When a sample is less than 30, the assumption of normal distribution does not hold good and, as such, the Z-test will not be appropriate. Instead, another test known as the t-test is used.

The procedure of testing the hypotheses is the same except that instead of the Z-value the t-value is used.

A few examples on the use of the t-test in hypothesis testing are given below.

Example 3

A company manufacturing ice cream sells it in 500 grams packs. Periodically, a sample is taken to check whether, on the average, each pack contains 500 grams. A sample of 16 packs is taken and the sample mean is found to be $\bar{x} = 460$ grams and the estimated standard deviation $\hat{\sigma} = 40$ grams. Does the sample mean differ significantly from the intended weight of 500 grams?

In this case, we take the null hypothesis that there is no difference between the sample mean and the population mean. Thus, H_0 is $\mu = 500$ grams and we have a two-tail test. The t statistic is

$$t = \frac{\bar{x} - \mu}{\frac{\hat{\sigma}}{\sqrt{n}}}$$

$$= \frac{460 - 500}{\frac{40}{\sqrt{16}}} = \frac{-40}{\frac{40}{4}} = -4$$

This t has a t distribution $16 - 1 = 15$ degrees of freedom. Assuming α, the risk of Type I error 0.05 for 15 degrees of freedom, the critical value of t is 2.131.

It will be seen from Fig. 15.4, that the calculated value of t falls within the rejection region. We, therefore, reject the null hypothesis and conclude that the sample means differs significantly from the population mean of 500 grams. The company should bring the production process under cntrol.

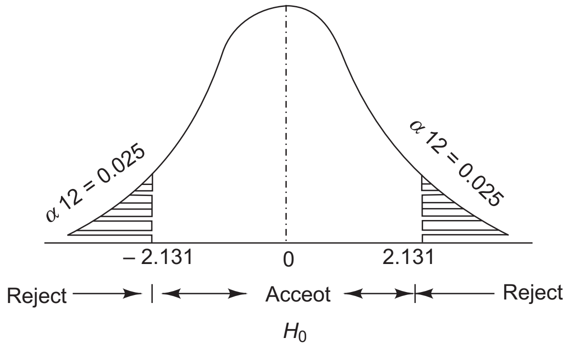

Fig. 15.4 Test of Hypothesis

$H_0 : \mu = 500$ grams

In several cases, marketing management has to decide whether the population mean is more than (or less than) a given value μ_0. In such cases, the researcher has to conduct one-tail tests of the population mean, i.e., $\mu \geq \mu_0$ or $\mu \leq \mu_0$. This is illustrated by the following examples.

Example 4

A company employs a large number of typists in its head office. It has developed a new training programme for them and claims that it has increased their typing speed by 15 words per minute. A random sample of 9 typists is taken and their speed observed. It is noticed that the average increase has been 10 words a minute. The estimated standard deviation is 8 words per minute. Can it be concluded that the company has made a legitimate claim?

We set up the following hypotheses:

Null hypothesis, $H_0 : \mu = 15$

Alternative hypothesis, $H_1 : \mu < 15$

The t statistic is

$$t = \frac{\bar{X} - \mu}{\frac{\hat{\sigma}}{\sqrt{n}}} = \frac{10 - 15}{\frac{8}{\sqrt{9}}} = \frac{-5}{\frac{8}{3}} = -1.87$$

This t has a t distribution with $9 - 1 = 8$ degrees of freedom. Assuming $\alpha = 5$ per cent, the critical value of t for 8 degrees of freedom is 1.86 for a one-tail test. As can be seen from Fig. 15.5, the calculated value of $t = -1.87$ lies in the rejection region. We, therefore, reject the null hypothesis and accept the alternative hypothesis. In other words, the company's claim regarding the new training programme is not legitimate as the data do not support it.

The above example shows the left-tail test. Let us take another example to illustrate the right-tail test.

Example 5

Suppose in the preceding example, the company finds that the average increase has been 17 words per minute instead of 10 words.

Null hypothesis, $H_0 : \mu = 15$
Alternative hypothesis, $H_1 : \mu > 15$
The t statistic is

$$t = \frac{\bar{X} - \mu}{\frac{\hat{\sigma}}{\sqrt{n}}} = \frac{17 - 15}{\frac{8}{\sqrt{9}}} = \frac{2}{\frac{8}{3}} = 0.75$$

Although Fig. 15.5 relates to Examlpe 4, one can visualise from it, that the calculated value of t = 0.75 would lie in the acceptance region. We, therefore, accept the null hypothesis and conclude that the company has made a legitimate claim regarding the efficacy of its new training programme.

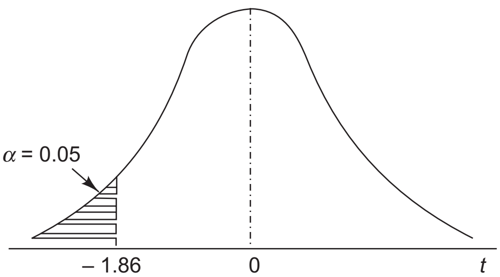

Fig. 15.5 Test of Hypothesis
H_0: μ = 15 words

Test Concerning the Difference of Two Means

(i) *When $n \geq 30$*

Marketing people are often interested in ascertaining the reaction of different groups of consumers to certain changes such as price of the product, packaging, etc. For example, management may like to know the difference in the consumption of a product by males and females separately as also their reaction to a certain change. The logic and procedure used to test hypotheses about a single mean as described earlier, are applicable in such cases with one difference. Instead of standard error of the mean, the standard error of the difference between two means is used in such cases.

When $n \geq 30$, the Z statistic takes the following form

$$Z = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$$= \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Let us take an example to explain this.

Example 6

A potential buyer wants to decide which of two brands of electric bulbs he should buy as he has to buy them in bulk. As a specimen, he buys 100 bulbs of each of the two brands—*A* and *B*. On using these bulbs, he finds that brand *A* has a mean life of 1000 hours with a standard deviation of 30 and brand *B* has a mean life of 1050 hours with a standard deviation of 50 hours. Do the two brands differ significantly in quality?

Let us set up the null hypothesis that the two brands do not differ significantly in quality. In other words,

Null hypothesis, $H_0 : \bar{X}_1 = \bar{X}_2$

Alternative hypothess, $H_1 : \bar{X}_1 \neq \bar{X}_2$

We now construct the Z statistic

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

$$\frac{1000 - 1050}{\sqrt{\frac{(30)^2}{100} + \frac{(50)^2}{100}}}$$

$$= -\frac{50}{\sqrt{9 + 25}}$$

$$= -\frac{50}{5.83}$$

$$= -8.58 \text{ approx.}$$

Assuming $\alpha = 0.05$, we find that the value of Z is $\pm$ 1.96. As the calculated value of Z (– 8.58) falls in the rejection region, we reject the null hypothesis and, therefore, conclude that the bulbs of two brands differ significantly in quality.

(ii) *When n < 30*

When the sample is small (i.e., $n < 30$), the *t*-test is used instead of Z test. This will be clear from the example given below.

Example 7

Two salesmen, *A* and *B*, are employed by a company. Recently, it has conducted a sample survey yielding the following data:

	Salesman *A*	Salesman *B*
No. of sales	20	22
Average sales (Rs)	800	780
Standard deviation (Rs)	70	60

Is there any significant difference between the average sales of the two salesmen?

We first set up the null hypothesis that there is no significant difference between the average sales of the two salesmen. That is, Null hypothesis, $H_0 : \mu_1 = \mu_2$

Alternative hypothesis, $H_1 : \mu_1 \neq \mu_2$

The t statistic is calculated as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\hat{\sigma}} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

where

$$\hat{\sigma}^2 = \frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2}$$

where s_1 and s_2 are the standard deviations of samples 1 and 2, respectively.

Applying the standard deviation formula,

$$\hat{\sigma}^2 = \frac{(20)(70)^2 + (22)(60)^2}{20 + 22 - 2}$$

$$= \frac{98000 + 79200}{40}$$

$$= 4430$$

$$\hat{\sigma} = \sqrt{4430} = 66.56$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\hat{\sigma}} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

$$= \frac{800 - 780}{66.56} \sqrt{\frac{20 \times 22}{20 + 22}}$$

$$= 0.30048 \times 3.23669$$

$$= 0.97 \text{ approx.}$$

At $\alpha = 0.05$ level of significance, the critical value of t for $(20 + 22 - 2) = 40$ degrees of freedom is 2.021 (two-tail test). Since the calculated t value (0.97) is less than the critical value of t (2.021), it falls in the acceptance region. We, therefore, accept the null hypothesis that $\mu_1 = \mu_2$. Thus, there is no significant difference between the average sales by the two salesmen.

Let us take another example.

Example 8

A company has reorganised its sales department. The following data show its weekly sales both before and after reorganisation. The period for comparison is taken from January to March in two successive years.

	Week No.									
	1	2	3	4	5	6	7	8	9	10
Sales prior to reorganisation (Rs lakh)	12	15	13	11	17	15	10	11	18	19
Sales after reorganisation (Rs lakh)	16	17	14	13	15	14	12	11	17	22

Can it be concluded that the reorganisation of the sales department of the company has resulted in a significant increase in its sales?

Null hypothesis: The reorganisation of the sales department has not resulted in improved sales. Since the observations are paired together, the paired t-test may be applied. For this purpose, the t statistic is

$$t = \frac{\bar{d}}{\sqrt{\frac{s^2}{n}}}, \text{ where } d = X_2 - X_1$$

The computations are shown in Table 15.5

Table 15.5 Worksheet for the Paired t -Test

Week No.	Sale before reorganisation (Rs lakh) x_1	Sales after reorganisation (Rs lakh) x_2	Deviations $d = x_2 - x_1$	Deviations square $d^2 = (x_2 - x_1)^2$
1	12	16	4	16
2	15	17	2	4
3	13	14	1	1
4	11	13	2	4
5	17	15	– 2	4
6	15	14	– 1	1
7	10	12	2	4
8	11	11	0	0
9	18	17	– 1	1
10	19	22	3	9
			10	44

$$\bar{d} = \frac{\Sigma d}{n} = \frac{10}{10} = 1$$

$$s^2 = \frac{1}{10-1}\left[44 - \frac{(10)^2}{10}\right]$$

$$= \frac{1}{9}\left(\frac{440-100}{10}\right)$$

$$= 3.78$$

$$t = \frac{\bar{d}}{\sqrt{\frac{s^2}{n}}} \quad \frac{1}{\sqrt{\frac{3.78}{10}}} \quad \frac{1}{0.61} = 1.64 \text{ approx.}$$

The critical value of t for 10 – 1, i.e., 9 degrees of freedom at 5 per cent level of significance is 1.83 (one-tail test). As the calculated t value is less than the critical value, it falls in the acceptance region. We, therefore, accept the null hypothesis and conclude that the reorganisation of the sales department did not have significant increase in the company's sales.

Test Concerning Proportions

Example 9

It is known from the past data that 10 per cent of the families in a certain locality subscribe to a periodical called "Outlook". Of late, there has been some apprehension that this subscription rate has declined. In order to test whether or not there has been a decline, a random sample of 100 families is chosen. It is found that the sample proportion p is 0.07, i.e., 7 per cent. Can it be concluded that the subscription rate has really declined, assuming a 5 per cent level of significance?

As we are interested to test whether or not there has been a decline in the subscription rate, let us assume that there has been no decline. The null and alternative hypotheses are:

$$H_0 : \pi = 10 \text{ per cent}$$

$$H_1 : \pi < 10 \text{ per cent}$$

The sample proportion is p = 7 per cent. Using the Z-test, we find that

$$Z = \frac{p - \pi}{\sigma_p} = \frac{p - \pi}{\sqrt{\frac{\pi(1-\pi)}{n}}}$$

$$= \frac{0.07 - 0.10}{\sqrt{\frac{(0.10)(0.90)}{100}}}$$

$$= -\frac{0.03}{\sqrt{\frac{0.09}{100}}}$$

$$= -\frac{0.03}{\sqrt{0.0009}}$$

$$= -\frac{0.03}{0.03}$$

$$= -1$$

The level of significance is 0.05, which means that $Z = \pm 1.64$ for a one-tail test. Further, as $Z = -1$ falls within the acceptance region as shown in Fig. 15.6, we accept the hypothesis that the subscription rate has not dropped. The management need not be unnecessarily alarmed and it may be concluded that the same subscription rate continues as before.

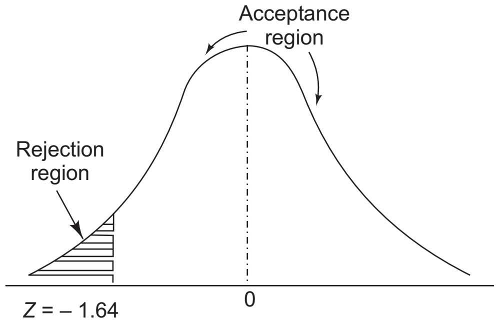

Fig. 15.6 Test of Hypothesis

$H_0 : \pi = 10$ per cent

Example 9 was a left-tail test. Let us take another example to illustrate a right-tail test.

Example 10

In 1983, 15 per cent of households in a certain city indicated that they owned a sewing machine. In 1985, there was reason to believe that there was some increase in this percentage. A survey based on a random sample of 900 households was taken and it was found that 189 households had a sewing machine. Can we conclude that there has been a significant increase in the sale of sewing machines?

As we are interested to test whether or not there has been a significant increase in the sale of sewing machines, we set up the null and alternative hypotheses as follows :

Null hypothesis, $H_0 : \pi = 15$ per cent

Alternative hypothesis, $H_1 : \pi > 15$ per cent

This is a right-tail test.

Now,

$$Z = \frac{p - \pi}{\sqrt{\dfrac{\pi(1-\pi)}{n}}}$$

$$= \frac{\dfrac{189}{900} - 0.15}{\sqrt{\dfrac{0.15(1-0.15)}{900}}}$$

$$= \frac{0.21 - 0.15}{\sqrt{\dfrac{0.15(1-0.15)}{900}}}$$

$$= \frac{0.06}{\sqrt{\dfrac{0.1275}{900}}}$$

$$= \frac{0.06}{0.0119} = 5.04$$

As the value of Z at $\alpha = 0.05$ is 1.64 for a one-tail test, the calculated value of Z falls in the rejection region. We, therefore, reject the null hypothesis and conclude that there has been a significant increase in the sale of sewing machines.

TEST OF DIFFERENCES BETWEEN TWO PROPORTIONS AND INDEPENDENT SAMPLES

Often, marketing researchers are interested in knowing whether or not there exist significant differences between the proportion of two groups of, say, consumers in respect of a certain activity. For example, they may like to know if male and female consumers show distinctive differences in their consumption of a particular product. An example of this type can be applied to other groups such as rural and urban consumers, educated and uneducated consumers, and so forth. While the procedure for testing hypothesis in such cases is the same as is used in the case of differences between means, there is one difference that the standard error of the difference between two proportions is used in place of the standard error of the difference between two means. The following formula is used for this purpose

$$\hat{\sigma}_{p_{1-2}} = \sqrt{\bar{p}(1-\bar{p})\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}$$

where $\hat{\sigma}_{p_{1-2}}$ is the estimated standard error of the differences between two proportons

$$\bar{p} = \frac{n_1 p_1 + n_2 p_2}{n_1 + n_2}$$

p_1 = proportion in sample 1

p_2 = proportion in sample 2

n_1 = size of sample 1

n_2 = size of sample 2

Let us take an example.

Example 11

A company maintains two regional offices. It is interested in knowing whether or not there are significant differences in the proportion of smokers in the two offices. In regional office A, a random sample of 70 employees was taken and it was found that 40 per cent were smokers. In regional office B, a random sample of 100 employees indicated 55 as smokers. Is the difference between the proportions of smokers in the two regional offices significant?

Let p_1 and p_2 be the proportion of smokers in regional offices A and B. Then null hypothesis, $H_0 : p_1 = p_2$.

Alternative hypothesis, $H_1 : p_1 \neq p_2$

$$\bar{p} = \frac{n_1 p_1 + n_2 p_2}{n_1 + n_2}$$

$$= \frac{(70 \times 0.4) + (100 \times 0.55)}{70 + 100}$$

$$= \frac{28 + 55}{170}$$

$$= 0.488 \text{ say, } 0.49$$

$$\hat{\sigma}_{p_{1-2}} = \sqrt{\bar{p}(1 - \bar{p})\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}$$

$$= \sqrt{0.49(1 - 0.49)\left[\frac{1}{70} + \frac{1}{100}\right]}$$

$$= \sqrt{0.2499 \times \frac{17}{700}}$$

$$= \sqrt{\frac{4.2483}{700}}$$

$$= 0.078$$

$$Z = \frac{p_1 - p_2}{\hat{\sigma}_{p_{1-2}}}$$

$$= \frac{0.4 - 0.55}{0.078}$$

$$= -1.92$$

From the normal area table, we find that the critical value of Z for 0.05 level of significance is $\pm$ 1.96. We, therefore, accept the null hypothesis and conclude that the difference between the two proportions of smokers is not significant.

Tests of Differences among Two or More Means, Independent Samples

When two or more means of independent samples are involved, analysis of variance ANOVA technique is used to test differences among such means. It is a powerful statistical tool that is frequently used in marketing research.

In order to understand ANOVA, it is desirable to discuss it in two parts: (i) one way classification, and (ii) two and three way classification. In this chapter, the discussion is confined to one-way classification which implies that there is only one criterion on the basis of which data are classified. The null hypothesis is

$$H_0 : \mu_1 = \mu_2 = \mu_3 \dots \mu_k$$

and the alternative hypothesis is

$$H_1 : \text{All the } \mu_i \text{ are not equal.}$$

The following steps are involved in the analysis of variance.

1. Calculate variance between the samples.
2. Calculate variance within the samples.
3. Calculate the F ratio by the following formula:

$$F = \frac{\text{Variance between the samples}}{\text{Variance within the samples}}$$

4. Compare the value of F as arrived in (3) above with the critical value of F such as 5% level of significance for the applicable degrees of freedom.

When the calculated value F is less than the table value of F, the difference in sample means is not significant and the null hypothesis is accepted. In contrast, when the calculated value of F is more than the critical value of F, the difference in sample means is regarded as significant and the null hypothesis is rejected.

This procedure of the analysis of variance can be understood with the help of a suitable illustration.

Example 12

Suppose a manufacturer of a breakfast food is interested to know the effectiveness of three different types of packaging. He puts each kind of packaged breakfast food into five different stores. He finds that during a given week the number of packages sold were as follows:

Packaging 1: 25, 28, 21, 30, 26
Packaging 2: 27, 25, 25, 33, 30
Packaging 3: 22, 29, 26, 20, 23

The mean sales of these three packagings are packaging 1 : 26, packaging 2 : 28 and packaging 3 : 24. What the manufacturer would like to know is whether the differences among these means are significant. If they are not significant, then they can be attributed to chance since the size of the sample is very small as the different packaged breakfast food was sold only in five stores.

Indicating the true average sale of three varieties of packagings per retail store by μ_1, μ_2 and μ_3, the null hypothesis can be written as $\mu_1 = \mu_2 = \mu_3$. The alternative hypothesis is that μ_1, μ_2 and μ_3 are not equal. For this purpose, we have to first calculate the variance of these observations as it is an obvious measure of the discrepancies in the data. This has been calculated in Table 15.6.

Now, the three sample variancs are

$$S_1^2 = \frac{1}{n_1} \sum_{j=1}^{n_1} (X_{1j} - \bar{X}_1)^2 = \frac{1}{5}(46) = 9.2$$

$$S_2^2 = \frac{1}{n_2} \sum_{j=1}^{n_2} (X_{2j} - \bar{X}_2)^2$$

$$= \frac{1}{5}(48) = 9.6$$

$$S_3^2 = \frac{1}{n_3}\sum_{j=1}^{n_3}(X_{3j} - \bar{X}_3)^2$$

$$= \frac{1}{5}(50) = 10$$

Table 15.6 Worksheet for Calculating Variances

Packaging 1			Packaging 2			Packaging 3		
X_{1_j}	$X_{1_j} - \bar{X}_1$	$(X_{1_j} - \bar{X}_1)^2$	X_{2_j}	$X_{2_j} - \bar{X}_2$	$(X_{2_j} - \bar{X}_2)^2$	X_{3_j}	$X_{3_j} - \bar{X}_3$	$(X_{3_j} - \bar{X}_3)^2$
25	– 1	1	27	– 1	1	22	– 2	4
28	+ 2	4	25	– 3	9	29	+ 5	25
21	– 5	25	25	– 3	9	26	+2	4
30	+ 4	16	33	+ 5	25	20	– 4	16
26	0	0	30	+ 2	4	23	– 1	1
130		46	140		48	120		50
Mean 26			28			24		

We can estimate the variance by the pooled variance method as follows:

$$\hat{\sigma}^2 = \frac{\Sigma\Sigma\,(X_{ij} - \bar{X}_i)^2}{n-1}$$

The numerator can be written as

$$\sum_i \sum_j \left(\sum X_{ij} - \bar{X}_i\right)^2 = \sum_j (X_{1j} - \bar{X}_1)^2 + \sum_j (X_{2j} - \bar{X}_2)^2 + \sum_j (X_{3j} - \bar{X}_3)^2$$

The denominator can be written as

$$n_1 + n_2 + n_3 - 3$$

$$= \frac{46 + 48 + 50}{5 + 5 + 5 - 3}$$

$$= \frac{144}{12}$$

$$= 12$$

The arithmetic mean of all 15 items is

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{3}\sum_{j=1}^{5} = \frac{1}{15}(130 + 140 + 120)$$

$$= 26$$

The pooled variance is

$$\hat{\sigma}^2 = \frac{n_1 s_1^2 + n_2 s_2^2 + n_3 s_3^2}{n_1 + n_2 + n_3 - 3}$$

$$= \frac{\sum_{j=1}^{n_1}(X_{1j} - \bar{X}_1)^2 + \sum_{j=1}^{n_2}(X_{2j} - \bar{X}_2)^2 + \sum_{j=1}^{n_3}(X_{3j} - \bar{X}_3)^2}{n-3}$$

$$= \frac{\sum_{i=1}^{3}\sum_{j=1}^{n_i}(X_{ij} - \bar{X}_i)^2}{n-3}$$

The variance σ^2 can also be estimated in another way.

Since $$\sigma_{\bar{x}}^2 = \frac{\sigma^2}{n}$$

or $$\sigma^2 = n\sigma_{\bar{x}}^2$$

By estimating $n\sigma_{\bar{x}}^2$, σ^2 can be estimated. For the first packaging we have

$$\sigma^2 = n_1 \ \alpha_{\bar{x}1}^2 = n_1 \ (\bar{X}_1 - \bar{X})^2$$

In the same manner, for the second and third packagings, we have

$$\sigma^2 = n_2 \ \sigma_{\bar{x}2}^2 = n_2 \ (\bar{X}_2 - \bar{X})^2$$

$$\sigma^2 = n_3 \ \sigma_{\bar{x}3}^2 = n_3 \ (\bar{X}_3 - \bar{X})^2$$

Thus $$3\ \sigma^2 = \sum_{ni}(\bar{X}_i - \bar{X})^2$$

or $$\sigma^2 = \frac{\sum_{ni}(\bar{X}_i - \bar{X})^2}{3}$$

Since we have $n - 1$, i.e., 3 – 1 degrees of freedom, this could be written as:

$$\hat{\sigma}^2 = \frac{\sum_{i=1}^{3} n_i \ (\bar{X}_i - \bar{X})^2}{3-1}$$

Now we may use the F-test in order to put the comparison of these two estimates of σ^2 on a rigorous basis.

$$F = \frac{\text{Estimate of } \sigma^2 \text{ based on the variation among the } \bar{X}_s}{\text{Estimate of } \sigma^2 \text{ based on the variation within the samples}}$$

$$= \qquad = \frac{\dfrac{\sum_{i=1}^{n} n_i \ (\bar{X}_i - \bar{X})^2}{3-1}}{\dfrac{\sum_{i=1}^{3}\sum(\bar{X}_{ij} - \bar{X}_i)^2}{n-3}}$$

$$= \frac{\sum_{i=1}^{3} \sum_{j=1} \left(\bar{X}_{ij} - \bar{X}_i\right)^2}{n - 3}$$

$$= \frac{46 + 48 + 50}{15 - 3}$$

$$= \frac{144}{12} = 12$$

The numerator is

$$\frac{\sum_{i=1}^{n} n_i \left(\bar{X}_i - \bar{X}\right)^2}{3 - 1}$$

Since $n_1 = n_2 = n_3 = 5$, this could be writen as

$$\frac{5[(\bar{X}_1 - \bar{X})^2 + (\bar{X}_2 - \bar{X})^2 + (\bar{X}_3 - \bar{X})^2]}{3 - 1}$$

$$= \frac{5[(26 - 26)^2 + (28 - 26)^2 + (24 - 26)^2]}{3 - 1}$$

$$= \frac{(5)\,(0 + 4 + 4)}{2}$$

$$= 20$$

$$\therefore \qquad F_0 = \frac{20}{12}$$

$$= 1.67 \text{ approx.}$$

Since an F distribution with 2 and 12 degrees of freedom, for $\alpha = 5$ per cent is

$$P\,[F > 3.89/2,\ 12] = 0.05$$

Since $F_0 = 1.67 < F_0\, 0.95 = 3.89$, we accept the null hypothesis, i.e., $\mu_1 = \mu_2 = \mu_3$. In other words, there is no significant difference among the means of three packagings and the three samples come from the same population.

The foregoing example can be summarised in an analysis of variance table as follows:

Table 15.7 Analysis of Variance Table

Variation	**Sum of squares**	**Degrees of freedom**	**Mean square**
Between	40	3 – 1	$S'_A = 40/2 = 20$
Within	144	15 – 3	$S'_E = 144/12 = 12$
Total	184	15 – 1	$S'_T = 184/14 = 13.14$

The variance ratio is

$$F_0 = \frac{20}{12} = 1.67 \text{ approx. (The same as shown earlier)}$$

Assumptions of the Analysis of Variance

At this stage, it may be worthwhile to understand the assumptions involved in the analysis of variance. Mere familiarity with the procedure of carrying out an analysis of variance is not enough. The researcher ought to know whether the use of this technique to a given data is justified. The following are the assumptions implicit in the use of an analysis of variance.

1. The data are quantitative in nature and are normally distributed. In many cases, marketing research generates nominal or ordinal data whose results are given in percentages or ranks. Analysis of variance in respect of such data should not be carried out.
2. The samples drawn from the population are on a random basis. In case of experimental designs, the treatments must be assigned to test units by means of some randomising device.
3. The variances of the population from which samples have been drawn are equal.

The researcher should ensure the fulfilment of these assumptions. However, sometimes one may find that all the three assumptions may not hold good in entirety and, as such, there may be some deviation in the data. But this is not likely to impair the relevance of the *F*-test which can still be used.

NON-PARAMETRIC TESTS

There are certain situations, particularly in psychological or marketing research studies where the assumption underlying the parametric tests is not valid. In other words, there is no assumption that a particular distribution is applicable, or that a certain value is attached to a parameter of the population. In such cases, instead of parametric tests non-parametric tests are used. These tests are also known as distribution-free tests. There are a number of such tests such as chi-square test, the McNemar test, rank-sum test, etc.

A major advantage of non-parametric tests is that they are quick and easy to use. Moreover, when data are not as accurate as they should be for proper application of standard tests of significance, then these tests which are very convenient to use, can give fairly satisfactory results.

It may be noted that the use of a non-parametric test involves a greater risk of accepting a false hypothesis and thus committing a type II error. Further, as the null hypothesis is rather loosely defined and when it is rejected, then the non-parametric test yields a less precise result as compared to the parametric test.

Some of the non-parametric tests that are frequently used will be discussed here.

Chi-square One-sample Test

At times the researcher is interested in determining whether the number of observations or responses that fall into various categories differ from chance. If the data are nominally scaled, a chi-square test is applied. When tests are undertaken to examine whether the sample data support the hypothetical distribution, such problems are called tests of goodness of fit.

The chi-square test requires the following steps:

1. State the null hypothesis and calculate the number in each category if the null hypothesis were correct.

2. Determine the level of significance, that is, how much risk of the type I error the researcher is prepared to take.
3. Calculate χ^2 as follows.

$$\chi^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i}$$

where O_i = observed frequency in ith category
E_i = expected frequency in ith category
k = number of categories

4. Determine the number of degrees of freedom. For the specified level of significance and the degrees of freedom, find the critical or theoretical value of χ^2.
5. Compare the calculated value of χ^2 with the theoretical value and determine the region of rejection.

Let us illustrate the use of the χ^2 test, taking a hypothetical example.

Example 13

A company has been engaged in the manufacture of ice cream which is sold in three sizes, namely large, normal and small. It has observed that it sells the ice cream in large, normal and small packs in the ratio of 3 : 5 : 2. The company has been thinking of introducing a different flavour, and has conducted a test market for two weeks in a certain territory. The results of the test market show that it has sold 250 large packs, 400 normal packs and 350 small packs of newly developed ice cream. The company is now interested to know whether the consumption pattern of the new ice cream is different from that of the earlier one. If so, it may have to change the percentage of three different packs for the new ice cream.

We first set up a null hypothesis that the consumption pattern of the new ice cream is not different from that of the earlier one. Now, the value of χ^2 is to be calculated.

Table 15.8 Worksheet for the Calculation of Chi-Square

Package size	Observed frequency	Expected frequency	O – E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Large	250	300	– 50	2500	8.33
Normal	400	500	– 100	10000	20.00
Small	350	200	150	22500	112.50
					$\chi^2 = 140.83$

Degree of freedom 3 – 1 = 2. At 5% level of significance the critical value of χ^2 for 2 degrees of freedom is 5.991. Since the calculated χ^2 is more than the critical value of χ^2, it falls in the rejection region. We, therefore, reject the null hypothesis that the consumption pattern of new ice cream is not different from the earlier one. In other words, it is different from what it has been in respect of the earlier ice cream.

The McNemar Test

When the research design involves a before-and-after situation and the data are measured nominally, the McNemar test is applicable. This test may be used to test the effectiveness of a particular treatment such as an advertising campaign, or a scheme of discount coupons to promote the sale of a particular brand. Let us illustrate the application of the McNemar test.

Example 14

Suppose that a company manufacturing 'lux' toilet soap gets regular consumer panel data regarding purchases of the panel members. The company has launched an advertising campaign to boost the sale of lux soap. It uses the same panel comprising 500 families. The company gets the data after its advertising campaign and finds its position as shown in Table 15.9.

It should be noted that Cells *B* and *C* show a change between the first and second periods. A family is placed in cell *B* if it purchased lux soap before the advertising campaign and another soap after the campaign. Likewise, a family is placed in cell *C* if it purchased other brands before the advertising campaign but switched over to lux soap after the campaign. Cells *A* and *D* show the number of families which do not show any change in their buying behaviour, that is, these families continued to patronise the same brand of soap during the two periods.

The question is whether the advertising campaign was a success. The null hypothesis is that the advertising campaign was not successful which would imply that the buying behaviour of families did not change as a result of it. If the null hypothesis holds good, it would mean that the proportion changing from another brand to lux soap would be the same as the proportion changing from lux soap to another brand. It is, therefore, necessary to examine the changes depicted by cells *B* and *C*.

Table 15.9 Purchase of Soaps Before and After the Advertising Campaign

Before advertising campaign	After advertising campaign		Total
	Purchased Lux soap	Purchased other brands	
Purchased lux soap	80 (A)	60 (B)	140
Purchased other brands	100 (C)	260 (D)	360
Total	180	320	500

The McNemar test involves the calculation of chi-square according to the following formula:

$$\chi^2 = \frac{[|C - B| - 1]^2}{C + B}$$

$$= \frac{[|100 - 60| - 1]^2}{160}$$

$$= 9.51 \text{ approx.}$$

The calculated value of χ^2 turns out to be 9.51 approx. The critical value of χ^2 for $\alpha = 0.05$ and $(r - 1)(c - 1) = 1$ degree of freedom is 3.84. As the calculated χ^2 exceeds the critical value, the null hypothesis is rejected. We, therefore, conclude that the advertising campaign resulted in a positive outcome, i.e., it increased the purchase rate of Lux soap.

Kolmogorov–Smirnov One-Sample Test

This test is concerned with the degree of agreement between a set of observed values and the values specified by the null hypothesis. It is similar to the chi-square test of goodness of fit. It is used when the researcher is interested in comparing a set of values on an ordinal scale. Let us take an example.

Example 15

Suppose a company has conducted a field survey covering 200 respondents. Apart from other questions, it asked the respondents to indicate on a 5-point scale how much the durability of a particular product is important to them. The respondents indicated as follows:

Very important	50	
Somewhat important	60	
Neither important nor unimportant	20	
Somewhat unimportant	40	
Very unimportant	30	
	200	Respondents

In order to apply the Kolmogorov–Smirnov test to the above data, first of all we should have the cumulative frequency distribution from the sample. Second, we have to establish the cumulative frequency distribution which would be expected on the basis of the null hypothesis. Third, we have to determine the largest absolute deviation between the two distributions mentioned above. Finally, this value is to be compared with the critical value to ascertain its significance.

Table 15.10 shows the calculations.

Table 15.10 Worksheet for the Kolmogorov–Smirnov *D*

Importance of durability	Observed number	Observed proportion	Observed cumulative proportion	Null proportion	Null cumulative proportion	Absolute difference observed and null
Very important	50	0.25	0.25	0.2	0.2	0.05
Somewhat important	60	0.30	0.55	0.2	0.4	0.15
Neither important nor unimportant	20	0.10	0.65	0.2	0.6	0.05
Somewhat unimportant	40	0.20	0.85	0.2	0.8	0.05
Very unimportant	30	0.15	1.00	0.2	1.0	0.00

From Table 15.10 one finds that the largest absolute difference is 0.15, which is known as the Kolmogorov–Smrinov *D* value. For a sample size of more than 35, the critical value of *D* at an alpha of 0.05 is $\frac{1.36}{\sqrt{n}}$. As sample size in this example is 200, $D = \frac{1.36}{\sqrt{200}} = 0.096$. As the calculated *D* exceeds the critical value of 0.096, the null hypothesis that there is no difference in importance ratings for durability among the respondents is rejected.

The Two-sample and K-sample Median Tests

In order to perform this test, let us use our previous example, which pertains to the downtimes of the two computers. The median of the **combined data** is 52, which can easily be checked. There are 5 values below 52 and 15 values about it, in case of computer *A*. As regards computer *B*, the corresponding figures are 16 and 6. All this information is summarised in Table 15.11 which also indicates the totals of the rows and columns.

Table 15.11 Classification of Downtime for Computers *A* and *B*

	Below median	**Above median**	**Total**
Computer *A*	5	15	20
Computer *B*	16	6	22
Total	**21**	**21**	**42**

Our null hypothesis H_0 is that there is no difference in the median downtime for the two computers. The alternative hypothesis H_1 is that there is difference in the downtime of the two computers.

We now calculate the expected frequencies by the formula (Row$_i$ × Column$_i$)/Grand total. Thus, Table 15.12 shows both the observed and the expected frequencies. Of course, we could have obtained these results by arguing that half the values in each sample can be expected to fall above the median and other half below it.

Table 15.12 Calculation of Chi-square

Observed frequencies (O)	**Expected frequencies (E)**	**O – E**	**(O – E)**	**(O – E)²/E**
5	10	–5	25	2.50
15	10	5	25	2.50
16	11	5	25	2.27
6	11	–5	25	2.27
			Total	9.54

$$\chi^2 = \Sigma \frac{(O_i - E_i)^2}{E_i} = 9.54$$

The critical value of χ^2 at 0.05 level of significance for (2–1) (2–1) = 1 degree of freedom is 3.841 (Appendix Table 5). Since the calculated value of χ^2 exceeds the critical value, the null hypothesis has to be rejected. In other words, there is no evidence to suggest that the downtime is the same in case of the two computers.

It may be recalled that in the previous example having the same data, the null hypothesis could not be rejected. In contrast, we find here that the two-sample median test has led to the rejection of the null hypothesis. This may be construed as evidence that the median test is not quite so wasteful of the information as the sign test. However, in general, it is very difficult to make a meaningful comparison of the merits of two or more non-parametric tests, which can be used for the same purpose.

The K-sample Median Test

The median test can easily be generalised so that it can be applied to K-samples. In accordance with the earlier procedure, first find the median of the combined data. We then determine how many of the values in each sample fall above or below the median. Finally, we analyse the resulting contingency table by the method of chi-square. Let us take an example.

Example 16

Suppose that we are given the following data relating to marks obtained by students in Statistics in the three different sections of a B.Com class in a certain college. The maximum marks were 100.

Section A	46	60	58	80	66	39	56	61	81	70
	75	48	43	64	57	59	87	50	73	62
Section B	60	55	82	70	46	63	88	69	61	43
	76	54	58	65	73	52				
Section C	74	67	37	80	72	92	19	52	70	40
	83	76	68	21	90	74	49	70	65	58

Test whether the differences among the three sample means are significant.

Solution

In case of such problems, analysis of variance is ordinarily performed. However, here we find that the data for Section C have much more variability as compared to the data for the other two sections. In view of this, it would be wrong to assume that the three population standard deviations are the same. This means that the method of one-way analysis of variance cannot be used.

In order to perform a median test, we should first determine the median of the combined data. This comes out to 63.5, as can easily be checked. Then we count how many of the marks in each sample fall below or above the median. Thus, the results obtained are shown in Table 15.13.

Table 15.13 Worksheet for Calculating Chi-square

	Below Median	Above Median	Total
Section A	12	8	20
Section B	9	7	16
Section C	7	13	20
Total	**28**	**28**	**56**

O the basis of $\left(\dfrac{\text{Row total} \times \text{Column total}}{\text{Grand total}}\right)$, the expected frequencies for each cell can be worked out. Thus the corresponding expected frequencies for Section A are 10 and 10, for Section B are 8 and 8, and for Section C 10 and 10. We can now obtain the value of chi-square. These calculations are shown below:

$$\chi^2 = \frac{(12-10)^2}{10} + \frac{(8-10)^2}{10} + \frac{(9-8)^2}{8} + \frac{(7-8)^2}{8} + \frac{(7-10)^2}{10} + \frac{(13-10)^2}{10}$$

$$= 0.4 + 0.4 + 0.125 + 0.125 + 0.9 + 0.9 = 2.85$$

Now, we have to compare this value with the critical value of χ^2 at 5 per cent level of significance. This value is 5.991 for 2 ($K - 1 = 3 - 1$) degrees of freedom (Appendix Table 5). As the calculated value of χ^2 is less than the critical value, the null hypothesis that there are no differences in the average marks, cannot be rejected. Hence we conclude that there is no significant difference in the true average (median) marks obtained by the students in Statistics test from the three sections.

Wilcoxon Matched-Pairs Test (Or Signed Rank Test)

Wilcoxon matched-pairs test is an important non-parametric test, which can be used in various situations in the context of two related samples such as a study where husband and wife are matched or when the output of two similar machines are compared. In such cases we can determine both direction and magnitude of difference between matched values, using Wilcoxon matched-pairs test.

Procedure of Wilcoxon Matched-pair Test

The procedure involved in using this test is simple. To begin with, the difference (d) between each pair of values is obtained. These differences are assigned ranks from the smallest to the largest, ignoring signs. The actual signs of differences are then put to corresponding ranks and the test statistic T is calculated, which happens to be the smaller of the two sums, namely, the sum of the negative ranks and the sum of the positive ranks.

There may arise two types of situations while using this test. One situation may arise when the two values of some matched-pair(s) is/are equal as a result the difference (d) between the values is zero. In such a case, we do not consider the pair(s) in the calculations. The other situation may arise when we get the same difference (d) in two or more pairs. In such a case, ranks are assigned to such pairs by averaging their rank positions. For instance, if two pairs have rank score of 8, then each pair is assigned 8.5 rank [(8 + 9)/2 = 8.5] and the next largest pair is assigned the rank 10.

After omitting the number of tied pairs, if the given number or matched pairs is equal to or less than 25, then the table of critical value T is used for testing the null hypothesis. When the calculated value of T is equal to or smaller than the table (i.e., critical) value at a desired level of significance, then the null hypothesis is rejected. In case the number exceeds 25, the sampling distribution of T is taken as approximately normal with mean $\mu_T = n\,(n + 1)/\mu$ and standard deviation

$$\sigma_T = \sqrt{n(n+1)\,(2n+1)/24}$$

where n is taken as the number of given matched pairs—number of tied pairs omitted, if any. In such a situation, the test Z statistic is worked out as follows:

$$Z = (T - \mu_r)/\sigma_r$$

Let us now take an example to illustrate the application of Wilcoxon matched-pairs test.

Example 17

The management of the Punjab National Bank wants to test the effectiveness of an advertising company that is intending to enhance the awareness of the bank's service features. It administered a questionnaire before the advertising campaign, designed to measure the awareness of services offered. After the advertising campaign, the bank administered the same questionnaire to the same group of people. Both the before and after advertising campaign scores are given in the following table.

Consumer Awareness of Bank Services Offered

Consumer	1	2	3	4	5	6	7	8	9	10
Before ad campaign	82	81	89	74	68	80	77	66	77	75
After ad campaign	87	84	84	76	78	81	79	81	81	83

Using Wilcoxon matched-pairs test, test the hypothesis that there is no difference in consumer awareness of bank services offered after the advertising campaign.

Solution

Table 15.14 Application of Wilcoxon Matched-pairs Test

Consumer	AfterAd Campn.	Before Ad Campn.	Diff. d_i	Rank of d_i	Rank(–) Sign	Rank(+) Sign
1	87	82	5	6.5		6.5
2	84	81	3	4		4
3	84	89	– 5	6.5	– 6.5	
4	76	74	2	2.5		2.5
5	78	68	10	9		9
6	81	80	1	1		1
7	79	77	2	2.5		2.5
8	81	66	15	10		10
9	81	77	4	5		5
10	83	75	8	8		8
				Total	**– 6.5**	**+ 48.5**

Null hypothesis H_0 : There is no difference in the consumer awareness of bank services after the ad campaign.

Alternative hypothesis H_1 There is difference in the consumer awareness of bank services after the ad campaign.

Computed 'T' value is 6.5. The critical value of T for $n = 10$ at 5 per cent level of significance is 8 (Appendix Table 6). Since the computed T value is less than the critical T value, the null hypothesis is rejected. We can conclude that after the ad campaign there is difference in the consumer awareness of the bank's services. Our conclusion that there is some difference in the consumer awareness of the bank's services needs some explanation. Had there been no difference in the awareness before and after the ad campaigns, the sum of positive and negative ranks would have been almost equal. However, if the difference between the two series being compared is larger, then the value of T will tend to be smaller as it is defined as smaller of ranks. This is the case we find in this problem. It may be noted that with this test the calculated value of T must be smaller than the critical value in order to reject the null hypothesis.

Rank Sum Tests

The Mann–Whitney U Test

Although there are a number of rank sum tests, we shall confine ourselves to just two such tests—the Mann–Whitney U test and the Kruskal–Wallis test. When only two populations are involved we shall use the former test. When more than two populations are involved, we shall use the latter test. It may be pointed out that as these tests use ranking data rather than plus and minus signs, their use will definitely be less wasteful than the sign test.

One of the most common and best known distribution-free tests is the Mann–Whitney test for two independent samples. The logical basis of this test is particularly easy to understand. Suppose we have two independent treatment groups, with n_1 observations in Group 1 and n_2 observations in Group 2. Now, we assume that the population from which Group 1 scores have been sampled contained generally lower values than the population from which Group 2 scores were drawn. If we were to rank these scores disregarding the group to which they belong then the lower ranks would generally fall to Group 1 scores and the higher ranks would generally fall to Group 2 scores. Proceeding one step further, if we were to add together the ranks assigned to each group, the sum of the ranks in Group 1 would be expected to be considerably smaller than the sum of the ranks in Group 2. This would result in the rejection of the null hypothesis.

Let us now take another situation where the null hypothesis is true and the scores for the two groups are sampled from identical populations. If we were to rank all N scores regardless of the group, we would expect a mix of low and high ranks in each group. Thus, the sum of the ranks assigned to Group 1 would be broadly equal to the sum of the ranks assigned to Group 2.

The Mann–Whitney test is based on the logic just described, using the sum of the ranks in one of the groups as the test statistic. In case that sum turns out to be too small as compared to the other sum, the null hypothesis is rejected. The common practice is to take the sum of the ranks assigned to the smaller group, or if $n_1 = n_2$, the smaller of the two sums as the test statistic. This value is then compared with the critical value that can be obtained from the table of the Mann–Whitney statistic (W_s) to test the null hypothesis.

Let us take an example to illustrate the application of this test.

Example 18

The following data indicate the lifetime (in hours) of samples of two kinds of light bulbs in continuous use:

Brand A	603	625	641	622	585	593	660	600	633	580	615	648
Brand B	620	640	646	620	652	639	590	646	631	669	610	619

We are required to use the Mann–Whitney test to compare the lifetimes of brands A and B light bulbs.

Solution

The first step for performing the Mann–Whitney test is to rank the given data *jointly* (as if they were one sample) in an increasing or decreasing order of magnitude. For our data, we thus obtain the following array where we use the letters A and B to denote whether the light bulb was from brand A or brand B.

Table 15.15 Ranking of Light Bulbs of Brands A and B

Sample score	Group	Rank	Sample score	Group	Rank
580	A	1	625	A	13
585	A	2	631	B	14
590	B	3	633	A	15
593	A	4	639	B	16
600	A	5	640	B	17
603	A	6	641	A	18
610	B	7	646	B	19.5
615	A	8	646	B	19.5
619	B	9	648	A	21
620	B	10.5	652	B	22
620	B	10.5	660	A	23
622	A	12	669	B	24

As both the samples come from identical populations, it is reasonable to assume that the means of the ranks assigned to the values of the two samples are more or less the same. As such, our null hypothesis is:

H_0 : Means of ranks assigned to the values in the two groups are the same.

H_1 : Means are not the same.

However, instead of using the means of the ranks, we shall use *rank sums* for which the following formula will be used.

$$U = n_1 n_2 + [n_1(n_1 + 1)]/2 - R_1$$

where n_1 and n_2 are the sample sizes of Group 1 and Group 2, respectively, and R_1 is the sum of the ranks assigned to the values of the first sample. In our example, we have $n_1 = 12$, $n_2 = 12$ and $R_1 = 1 + 2 + 4 + 5 + 6 + 8 + 12 + 13 + 15 + 18 + 21 + 23 = 128$. Substituting these values in the above formula,

$$U = (12)\ (12) + [12\ (12 + 1)]/2 - 128$$

$$= 144 + 78 - 128$$

$$= 94$$

From Appendix Table 7 for n_1 and n_2, each equal to 12, and for 0.05 level of significance is 37. Since the critical value is smaller than the calculated value of 94, we accept the null hypothesis and conclude that there is no difference in the average lifetimes of the two brands of light bulbs. For this test, the computed value must be less than the critical value U to reject the null hypothesis.

The test statistic we have just applied is suitable when n_1 and n_2 are less than or equal to 25. For larger values of n_1 and/or n_2, we can make use of the fact that the distribution of W_s approaches a normal distribution as sample sizes increase. We can then use the Z test to test the hypothesis.

The Normal Approximation

When both n_1 and n_2 are more than 10, the sampling distribution of the U statistic can be approximated by the normal distribution. As our problem meets this requirement, we can also apply the normal approximation to this problem. For this, we have to use the Z statistic.

1. Mean = $\mu u = [(n_1 n_2/2] = [(12 \times 12)/2] = 72$

2. Standard error $= \sqrt{\dfrac{n_1 n_2 (n_1 + n_2 + 1)}{12}}$

$$= \sqrt{\frac{12 \times 12\,(12 + 12 + 1)}{12}}$$

$$= \sqrt{300} = 17.3$$

3. (Statistic – Mean)/Standard deviation

$$= (94 - 72)/17.3 = 1.27$$

The critical value of Z at 0.05 level of significance is 1.96. Since the calculated value of Z=1.27 is smaller than 1.96, the null hypothesis is accepted. This shows that there is no difference in average lifetimes of brands A and B bulbs. The Z test is more dependable as compared to the earlier one. Both the tests give the same result. It may be noted that Mann–Whitney test required fewer assumptions than the corresponding standard test. In fact, the only assumption required is that the populations from which samples have been drawn are continuous.

The Kruskal–Wallis Test

This test is a direct generalisation of the Mann-Whitney test to the case in which we have three or more independent groups. It tests the null hypothesis that all samples came from identical populations. As against this, the alternative hypothesis is that the means of the populations are not all equal.

To perform the Kruskal–Wallis test, we have to rank all scores without regard to groups to which they belong and then compute the sum of the ranks for each group. The sums are denoted by R_i. If the null hypothesis is true, we would expect the $R_i s$ to be moe or less equal.

The formula used in this test is

$$H = \frac{12}{n(n+1)} \sum_{i=1}^{K} \frac{R_i^2}{n_i} - 3\,(n+1)$$

where H is test statistic, $n = n_1 + n_2 + \ldots + n_K$ is the total number of observations in all samples and R_i is the sum of ranks of all items in sample i.

If the null hypothesis is true and each sample is at least of size 5, the sampling distribution of this statistic can be approximated closely with a chi-square distribution with $K - 1$ degrees of freedom. Consequently, we can reject the null hypothesis at a level of significiance if H exceeds χ^2_α for $K - 1$ degrees of freedom. If the size of one or more samples is too small to use this approximation, the test will have to be based on special tables.

Let us take an example to illustrate the application of the Kruskal–Wallis test.

Example 19

Suppose that three groups of salesmen (being employees of a company) underwent training. The method of training used was different for each group. When training was completed, the salesmen were given a test. The marks scored by them are shown below:

Training method A	75	83	68	85	90	61	
Training method B	62	70	67	82	80	87	64
Training method C	65	71	74	63	89		

We have to use the Kruskal–Wallis Test to find out whether there was difference in the effectiveness of the three training methods.

Solution

First of all, we set up the null hypothesis that there was no difference in the effectiveness of the three training methods. The alternative hypothesis is: there was difference in the effectiveness of the three training methods. As a next step, we have to rank these data taking all the three groups as if they are one. We start with the highest marks as rank one and proceed in a descending order.

Table 15.16 Ranking of Marks in Three Groups

Marks	90	89	87	85	83	82	80	75	74
Group	A	C	B	A	A	B	B	A	C
Rank	1	2	3	4	5	6	7	8	9
Marks	71	70	68	67	65	64	63	62	61
Group	C	B	A	B	C	B	C	B	A
Rank	10	11	12	13	14	15	16	17	18

The observations in the first sample are assigned the ranks 1, 4, 5, 8, 12, and 18 so that $R_1 = 48$. Observations in the second sample are assigned the ranks 3, 6, 7, 11, 13, 15, and 17 so that $R_2 = 72$. Observations in the third sample are assigned the ranks 2, 9, 10, 14, and 16 so that $R_3 = 51$. Substituting the values obtained for R_1, R_2 and R_3 together with $n_1 = 6$, $n_2 = 7$ and $n_3 = 5$ in the formula for H, we get.

$$H = \frac{12}{n\,(n+1)} \sum_{i=1}^{K} \frac{R_i^2}{n_i} - 3\,(n+1)$$

After calculating H, it will be evaluated against the chi-square distribution with $K - 1$ degrees freedom.

$$H = \frac{12}{18\,(18+1)} \left(\frac{48^2}{6} + \frac{72^2}{7} + \frac{51^2}{5} \right) 3\,(18+1)$$

$$= \frac{12}{342} \left(\frac{2{,}304}{6} + \frac{5{,}184}{7} + \frac{2{,}601}{5} \right) - 57$$

$$= 0.035\,(384 + 740.571 + 520.2) - 57$$

$$= (0.035 \times 1{,}644.771) - 57 = 57.57 - 57 = 0.57$$

The critical value of $\chi^2_{0.05}$ for $K - 1 = 3 - 1 = 2$ degrees of freedom is 5.991 (Appendix Table 3). Since the calculated value of $H = 0.57$ (which can be treated as a chi-square) is less than the critical value of χ^2, the null hypothesis cannot be rejected. In other words, we can conclude that there is no difference in the effectiveness of the three methods of training imparted to salesmen.

Conclusion on Non-parametric Tests

As was mentioned earlier, non-parametric tests are suitable when stringent assumptions about the population may not be necessary. A major advantage of such tests is that they need limited information though, as a result, they are less powerful. Since there are several non-parametric tests, one has to be careful in choosing the most appropriate test for a given set of data or problem.

Summary

This chapter has first dealt with the concept of hypothesis and the steps involved in testing it. This is followed by a discussion on two types of error – Type I error and Type II error – that are likely to be made in testing a hypothesis. Type I error arises when the hypothesis is true but the test leads to its rejection. Type II error arises when the hypothesis is false but the test leads to its acceptance. Examples have been given to explain both types of error.

The chapter then discusses hypothesis testing with examples. The concept of one-tail test and two-tail test has been explained with examples. Since different tests are used for large and small samples, examples have been given specifically to bring out this aspect. The chapter thus discusses the application of the Z-test and the t-test. While dealing with tests of differences among two or more means, analysis of variance (ANOVA) technique has been explained with an illustration pointing out that the researcher should ensure the compliance of certain assumptions before using it. The application of a number of non-parametric tests in hypothesis testing has also been explained with examples. At the end, the chapter points out that non-parametric tests are suitable when stringent assumptions about the population may not be necessary.

Key Terms and Concepts

Questions

1. What is a hypothesis?
2. Explain the terms—null hypothesis and alternative hypothesis.
3. What steps are involved in statistical testing of a hypothesis?
4. "A hypothesis can only be rejected but it can never be accepted". Do you agree with this statement? Why or why not?
5. Explain how hypothesis testing is useful to marketing people.
6. What is a Type I error?
7. What is a Type II error?
8. Explain the relationship between Type I and Type II errors.
9. Distinguish between a one-tail test and a two-tail test.
10. When would you prefer (i) a one-tail test, and (ii) a two-tail test?
11. What do you understand by nonparametric tests?
12. What are the major advantages and limitations of nonparametric tests?
13. Enumerate the different nonparametric tests and explain any two of them.
14. State the conditions necessary for the use of the following tests.
    (a) *Z*-test of a mean
    (b) *t*-test
    (c) chi-square one-sample test
    (d) The McNemar test
    (e) Kolmogorov-Smirnov one-sample test
    (f) One-way ANOVA
15. What is the major difference between parametric and non-parametric tests?
16. Below are given a few situations characterised by (i) the type of data involved, (ii) sample size, (iii) whether or not the sample is independent, and (iv) the number of samples. Identify one or more tests that would be suitable in these situations.

Data	Sample size	Whether or not independent sample	No. of samples
(i) Interval	60	Yes	1
(ii) Nominal	150	Yes	1
(iii) Ordinal	80	Yes	1
(iv) Ordinal	30	No	2
(v) Interval	25	Yes	1
(vi) Ratio	50	Yes	2

17. A pharmaceutical company has just introduced a new medicine to bring about almost instantaneous relief from headache. It claims that its medicine, which is in tablet form, is 75 per cent effective. A random sample of 200 persons was taken. Of these, 136 persons opined that the new tablet did cure their headache almost immediately. Assuming an alpha risk of 0.05, can it be said tht the clam made by the company with regard to its new medicine is legitimate?

18. Two salesmen, A and B, are employed by a company. The comprative data pertaining to sales made by the two salesmen are as follows:

	Salesman A	Salesman B
No. of sales	30	35
Average sales (Rs)	600	700
Standard deviation (Rs)	50	40

Do the average sales of the two salesmen differ significantly?
Assume alpha risk of 0.05.

19. A company has a large number of salesmen all over the country. It has found that the average sales of its product per salesman amounted to 650 units with a standrd deviation of 160 units. I has now decided to provide them training and to see whether it makes any difference in their sales performance. Accordingly, 100 salesmen were given intensive training for some time. It found that average sales of these salesmen amounted to 700 units. Is thre a significant difference between the sales performance of salesmen prior to training and after the training at 5 per cent level of significance?

20. A company has been engaged in advertising for its soft drink brand from time to time. It has now decided that if less than 25% of the consumers like it, the advertising campaign would be changed. A survey covering 400 consumers indicated that 125 respondents liked the advertising campaign.
    (a) Which statistical test would you use? Why?
    (b) Determine whether the advertising campaign needs to be changed. Why or why not?

21. A company having 17 stores across Delhi is thinking of end-of-season sale on airconditioners. After launching the sale campaign, it found that a sample of 8 stores recorded the sale of airconditioners as follows:
    50 30 25 5 20 17 43 10
    (a) Test the hypothesis that more than 25 airconditioners per store were sold during this sale. Use $\alpha = 0.05$.
    (b) In order to perform this test, what assumption is necessary?

22. A travel agency based in Delhi is interested to know consumer preferences for its package tours to different tourist centres within the country. The agency had offered two similarly priced package tours different in respect of places covered in two packages. The agency has been maintaining its records on a monthly basis.
    The number of people who availed themselves of the two packages during the past six months is given below:

Month	Package Tour I	Package Tour II
1	70	80
2	60	90
3	90	70
4	100	90
5	80	100
6	110	80

The travel agency has approached you to ascertain whether there is a difference in preferences for the two tours. Use an appropriate test applying $\alpha = 0.05$ level of significance.

23. A marketing researcher interested in the business-publication reading habits of purchasing agents has assembled the following data:
Business Publication Preferences (First-Choice Mentions)

Business publication	Frequency of first choice
A	40
B	50
C	30
D	25

(a) Test the null hypothesis ($\alpha = 0.05$) that there are no differences among frequencies of choice for publications A, B, C, and D.
(b) Suppose frequencies of business publication A and C and B and D are aggregated. Test the null hypothesis that there are no differences among frequencies in the two publication pairs.

16 Bivariate Analysis

Learning Objectives

After reading this chapter, you should be able to understand:

- Chi-square
- Correlation
- Rank Correlation
- Regression Analysis
- Analysis of Variance

Chapter 14 addressed itself to the simple analysis of data covering measures of central tendency and dispersion. In addition, the latter part of the chapter was devoted to statistical estimation. With that background, the preceding chapter discussed the testing of hypotheses and explained the use of the Z-test, the *t*-test analysis of variance, etc. So far, the discussion related to only one variable. However, the marketing researcher would normally come across situations or problems which are complex, involving two or more variables, in which case, an analysis based on only one variable will not be relevant. The bivariate and multivariate analysis would be more appropriate than the univariate analysis. Accordingly, this chapter deals with the bivariate analysis and the next one with the multivariate analysis.

CHI-SQUARE

In examining the relationship between two or more variables, the first step is to set up a frequency table which, in such cases, is called a contingency table. An example of such a table was given in Chapter 13 where Table 13.2 showed two variables—the income level and preference for shopping centers of 500 households. It had two rows and two columns. Each cell of a contingency table shows a certain relationship or interaction between the two variables. In general, a contingency table is of $r \times c$ size, where r indicates the number of rows and c indicates the number of columns.

In Chapter 15 we used the chi-square test as a test of goodness of fit, where the population and sample were classified on the basis of a single attribute. It may be noted that the chi-square test need not be confined to a multinomial population but can be applied to other continuous distributions such as the normal distribution. Here, we will be concerned with the use of chi-square as a test of independence. With the help of this technique, we can test whether or not two or more attributes are associated. Suppose we have a certain number of observations classified according to two attributes. We may like to know if the two attributes are independent or associated. *For example,* we may wish to know whether a newly introduced medicine is effective in the treatment of a certain disease. Let us take a numerical example to explain the use of chi-square in ascertaining the relationship between two attributes

Example 1

A survey of farmers in a certain territory revealed that of the total 200 respondent-farmers, one-half of them used fertilisers. As many as 120 farmers rented the farms while the remaining owned them. Fifty farmers in each of the two categories, namely, farmers who owned farms and farmers who rented farms used fertilisers. Can it be said that the use of fertilisers is related to the ownership of farms?

First of all, we set up a contingency table on the basis of the above data. Table 16.1 is given below.

Table 16.1 Use of Fertilisers and Ownership of Farms

No. of farmers	No. of farmers who		Total
	Owned farms	Rented farms	
Using fertilisers	50	50	100
Not using fertilisers	30	70	100
Total	80	120	200

After having formed the table, we have to calculate chi-square, indicated by the Greek letter χ^2, which shows the magnitude of discrepancy between actual observations and theoretical ones. Symbolically,

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

where, O indicates the observed frequency and E indicates the expected frequency. The following formula is used for calculating the expected frequency:

$$E_i = \frac{\text{Row total } i \times \text{Column total } i}{\text{Grand total}}$$

To calculate the expected frequency of cell 1, for example, the total of row 1 is to be multiplied by the total of the column 1 and the resultant is to be divided by the total number of observations in the entire table. The assumption involved in the calculation of expected frequency is that the two attributes are not related.

We set up a null hypothesis that the use of fertiliser and ownership of farms are not related. The alternative hypothesis is that they both are related. We now calculate the expected frequency of each cell for the data given in Table 16.1. This is shown in Table 16.2.

Table 16.2 Calculation of Expected Frequencies

No. of farmers	No. of farmers who		Total
	Owned farms	Rented farms	
Using fertilisers	$\frac{100\times 80}{200}=40$	$\frac{100\times 120}{200}=60$	100
Not using fertilisers	$\frac{100\times 80}{200}=40$	$\frac{100\times 120}{200}=60$	100

Now, to calculate χ^2 a table is to be put up as follows.

Table 16.3 Worksheet for Calculation of Chi-Square

Row	Column	Frequency O – E		O – E	(O – E)2	$\frac{(O-E)^2}{E}$
		O	E			
1	1	50	40	10	100	2.50
1	2	50	60	–10	100	1.67
2	1	30	40	–10	100	2.50
2	2	70	60	10	100	1.67
					Total	8.34

$$\chi^2 = \Sigma\frac{(O-E)^2}{E}$$

$$= 2.50 + 1.67 + 2.50 + 1.67$$

$$= 8.34$$

It is now necessary to compare this value with the critical value of χ^2. In a 2×2 table, the degree of freedom is (2 – 1) (2 – 1) = 1. In this case, the degree of freedom is 1. The critical value of χ^2 with 1 degree of freedom at 5% level of significance is 3.841. Since the calculated χ^2 is much greater than the critical value of χ^2, the null hypothesis that there is no relationship between the use of fertilizers and the ownership of farms is rejected. Thus, we can say that owner-farmers are more inclined to use fertiliser than farmers who have rented the farms.

It may be noted that the chi-square test indicates whether or not the two attributes are related. It does not provide any indication of the degree of association or the direction of relationship.

As the chi-square test is simple and as it can be applied to any type of data with frequency distributions, it has become a popular technique amongst marketing researchers.

CORRELATION

When we are interested in measuring the degree of relationship between two variables, we use another concept, i.e., coefficient of correlation. The two terms correlation and regression, sometimes used interchangeably, are distinct. **Correlation** is a statistical technique used for measuring the relationship or inter-dependence of two or more variables, none of which is restricted by the researcher. Correlation does not necessarily indicate a causal relationship between two or more variables. **Regression analysis,** on the other hand, refers to the technique for deriving an equation that relates the dependent variable to one or more independent variables. It is used to predict one variable on the basis of another variable. It is also helpful in bringing out the causal relationship between two or more variables.

Whenever a correlation analysis is to be attempted, it is advisable first to draw a graph of the two series in question. Such a graph is known as a scatter diagram wherein the values of the two variables are plotted in such a manner that a point on the graph indicates a pair of values. The usual practice is to plot the independent variable on the horizontal axis and the dependent variable on the vertical axis. A scatter diagram reveals whether the movements in one series are associated with those in the other series. In case of a perfect correlation, the points will fall on a straight line in a diagonal form. If this straight line is rising on the right, the correlation is positive and if it is falling, the correlation is negative.

Figure 16.1 shows different scatter diagrams. Each point in a diagram shows a pair of values (*X* and *Y*). It may be noted that scatter diagrams A and B show a high degree of the positive and negative relationship between *X* and *Y*, respectively. Scatter diagram C shows that there is a non-linear relationship between the two variables. Scatter diagram D shows that there is no relationship between them.

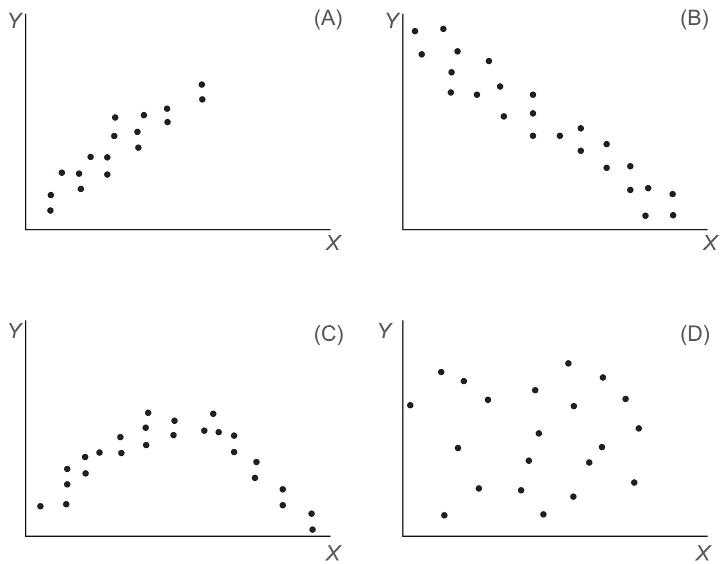

Fig. 16.1 Some Scatter Diagrams

Let us now take some numerical examples to explain how the degree of relationship between two variables can be measured.

Example 2

The following data relate to two variables X and Y. It is required to be ascertained whether there is any relationship between the two variables.

X :	2	5	4	6	9
Y :	3	4	4	8	9

We carry out this exercise with absolute values. Table 16.4 gives the worksheet for the calculation of correlation.

Table 16.4 Worksheet for the Calculation of Correlation

Series X	Series Y	XY	X^2	Y^2
2	3	6	4	9
5	4	20	25	16
4	4	16	16	16
6	8	48	36	64
9	9	81	81	81
26	28	171	162	186

The formula for calculating the coefficient of correlation *r*, when the calculations are carried out with original data, is:

$$r = \frac{n\,.\,\Sigma XY - (\Sigma X)\,(\Sigma Y)}{\sqrt{[n\,\Sigma X^2 - (\Sigma X)^2]\,[n\Sigma Y^2 - \Sigma(Y)^2]}}$$

Applying this formula to the above data,

$$r = \frac{5 \times 171 - (26 \times 28)}{\sqrt{[(5 \times 162) - (26)^2]\,[(5 \times 186) - (28)^2]}}$$

$$= \frac{855 - 728}{\sqrt{(810 - 676)\,(930 - 784)}}$$

$$= \frac{127}{\sqrt{134 \times 146}}$$

$$= \frac{127}{139.87}$$

$$= 0.908$$

In our example, $r = 0.908$, a value very close to 1.0. This means that there is a strong association between the two variables. Another point to note is that it is a positive relationship. When $r = 1$ or -1, all the points lie on a straight line in a graph, then it becomes evident that there is a perfect relationship between the two variables. However, when it comes to other values of r, one has to be careful in its interpretation.

The strength of r is judged by coefficient of determination, r^2. In our example, $r^2 = (0.908)^2 = 0.824$. This suggests that 82 percent of the total variation in the Y series can be attributed to the relationship with X. A limitation of the concept of r^2 is that it suggests that the independent variable X is in a determining position, that is, there is a causal relationship between the two variables. Instead, the statistical evidence suggests that there is covariation regardless of the fact whether it is causal or not.

The term r^2 can be expressed in terms of the decomposition of total variation in the series as shown below:

$$r^2 = \frac{\textit{Explained Variation}}{\textit{Total Variation}}$$

$$= \frac{\textit{Total Variation} - \textit{Error Variation}}{\textit{Total Variation}}$$

$$= 1 - (1 - 0.908)$$

$$= 0.908$$

The value of $r = 0.908$ indicates that the movement of the two variables are very similar to each other and there is a very high degree of positive relationship between them.

t Test for a Correlation Coefficient

It may be noted that we often use the sample correlation coefficient for descriptive purposes as a point estimate of the population correlation coefficient p. This means r is used as if it is a parameter p, which it estimates.

The most frequently used test to examine whether the two variables x and y are correlated is the t test. To apply this test, we first set up the two hypotheses as follows:

$H_0\ p = 0$ Absence of correlation

$H_1\ p \neq 0$ Presence of correlation

where p is the population correlation coefficient. The formula for the t test is as follows:

$$t = \frac{r - p}{\sqrt{(1 - r^2)(n - 2)}}$$

Applying this formula to our example

$$t = \frac{0.908 - 0}{\sqrt{1 - (0.908)^2 (5 - 2)}}$$

$$= \frac{0.908}{\sqrt{(1 - 0.824)/3}}$$

$$= \frac{0.908}{\sqrt{0.0587}}$$

$$= \frac{0.908}{0.242}$$

$$= 3.75$$

The critical value of *t* for 3 df, at 0.05 level of significance is 3.182. As the calculated value of *t* is more than the critical value, the null hypothesis is rejected. This means that there is statistically significant correlation between the two variables.

Example 3

Table 16.5 Worksheet for the Calculation of Correlation by the Alternative Method

X	Y	$x = (X - \bar{X})$	$y = (Y - \bar{Y})$	x^2	y^2	xy
1	7	–4	–3	16	9	12
2	6	–3	–4	9	16	12
3	8	–2	–2	4	4	4
4	10	–1	0	1	0	0
5	9	0	–1	0	1	0
6	11	1	1	1	1	1
7	12	2	2	4	4	4
8	14	3	4	9	16	12
9	13	4	3	16	9	12
45	90			$\Sigma x^2 = 60$	$\Sigma y^2 = 60$	$\Sigma xy = 57$

There is an alternative method of calculating coefficient of correlation. In this case, instead of calculating from absolute values, deviations from the mean are taken and further calculations are carried out from these deviations.

$$\bar{X} = \frac{\Sigma X}{N} = \frac{45}{9} = 5$$

$$\bar{Y} = \frac{\Sigma Y}{N} = \frac{90}{9} = 10$$

$$r = \frac{\Sigma xy}{N \, . \, \sigma_x \, . \, \sigma_y} = \frac{\Sigma xy}{N \, . \sqrt{\frac{\Sigma x^2}{N} \, . \, \frac{\Sigma y^2}{N}}} = \frac{\Sigma xy}{N \, . \sqrt{\frac{\Sigma x^2}{N}} \, . \sqrt{\frac{\Sigma y^2}{N}}}$$

$$= \frac{\Sigma xy}{N \, . \sqrt{\Sigma x^2 \, . \, \Sigma y^2}}$$

$$= \frac{57}{\sqrt{60} \, . \sqrt{60}}$$

$$= \frac{57}{60} = 0.95$$

Here, too, the relationship between the two variables is positive and high.

Sometimes, calculations from the mean become cumbersome. To avoid this, an arbitrary mean is used for each of the two series and deviations are calculated from these arbitrary means. In such a case, the following formula is used.

$$r = \frac{\Sigma dx \,.\, dy - \dfrac{\Sigma dx \times \Sigma dy}{N}}{\sqrt{\left(\Sigma dx^2 - \dfrac{(\Sigma dx)^2}{N}\right)\left(\Sigma dy^2 - \dfrac{(\Sigma dy)^2}{N}\right)}}$$

It may be noted that this formula is derived by introducing the necessary correction factors for using the arbitrary mean instead of the actual mean. In the numerator, the correction factor is the second term, namely $\dfrac{\Sigma dx \times \Sigma dy}{N}$ whereas in the denominator, the correction factors are $\dfrac{(\Sigma dx)^2}{N}$ and $\dfrac{(\Sigma dy)^2}{N}$ for X and Y series, respectively. This formula makes it more convenient to carry out computations.

RANK CORRELATION

Sometimes we are required to examine the extent of association between two ordinally scaled variables such as two rank orderings or two attitudes. In such cases, the previous method of finding the r is not applicable. A measure to ascertain the degree of association between two variables X and Y when their distribution is unknown is called the rank correlation coefficient, which was developed by C. Spearman. As the name implies, this method is based on the ranks (or order) of the observations rather than on a specific distribution of X and Y.

In marketing research, the ranking or ordering of alternative preferences is quite common. In such cases, the Spearman's rank correlation coefficient will be appropriate and it will indicate the extent of association between the two rankings. The method is very handy, involving simple computations. The following example illustrates how the coefficient of rank correlation can be computed.

Example 4

Suppose that ten salesmen employed by a company were given a month's training. At the end of the specified training, they took a test and were ranked on the basis of their performance. They were then posted to their respective areas. At the end of six months, they were rated in respect of their sales performance. These data are given in Table 16.6.

To compute the coefficient of rank correlation, the following formula is used:

$$r_s = 1 - \frac{6 \sum_{i=1}^{n} d_i^2}{N\,(N^2 - 1)}$$

where r_s = the coefficient of Spearman's rank correlation
N = the number of pairs of ranks
d = the difference between the two rankings, $X - Y$

Applying the above formula to our Example, we compute

Table 16.6 Ranks of Salesmen in Respect of Training and Sales Performance

Salesmen	Ranks obtained in training X	Ranks on the basis of sales performance Y	Difference (d)	Difference squared (d^2)
1	4	5	–1	1
2	6	8	–2	4
3	1	3	–2	4
4	3	1	+2	4
5	9	7	+2	4
6	7	6	+1	1
7	10	9	+1	1
8	2	2	0	0
9	8	10	–2	4
10	5	4	+1	1
				$\Sigma d^2 = 24$

$$r_s = 1 - \frac{(6)(24)}{(10)\left[(10)^2 - 1\right]}$$

$$= 1 - \frac{144}{10 \times 99}$$

$$= 1 - 0.145$$

$$= 0.855$$

A coefficient of 0.855 shows that there is a very high degree of correlation between the performance in training and the sales performance of the ten salesmen.

Now, the significance of the coefficient of rank correlation can be tested. When the number of paired observations in not less than ten, a t statistic[1] can be computed to test the null hypothesis that the two variables are not associated. In other words, the null hypothesis is that $r_s = 0$. The formula for computing the t statistic is

$$t = r_s \sqrt{\frac{N-2}{1-r_s^2}}$$

Applying the above formula to the Example, we compute

$$t = 0.855 \sqrt{\frac{10-2}{1-(0.855)^2}}$$

$$= 0.855 \sqrt{\frac{8}{0.2690}} = 0.855.\sqrt{29.7398}$$

$$= 0.855 \times 5.453 = 4.662$$

[1] See, Siegel, Sidney: *Nonparametric Statistics for the Behavioural Sciences,* New York, McGraw-Hill Book Company, Inc. 1956, p. 212.

The critical value of t for $\alpha = 0.05$ and 8 degrees of freedom ($n - 2$, $8df$) (See Appendix Table 4) is 2.306. As the calculated value of t is more than the critical value of t, the null hypothesis is rejected. In other words, the performance in training and the sales performance of a sample of ten salesmen are associated.

Contingency Coefficient

At times we are interested to ascertain the degree of association between two sets of data, one or both of which are nominally scaled. For this purpose, a contingency coefficient, C, is computed from the data arranged into a contingency table. The contingency coefficient is computed by using the following formula:

$$C = \sqrt{\frac{\chi^2}{N + \chi^2}}$$

where χ^2 is computed by the method explained in the earlier part of this chapter.

Applying the above formula to the value of $\chi^2 = 8.34$ in Example 1 of this chapter, we compute

$$C = \sqrt{\frac{8.34}{200 + 8.34}}$$

$$= \sqrt{0.0400307}$$

$$= 0.2 \text{ approx.}$$

The question is: what does the value of $C = 0.2$ indicate—a strong or weak association? It is difficult to interpret the contingency coefficient C. When there is no association at all between the two attributes, the value of C will be 0. However, when there is perfect association, the value of C will not be 1. Its upper limit depends on the number of categories. For example, the upper limit of C for a 2×2 contingency table is 0.707, for a 3×3 table it is 0.816 and for a 10×10 table it is 0.949. In view of this, a comparison of two contingency coefficients will not be meaningful if these are based on different sizes of tables. Reverting to our example, we find that the contingency coefficient is in respect of the 2×2 table. Thus, the upper limit of C is 0.707. Against this upper limit, the value of $C = 0.2$ suggests that the two variables are at best, only moderately associated.

REGRESSION ANALYSIS

After having discussed correlation, we now turn to regression analysis, which is one of the most frequently used techniques in social science research. It is often used when the researcher is interested in estimating or predicting the value of one variable, given the value of another. For example, it is believed that advertising expenditure and sales are related in such a way that the former increases sales. In such a case, one may like to know the likely sales against a given advertising expenditure or vice versa. A regression analysis is used for this purpose.

The relationship between the two variables can be either linear or non-linear. When the relationship is linear, a change in the independent variable is followed by a constant absolute change in the dependent variable.

The linear relationship between two variables x and y is of the form

$$Y = a + bX$$

where Y is the dependent variable and X is an independent variable. It is conventional to use the terms 'independent variable' for X and 'dependent variable' for Y. This use does not imply that X causes Y or Y causally depends on X. The regression model does not necessarily imply any cause and effect relationship between the two variables. However, the model implies that a change in the value of X will bring about a change in Y such that the pair of observations, if plotted on a graph will form a straight line. The regression equation indicating the specific relationship between the two variables can be found out with the help of normal equations. This is illustrated by the following example.

A trading company has the following territory-wise data in respect of sales and advertising:

Example 5

Sales territory	1	2	3	4	5	6	7	8
Advertising ('000 Rs)	40	30	20	50	60	40	20	60
Sales (in units)	100	80	60	120	150	90	70	130

We set up Table 16.7 to carry out calculations.

Table 16.7 Worksheet for Calculation of Regression Coefficients

Sales territory	**Sales (in units)**	**Advertsing ('000 Rs)**		
	Y	***X***	X^2	***XY***
1	100	40	1600	4000
2	80	30	900	2400
3	60	20	400	1200
4	120	50	2500	6000
5	150	60	3600	9000
6	90	40	1600	3600
7	70	20	400	1400
8	130	60	3600	7800
	800	320	14600	35400

$$\Sigma X = 320 \quad \Sigma X^2 = 14600$$
$$\Sigma Y = 800 \quad \Sigma XY = 35400$$

The linear regression is of the form

$$Y = a + bX$$

where Y is sales and X is advertising, the parameter a is the intercept and the parameter b is the coefficient of variable X. The two normal equations for fitting a regression line are:

$$\Sigma Y = na + b\,\Sigma X$$
$$\Sigma XY = a\,\Sigma X + b\,\Sigma X^2$$

Substituting the values calculated above in these normal equations,

$$800 = 8a + 320b \quad \text{(i)}$$

$$35400 = 320a + 14600b \quad \text{(ii)}$$

Multiplying (i) by 40 and then subtracting (ii) from the resultant figures,

$$32000 = 320a + 12800b \quad \text{(iii)}$$

$$35400 = 320a + 14600b \quad \text{(ii)}$$

$$-3400 = -1800b$$

$$\therefore \quad b = \frac{3400}{1800} = 1.8889 \text{ approx.}$$

Substituting the value of (b) = 1.8889 in (i) above

$$800 = 8a + (1.8889 \times 320)$$

or $$8a = 800 - 604.448$$

$$\therefore \quad a = 24.444 \text{ approx.}$$

Hence, the regression equation is

$$Y_c = 24.444 + 1.889\, X \text{ (Rounding the values to 3 decimal places)}$$

In the above calculations, we have used the normal equations to estimate the parameters a and b. Alternatively, the values of a and b can be obtained directly by applying formulae. Parameter b can be computed by the following formula:

$$b = \frac{n\,(\Sigma XY) - (\Sigma X)\,(\Sigma Y)}{n\,(\Sigma X^2) - (\Sigma X)^2}$$

Applying this formula to the data given in Table 16.7, we get

$$b = \frac{8(35400) - (320)\,(800)}{8(14600)\,(320)^2}$$

$$= \frac{283200 - 256000}{116800 - 102400}$$

$$= \frac{27200}{14400}$$

$$= 1.8889 \text{ approx. (same as obtained earlier)}$$

The parameter a can be computed by the following formula:

$$a = \bar{Y} - b\bar{X}$$

Applying it to the data of Table 16.7,

$$a = 100 - 1.8889\,(40)$$

$$= 100 - 75.556$$

$$= 24.444 \text{ approx. (same as obtained earlier)}$$

Therefore, $Y_c = 24.444 + 1.889X$ (same as before).

It will be noticed that these calculations have become much simpler. This linear function is plotted in Fig. 16.2, it appears to fit the plotted points well.

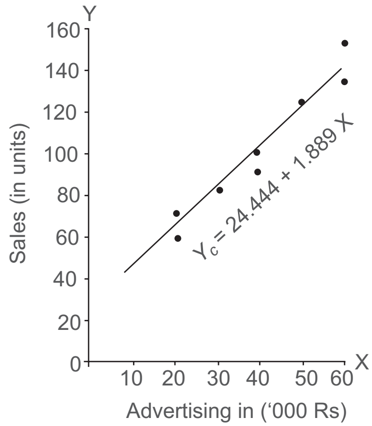

Fig. 16.2 Scatter Diagram and Least-Squares Regression Line

Let us understand the meaning of this linear regression. The parameters a and b are called regression coefficients. The parameter b is the slope of the regression line. The value of $b = 1.889$ indicates the change in the dependent variable, Y, for every unit change in the independent variable. A high value of parameter b shows its importance in the regression equation. The parameter a is the Y intercept of the regression line. The magnitude of this intercept shows the value of the regression function at $X = 0$. When a is 0, the regression equation of Y on X will pass through the point of origin where both X and Y are 0. A large intercept suggests that the dependent variable Y is determined by something other than the independent variable X. In such a case, the researcher should look for one or more other variables, the inclusion of which would improve the regression model.

A market researcher who uses the technique of regression analysis would be interested in knowing how good it is. In other words, how much variation observed in the dependent variable is explained by the regression equation. For this purpose, he is required to calculate another measure known as the coefficient of determination which, in fact, is the square of correlation coefficient.

The coefficient of determination (r^2) is calculated as follows:

$$r^2 = \frac{\text{(Total variance in the dependent variable)} - \text{(Variance "unexplained" by the regression equation)}}{\text{Total variance in the dependent variable}}$$

Symbolically,

$$r^2 = \frac{\Sigma(Y_i - \bar{Y})^2 - \Sigma(Y_i - Y_c)^2}{\Sigma(Y_i - \bar{Y})^2}$$

where Y_c, a new term, is calculated by applying the different values to the independent variable X, as given in the problem.

Taking out example where the following regression was arrived at

$$Y_c = 24.444 + 1.889\,X$$

Table 16.8 gives the calculations for determining r^2.

Table 16.8 Worksheet for the Calculation of Coefficient of Determination

X	Y	$Y_i - \bar{Y}$	$(Y_i - \bar{Y})^2$	Y_c	$Y_i - Y_c$	$(Y_i - Y_c)^2$
40	100	0	0	100	0	0
30	80	– 20	400	81	– 1	1
20	60	– 40	1600	62	– 2	4
50	120	20	400	119	1	1
60	150	50	2500	138	12	144
40	90	– 10	100	100	– 10	100
20	70	– 30	900	62	8	64
60	130	30	900	138	– 8	64
	800		6800			378

$$\bar{Y} = \frac{\Sigma Y}{N} = \frac{800}{8} = 100$$

$$r^2 = \frac{\Sigma(Y_i - \bar{Y})^2 - \Sigma(Y_i - Y_c)^2}{\Sigma(Y_i - \bar{Y})^2}$$

$$= \frac{6800 - 378}{6800} = 0.944$$

The value of $r^2 = 0.944$ shows that the regression equation $Y = 24.444 + 1.889\,X$ explains about 94.4 per cent of the total variation observed in the dependent variable. Thus, only 5.6 per cent of the total variation in the dependent variable, Y, remains unexplained by the regression equation.

In our example, r^2 is extremely high, though it may be small sometimes. A certain degree of relationship between two variables may occur on account of random sampling variation. It is, therefore, desirable to test the hypothesis that $r^2 = 0$. Let us illustrate this with respect to our example.

The null hypothesis, $H_0 : r^2 = 0$

The alternative hypothesis, $H_1 : r^2 \neq 0$

A t-test is used to test the null hypothesis. The formula used is:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \text{ with } n - 2 \text{ degrees of freedom.}$$

Applying this formula to our example,

$$t = \frac{0.97\sqrt{8-2}}{\sqrt{1-0.94}} = \frac{0.97 \times 2.45}{0.24}$$

$$= \frac{2.38}{0.24} = 9.92 \text{ approx.}$$

The critical value of t at $\alpha = 0.01$ for 6 degrees of freedom = 3.707. Since calculated t exceeds critical t, the null hypothesis is rejected. In other words $r^2 \neq 0$.

Tests of Hypotheses Concerning B

Marketing researchers are usually interested in parameter *B*. Suppose we have a linear population regression function $\mu_{yx} = A + BX$, where μ_{yx} is the sale of television sets and *X* is the amount spent on advertising. Here, the regression coefficient *B* shows the increase in the sale of television sets when there is a unit increase in the advertising expenditure. When *B* happens to be zero, the regression of *Y* on *X* is a horizontal line, which implies that the two variables, *X* and *Y*, are independent of each other. In view of this, the marketing researcher should check whether or not $B = 0$.

Let us illustrate the testing of the hypothesis in such a case, using our previous example on sales and advertising in eight territories. The data are given in the first two columns of Table 16.8. The regression model was $Y_c = 24.444 + 1.889\,X$. The null hypothesis H_0 is that $B = 0$ and the alternative hypothesis H_1 is that $B \neq 0$. That is

$$H_0 : B = 0$$

$$H_1 : B \neq 0$$

Since our sample was small, we should use the *t* distribution rather than the normal distribution in testing the hypothesis. The formula for this is $t = \dfrac{b - B}{\hat{\sigma}_b}$.

We first calculate $\hat{\sigma}_b$ for which the following formula is used

$$\hat{\sigma}_b^2 = \frac{\hat{\sigma} Y^2\ X}{\Sigma (X - \bar{X})^2}$$

The calculations are shown below

$$\hat{\sigma} Y^2\ X = \frac{1}{n-2} \Sigma (Y - Y_c)^2$$

$$= \frac{1}{8-2} (378) = 63$$

Table 16.9 Calculations for $\Sigma (X - \bar{X})^2$

X	$X - \bar{X}$	$(X - \bar{X})^2$
40	0	0
30	– 10	100
20	– 20	400
50	10	100
60	20	400
40	0	0
20	– 20	400
60	20	400
320		1800

$$\bar{X} = \frac{\Sigma X}{n} = \frac{320}{8} = 40$$

$$\Sigma (X - \bar{X})^2 = 1800$$

$$\hat{\sigma} b^2 = \frac{\hat{\sigma}^2 YX}{\Sigma(X - \bar{X})^2}$$

$$= \frac{63}{1800} = 0.035$$

Hence,

As the t distribution is to be used, we reproduce the formula for t

$$t = \frac{b - B}{\hat{\sigma}_b}$$

Let $B = 0$, then

$$t = \frac{1.889 - 0}{\sqrt{0.035}} = \frac{1.889}{0.187}$$

$$= 10.102 \text{ approx.}$$

The critical value of t for $n - 2$, i.e., 6 degrees of freedom for $\alpha = 0.05$ level of significance is 2.447 ($\alpha = 0.025$, as it is a two-tail test). Since the calculated t exceeds the critical t, it falls in the rejection region. We, therefore, reject the null hypothesis that $B = 0$.

When sample sizes are large, we should use the normal distribution. The calculation will be made in the same manner, whee $Z = \frac{b - B}{\hat{\sigma}_b}$ and the critical value of Z will be used to test the null hypothesis instead of t value.

When the null hypothesis is not rejected, it means that $B = 0$. However, it does not mean that Y and X are unrelated. There are two possibilities in such a case. First, we may be committing a Type II error by not rejecting a null hypothesis, which is not true. Second, Y and X might be related in some other manner which could not be brought out as we used a wrong model.

Confidence Interval for B

In our example, we have estimated B by applying the method of least squares. Our estimate of B is the sample regression coefficient of $b = 1.889$. This is a point estimate. As it is, we do not have a measure of reliability of b as an estimate of B. In order to have a measure of reliability, we have to use an interval estimate.

The sample regression line is

(1) $Y_c = 24.444 + 1.889\, X$

and the distribution of $t = \frac{b - B}{\hat{\sigma}_b}$ has a distribution with $n - 2$ degrees of freedom. For 95 per cent confidence, we have

(2) $$p\left[-t_{0.025} < \frac{b - B}{\hat{\sigma}_b} < t_{0.025}\right] = 0.95$$

Since $\alpha = 0.05$ and as it is a two-tail test, we should take t value corresponding to $\alpha/2 = 0.025$ in each tail. Thus equation (2) becomes

(3) $p[b - t_{0.025}\ \hat{\sigma}_b < B < b + {}_{0.025}\ \hat{\sigma}_b] = 0.95$

Applying numerical values from our example to equation (3), we find

$1.889 - (2.447)\ (0.187) < B < 1.889 + (2.447)\ (0.187)$

$= 1.889 - 0.458 < B < 1.889 + 0.458$

$= 1.431 < B < 2.347$

This shows that B is between 1.431 and 2.347 rupees. This means that if we take 100 samples of size 8 and if we construct 100 confidence intervals as in (3) above, then 95 of them are expected to have the true population parameter B.

It may be noted that in the same manner, hypotheses concerning A can be tested and confidence intervals constructed.

In fitting a linear regression to the data of Example 5, absolute values were used. Instead of using absolute values, one may use the deviations from the arithmetic mean of X and Y series and then apply a different formula. Let us take our earlier example.

$$\bar{X} = \frac{\Sigma X}{N} = \frac{320}{8} = 40$$

$$\bar{Y} = \frac{\Sigma Y}{N} = \frac{800}{8} = 100$$

Regression equation of Y on X:

$$Y - \bar{Y} = r\frac{\sigma_y}{\sigma_x}(X - \bar{X})$$

Example 6

Table 16.10 Worksheet for Calculation of Regression Coefficients by the Alternative Method

Sales territory	Sales (in units) Y	Advertising expenditure X	y $(Y - \bar{Y})$	x $(X - \bar{X})$	y^2	x^2	xy
1	100	40	0	0	0	0	0
2	80	30	– 20	– 10	400	100	200
3	60	20	– 40	– 20	1600	400	800
4	120	50	20	10	400	100	200
5	150	60	50	20	2500	400	1000
6	90	40	– 10	0	100	0	0
7	70	20	– 30	– 20	900	400	600
8	130	60	30	20	900	400	600
	$\Sigma Y = 800$	$\Sigma X = 320$			$\Sigma y^2 = 6800$	$\Sigma x^2 = 1800$	$\Sigma xy = 3400$

where,

$$r\,\frac{\sigma y}{\sigma x} = \frac{\Sigma xy}{\Sigma x^2} \text{ (Regression coefficient)}$$

$$= \frac{3400}{1800} \quad 1.8889 \text{ approx.}$$

$$Y - \bar{Y} = 1.8889\,(X - \bar{X})$$

$$Y - 100 = 1.8889\,(X - 40)$$

$$Y = 100 + 1.8889X - 75.556$$

$$= 24.444 + 1.8889X$$

It is the same regression as obtained earlier when normal equations were used. Likewise, regression of X on Y can be obtained by the following formula:

$$X - \bar{X} = r\,\frac{\sigma x}{\sigma y}\,(Y - \bar{Y})$$

where $r\,\frac{\sigma x}{\sigma y} = \frac{\Sigma xy}{\Sigma y^2}$ (Regression coefficient)

The relationship between r and the regression coefficients is shown below.

$$r = \sqrt{b_{xy} \,.\, b_{yx}}$$

$$= \sqrt{\frac{\Sigma_{xy}}{\Sigma_{y^2}} \cdot \frac{\Sigma_{xy}}{\Sigma_{x^2}}}$$

Applying the above formula to the data given in Table 16.10, we get

$$r = \sqrt{\frac{3400}{6800} \cdot \frac{3400}{1800}}$$

$$= \sqrt{0.5 \times 1.8889}$$

$$= \sqrt{0.9444}$$

$$= 0.97 \text{ approx.}$$

This shows a very high degree of positive correlation between the two variables.

Errors in Regression Analysis

Before we turn to another topic 'Analysis of Variance', it may be emphasised that while using regression analysis, one should be careful in avoiding errors that may arise on account of its wrong application. It is, therefore, necessary to know how errors can arise while using regression analysis.

1. The inclusion of one or two extreme items can completely change a given relationship between the variables. As such, extreme values should be excluded from the data.

2. It is advisable to first draw a scatter diagram so that one can have an idea of the possible relationship between x and y. In the absence of a scatter diagram one may attempt a linear regression model, but the given set of data may actually show a non-linear relationship.
3. When predictions based on regression analysis are made, one should be sure that the nature and extent of relationship between x and y remains the same. This assumption at times is completely overlooked, which may lead to errors in prediction.

ANALYSIS OF VARIANCE

In the preceding chapter, the discussion on analysis of variance was confined to one-way classification. We now turn to the application of analysis of variance in a two-way classification. In such a classification, the data are classified according to two criteria or factors. There is a little difference in the procedure followed for analysis of variance in a two-way classification as compared to that used in a one-way classification. The analysis of variance table takes the form in a two-way classification as shown in Table 16.11.

Table 16.11 Analysis of Variance Table

Source of variation	**Sum of squares**	**Degrees of freedom**	**Mean square**
Between rows	SSR	$(r-1)$	MSR = SSR/$(r-1)$
Between columns	SSC	$(c-1)$	MSC = SSC/$(c-1)$
Residual (error)	SSE	$(r-1)(c-1)$	MSE = $\dfrac{\text{SSE}}{(r-1)(c-1)}$
Total	SST	$N-1$	

The abbreviations used in the table are:
SSR = sum of squares between rows
SSC = sum of squares between column means
SST = total sum of squares
SSE is obtained by subtracting SSR and SSC from SST
$(r-1)$ indicates the number of degrees of freedom between rows
$(c-1)$ indicates the number of degrees of freedom between columns
$(r-1)(c-1)$ indicates the number of degrees of freedom for residual
MSR = mean of sum of squares between rows
MSC = mean of sum of squares between columns
MSE = mean of sum of squares for the residual
It may be noted that the total number of degrees of freedom

$$= (r-1) + (c-1) + (r-1)(c-1) = cr - 1 = N - 1$$

Let us now take a numerical example to illustrate the use of the analysis of variance.

Example 7

A firm has four types of machines—A, B, C and D. It has put four of its workers on each of its machines for a specified period. After the expiry of this period, it has calculated the average output for each worker on each type of machine. These data are given below.

Workers		Average production by the type of machine			
		A	B	C	D
	1	25	26	23	28
	2	23	22	24	27
	3	27	30	26	32
	4	29	34	27	33

The firm is interested to find out (a) whether the mean productivities of workers are significantly different, and (b) whether there is a significant difference in the mean productivity of the different machine types.

In order to simplify calculations, it is preferable to reduce the magnitude of these figures. We, therefore, subtract 30 from each figure. The table in the coded form is given below.

Table 16.12 Average Production by Type of Machine

Workers	Machine Type				Total
	A	B	C	D	
1	– 5	– 4	– 7	– 2	– 18
2	– 7	– 8	– 6	– 3	– 24
3	– 3	0	– 4	+ 2	– 5
4	– 1	+ 4	– 3	+ 3	+ 3
Total	– 16	– 8	– 20	0	– 44

Correction factor : $C = T^2/N$, where T stands for the total and N for the number of observations. In the above case,

$$\frac{T^2}{N} = \frac{(-44)^2}{16} = 121$$

Sum of squares between machine types

$$= \frac{(-16)^2}{4} + \frac{(-8)^2}{4} + \frac{(-20)^2}{4} + \frac{(0)^2}{4} - \frac{\mathrm{T}^2}{\mathrm{N}}$$

$$= \frac{256}{4} + \frac{64}{4} + \frac{400}{4} + 0 - 121$$

$$= 64 + 16 + 100 - 121 = 59$$

Sum of squares between workers

$$= \frac{(-18)^2}{4} + \frac{(-24)^2}{4} + \frac{(-5)^2}{4} + \frac{(3)^2}{4} - \frac{T^2}{N}$$

$$= \frac{324}{4} + \frac{576}{4} + \frac{25}{4} + \frac{9}{4} - 121$$

$$= \frac{934}{4} - 121$$

$$= 233.5 - 121 = 112.5$$

Total sum of squares

$$= [(-5)^2 + (-7)^2 + (-3)^2 + (-1)^2 + (-4)^2 + (-8)^2$$
$$+ (0)^2 + (4)^2 + (-7)^2 + (-6)^2 + (-4)^2 + (-3)^2$$
$$+ (-2)^2 + (-3)^2 + (2)^2 + (3)] - \frac{T^2}{N}$$
$$= 25 + 49 + 9 + 1 + 16 + 64 + 0 + 16 + 49 + 36$$
$$+ 16 + 9 + 4 + 9 + 4 + 9 - 121$$
$$= 316 - 121 = 195$$

These data can now be shown in the form of an analysis of variance table as follows:

Table 16.13 Analysis of Variance Table

Source of variance	Sum of squares	Degrees of freedom	Mean square
Between rows (workers)	112.5	4 – 1 = 3	37.50
Between columns (machine type)	59.0	4 – 1 = 3	19.67
Residual (error)	23.5	3 × 3 = 9	2.61
Total	195.0	16 –1 = 15	

Now, we apply the F test. Let us first set up the null hypothesis that there is no difference in the mean productivity of workers.

$$F_A \text{ (workers)} = \frac{37.50}{2.61} = 14.37$$

The table value of F for 3 and 9 degrees of freedom at $\alpha = 5$ per cent level of significance is 3.86 and at $\alpha = 1$ per cent level of significance is 6.99. Since the calculated values of F, is greater than the table value of F we reject the null hypothesis and conclude that mean productivities of workers differ.

$$F_B \text{ (machine types)} = \frac{19.67}{2.61} = 7.54$$

As before, the value of F for 3 and 9 degrees of freedom at the $\alpha = 5$ per cent and 1 per cent levels of significance are 3.86 and 6.99, respectively.

Since the calculated value of F is again greater than the table values of F, we reject the null hypothesis and conclude that the mean productivities of the four types of machines are significantly different.

Assumptions Involved in the ANOVA Model

There are four assumptions involved in Analysis of Variance (ANOVA) model. These are as follows.

1. Treatments are assigned to test units randomly.
2. Measurements are at least internally scale and are taken from a normally distributed population.

3. The variances in the test and control groups are equal.
4. The effects of treatments on response are additive.

Of these four assumptions, the first one is often overlooked. In other words, the use of non-randomly assigned pseudotreatments considerably increases the possibility that other variables associated with them affect responses, and these effects will be attributed to pseudotreatment.

Summary

At the outset, this chapter has dealt with the chi-square test. This is followed by a discussion on Karl Pearsonian coefficient of correlation. When the data are ordinal, this method is not applicable. In such a case, rank correlation is used. A discussion on rank correlation is, therefore, given.

A detailed discussion of regression analysis has also been given. The discussion is confined to simple linear regression. Tests of hypotheses concerning parameter *B* have been explained with numerical examples. In order to have a measure of reliability of *b* as an estimate of *B*, it has been mentioned that an interval estimate has to be used. Further, the chapter illustrates the use of *t* test, which is most frequently used to examine whether the association between two variables is statistically significant.

The chapter also illustrates the use of an alternative method, involving deviations from the arithmetic mean of the two series in fitting a linear regression. While closing the discussion on regression analysis, the chapter specifies errors that are likely to arise in the analysis.

Finally the analysis of variance in a two-way classification in contrast to a one-way classification as discussed earlier, has been dealt with. It has been mentioned that there is a little difference between analysis of variance in one-way and two-way classifications. Assumptions involved in the ANOVA model have also been specified.

Key Terms and Concepts

Questions

1. What is chi-square test? What are its uses?
2. Does the chi-square test indicate the degree of association or direction of the relationship between two attributes?
3. A company has categorized its 80 salesmen as having good or poor selling ability. It has also given them a psychological test to measure their flexibility. The results are given in the following table:

Selling ability	Flexibility		Total
	Poor	Good	
Poor	32	8	40
Good	12	28	40
Total	44	36	80

Use chi-square to test the hypothesis that selling ability is independent of flexibility at 5 per cent level of significance.

4. What is the Karl Pearsonian coefficient of correlation? Does it indicate causality?
5. What is rank correlation? Bring out its usefulness as also its limitations.
6. What is the coefficient of determination? What does it measure?
7. What is contingency coefficient?
8. Calculate the coefficient of correlation between price and sales from the following data:

Price (Rs) :	100	90	85	92	90	84	88	90
Sales (Unit) :	500	610	700	630	670	800	800	750

Interpret the value of r.

9. What is regression analysis?
10. How is regression analysis useful in marketing research?
11. Distinguish between regression analysis and correlation
12. What is meant by a criterion variable?
13. What is the least square method? How does it provide a best line?
14. Suppose a linear regression analysis gives the equation $Y_c = 100 + 20X$ where Y_c = predicted annual sales and X = annual advertising expenditure. What does this relationship signify?
15. Show that $b = \dfrac{\Sigma\, xy}{\Sigma\, x^2}$.
16. What is the only point through which the sample regression line must pass?
17. An investigation into the demand for television sets in seven towns has resulted into the following data:

Towns	Population ('000) X	Demand for T.V. sets (No.) Y
A	11	15
B	14	27
C	14	28
D	17	30
E	17	34
F	21	38
G	25	46

Fit a linear regression of Y on X and estimate the demand for television sets for a town with a population of (a) 20,000 and (b) 32,000.

18. What is ANOVA? What is it used for?

19. What is meant by the term 'spurious correlation'?
20. What is the purpose of the scatter diagram?
21. Explain the term 'standard error of the estimate'. What is its relevance in regression analysis?
22. What are the assumptions involved in the use of regression analysis?
23. What is an estimating equation in regression analysis?
24. What is meant by the strength of association? How is it measured in bivariate regression?
25. What technique is used to measure bivariate association when the data are:
    (a) ordinal
    (b) interval
    (c) nominal?

17 Experimental Designs

Learning Objectives

After reading this chapter, you should be able to understand:

- Terminology
- Experimental Design
- Randomisation
- Completely Randomised Design
- Randomised Block Design
- Latin Squares
- Factorial Experiments
- Requirements for a Good Experiment
- Need for Planning of Experiments

At the outset, it may be noted that experimentation is a powerful tool at the disposal of the marketing researcher, that enables him to establish causal relationships between variables.

Before we discuss some experimental designs, let us clarify the meaning of the term 'experiment'. The existence of a problem is a prerequisite for conducting an experiment which involves the manipulation of certain independent variables with a view to determining their effect on one or more dependent variables. Let us take an example of an experimental study. A pharmaceutical firm may be interested to ascertain the efficacy of a new drug in the treatment of cancer. A group of patients is chosen, to whom the drug is administered for a certain period of time. This group is called the test group. Another group of patients, identical to the test group is also chosen, to whom the drug is not administered. This group is known as the control group. The firm collects the relevant data and analyses the same. The difference in the extent of recovery from cancer between the test group and the control group is attributed to the use of the drug, thereby indicating the extent of its efficacy.

The foregoing example indicates one of several experimental designs and involves the use of the control group, against which the performance of the test group with respect to the recovery from cancer, can be compared. It aims at establishing a causal relationship between the use of the drug, an independent variable, and the recovery from cancer, a dependent variable. While conducting an experiment of this type, the firm has created a setting and manipulated the level of the independent variable so that it can compare the variation in the dependent variable. Thus, we may now define experimentation as a process which involves the manipulation of an independent or explanatory variable with a view to determining its effect on the dependent variable.

TERMINOLOGY[1]

Before we proceed further, it is useful at this stage to understand the meaning of certain terms used frequently in experiments. The definitions are those given by Seymour Banks.

Experimental Treatments

The alternatives whose effects are to be measured and compared, e.g., different package designs, self-service versus clerk service, different advertising themes.

Test Units

The individuals or organisations whose response to the experimental treatments is being studied, e.g. consumers, stores, sales territories.

Extraneous Forces

All the other forces and conditions which affect the response of test units to experimental treatments. These extraneous forces are of two kinds: classifications of test units in terms of market size, store type, or geographical region; and forces which the experimenter cannot control but for which he relies upon randomisation to apply more or less evenly to test units, e.g. weather, competitive efforts, local business conditions, fads.

Experimental Error

A measure of the apparent variation in performance of test units treated alike by the experimenter after the effect of 'extraneous' forces is removed from the data as far as possible. This variability in performance derives in part from internal forces, i.e., the inherent variation in performance of matched test units subjected to the same treatment; in part from external, possibly unidentified forces; and from non-constant errors of measurement.

Experimental error is comparable to within-stratum variance in stratified sampling. The experimental error determines the sensitivity or precision of the experimental procedure, since it is used to test the significance of the difference in performance of the experimental treatments.

1 Banks, Seymour: *Experimentation in Marketing*, New York, McGraw-Hill Book Company, 1965, pp. 5–6. Reprinted with permission.

EXPERIMENTAL DESIGN

Experimental design prevents systematic bias in favour of some experimental treatments over others and it also reduces experimental error.

Experimental design is analogous to stratification in that it ensures that each experimental treatment is used within each classification of test units and each classification of extraneous forces is applied equally to all test units.

The theory of experimental designs originated in the field of agricultural research. The most profound contribution was made by R.A. Fisher who observed that the practices prevalent for the measurement of output from plots of land were unable to give unbiased and unambiguous findings. As the theory of experimental designs developed first in agricultural research, most of the terminology used in experimental designs has agricultural overtones. Terms such as 'blocks' indicating plots of land, 'treatments' indicating samples or populations differentiated in terms of different cultivation methods, seeds, fertilisers and irrigation are commonly used.

The use of experimental designs has not remained confined to agriculture. In this chapter, we are concerned with their use in marketing research. There are two types of experiments used in marketing, namely, **field experiments and laboratory experiments**. In field experiments, actual market conditions are altered. For example, a firm tries two or more levels of advertising in a few cities so as to determine the impact of advertising on the demand for its product. Laboratory experiments are also used in marketing wherein a marketing researcher tries to create a laboratory setting to carry out his study. For example, a group of consumers is exposed to a certain programme on television and then the consumers are asked to show their preferences for the products.

Enis and Cox[2] have used a systems perspective in explaining the nature of an experiment, i.e., inputs processed to produce outputs. Figure 17.1 shows the systems model.

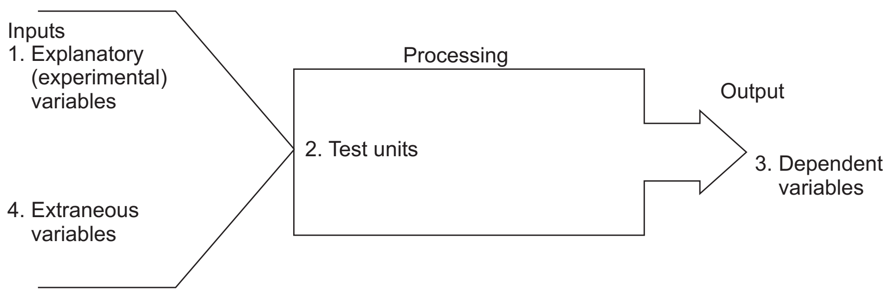

Fig. 17.1 System Model of an Experiment

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Figure 17.1 shows that inputs comprise two types of variables, namely explanatory and extraneous variables. The explanatory variables are manipulated by the researcher. In marketing, explanatory variables comprise some elements of the marketing mix—product, price, promotion, etc. Test units are the entities which are not only affected by the manipulation of the explanatory variables but are also influenced by extraneous variables. Very often, in marketing research, test units are customers (existing or potential) and physical entities such as retail stores, product lines and sales territories.

2 Enis, B.M. and Keith L. Cox, "Ad Experiments for Management Decisions" in *Journal of Advertising Research*, Vol. 15, No. 2, April 1975, pp. 35–41.

The third item in Figure 17.1 is that of the dependent variable. It is the criterion for measuring the attainment of the experimental objective. Generally, sales and profits are used as the dependent variables in marketing. Finally, there are certain factors which influence the dependent variable but these are over and above the explanatory variable. There are a number of such variables in marketing which influence the dependent variable. A few of these extraneous variables, for example, could be economic environment for business, government policies, technological development, attitudes of individual customers and competition. It is extremely difficult to offset the effect of such variables on the dependent variables in marketing as a result of which marketing experiments are extremely complex to handle. It may be noted that the systems model of an experiment given in Figure 17.1 can be applied to any marketing experiment. A systems perspective of an experiment is helpful in understanding the nature of the different elements involved in it.

RANDOMISATION

In a true experiment, randomisation is essential so that the experimenter can infer cause and effect. Randomisation ensures objectivity by avoiding any personal or subjective bias in the allotment of treatments to the experimental units. This can be explained by taking an example. Suppose there are two calculating machines. A set of statistical calculations is done on both of them by the same person. He carries out the calculations first on machine A and then on machine B. It is observed that machine B has taken less time than machine A. The question is whether this inference is right. Here, we should note that once a person has carried out a set of calculations on machine A, he has become somewhat familiar with the calculations and, therefore, needs less time to carry out the same set of calculations on machine B[3]. Obviously, this is a bias which could have been anticipated before conducting such an experiment. In order to avoid a bias of this type, the experimenter uses randomisation. In this particular case, the experimenter decides the order in which the two machines are used in any trial by tossing a coin. Thus, each of the two machines has an equal chance of being used first, though any specific randomisation may favour one or the other machine.

Randomisation of test units to treatments ensures that any peculiarities of test units will have an equal chance of occurrence in an individual operation. As a result, the estimate will be unbiased.

There are a number of experimental designs that are used in carrying out an experiment. However, marketing researchers have used four experimental designs more frequently. These are: completely randomised, randomised block, latin square and factorial designs. We shall discuss these in this chapter.

COMPLETELY RANDOMISED DESIGN

This is the simplest type of design in which treatments are applied to the experimental units entirely by a chance process. This is done by randomisation, as discussed earlier. A major advantage of the completely randomised design is its flexibility. On account of this, there is no restriction on the number of treatments that can be used nor on the number of test units that can be allocated to

3 This is an over-simplified example based on Cochran, W.G. and G.M. Cox, *Experimental Design*, New York, John Wiley and Sons, Inc. (Second edition), 1957, pp. 6–7.

each treatment. Although it is the simplest and a very flexible experimental design, it is seldom used in marketing research. The reason is that there is an implicit assumption in this design that the test units are more or less of an equal size or responsiveness. In marketing, however, we are not sure of this.

We may now take a numerical example of the completely randomised design.

The statistical tool used in the completely randomised design is the analysis of variance, discussed in Chapters 15 and 16. The technique is not discussed here but it is used in a numerical example.

Example 1

Suppose a firm is interested in determining whether the different methods of training its sales personnel show significant differences in their performance. The yardstick to judge the performance of sales personnel is the value of orders procured by them in a given time period. The firm chooses five salesmen from each of the four batches which have been trained by different training methods. The sales performance in terms of the orders obtained by them during a period of two consecutive months is shown in Table 17.1.

Table 17.1 Orders Obtained ('000 Rs)

Salesmen	Batch A	Batch B	Batch C	Batch D
1	20	18	16	25
2	30	21	18	22
3	16	24	25	23
4	18	27	19	19
5	26	25	22	26

In order to carry out calculations, let us first formulate the null and alternative hypotheses. The null hypothesis is

$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$ and the alternative hypothesis is

$H_1 : \mu_i$ not all equal, where μ_i are the population average sales.

Orders Obtained

A	B	C	D
20	18	16	25
30	21	18	22
16	24	25	23
18	27	19	19
26	25	22	26

Mean $\bar{y}_1 = \frac{110}{5} = 22$ $\bar{y}_2 = \frac{115}{5} = 23$ $\bar{y}_3 = \frac{100}{5} = 20$ $\bar{y}_4 = \frac{115}{5} = 23$ Grand Mean $\bar{y} = \frac{440}{20} = 22$

Sum of squares:

$$\sum_{i=1}^{5}(y_{i1}-\bar{y}_1)^2 = (20-22)^2+(30-22)^2+(16-22)^2+(18-22)^2+(26-22)^2$$

$$= (-2)^2+(8)^2+(-6)^2+(-4)^2+(4)^2$$

$$= 4+64+36+16+16$$

$$= 136$$

$$\sum_{i=1}^{5}(y_{i2}-\bar{y}_2)^2 = (18-23)^2+(21-23)^2+(24-23)^2+(27-23)^2+(25-23)^2$$

$$= (-5)^2+(-2)^2+(1)^2+(4)^2+(2)^2$$

$$= 25+4+1+16+4$$

$$= 50$$

$$\sum_{i=1}^{5}(y_{i3}-\bar{y}_3)^2 = (16-20)^2+(18-20)^2+(25-20)^2+(19-20)^2+(22-20)^2$$

$$= (-4)^2+(-2)^2+(5)^2\,(-1)^2+(2)^2$$

$$= 16+4+25+1+4$$

$$= 50$$

$$\sum_{i=1}^{5}(y_{i4}-\bar{y}_4)^2 = (25-23)^2+(22-23)^2+(23-23)^2+(19-23)^2+(26-23)^2$$

$$= (2)^2+(-1)^2+(0)^2+(-4)^2+(3)^2$$

$$= 4+1+0+16+9$$

$$= 30$$

Sum of squares of the Deviations from the Grand Mean

$$= 5\,(22-22)^2+5\,(23-22)^2+5\,(20-22)^2+5\,(23-22)^2$$

$$= (5\times 0)+(5\times 1)+(5\times 4)+(5\times 1)$$

$$= 0+5+20+5$$

$$= 30$$

Table 17.2 Analysis of Variance Table

Source of variation	Sum of squares	df	Mean square	F ratio
Treatments	30	3	10	
Error	266	16	16.62	1.66
Total	296	19		

The table value of F with df (16, 3) at a 0.05 level of significance is 8.69. Since the observed F value 1.66 is less than the table value of F, we accept the null hypothesis that there is no significant difference in the treatments, i.e., $H_0 = \mu_1 = \mu_2 = \mu_3 = \mu_4$. In other words, the different training methods do not result in significantly different performance of the sales personnel.

RANDOMISED BLOCK DESIGN

The term 'Randomised Block Design' has originated from agricultural research. In this design, several treatments of variables are applied to different blocks of land to ascertain their effect on the yield of a particular crop. However, the yield may vary on account of variations in the quality of blocks. In order to isolate these differences in blocks, the researcher resorts to randomisation whereby treatments are assigned to plots of each block on a random basis. Blocks are formed in such a manner that each block contains as many plots as there are treatments so that one plot from each is randomly selected for each treatment. The production of each plot is measured after the treatment is given. These data are then interpreted and inferences are drawn by using the analysis of variance technique to find the impact of treatments on the agricultural output. In agricultural experiments, for example, different doses of fertiliser, different levels of irrigation, different varieties of crops, different timings of sowing or different combinations of two or more of these factors may constitute the treatments.

The data are arranged in rows according to the blocks and in columns according to the treatment. Denoting the measurement corresponding to block i and treatment j by y_{ij}, the data structure for b blocks and k treatments in the form of a randomised block design will be as shown in Table 17.3.

Table 17.3 Data Structure of a Randomised Block Design with b Blocks and k Treatments

Block	Treatment 1	Treatment 2	...	Treatment k	Block means
1	y_{11}	y_{12}	...	y_{1k}	$\bar{y}_{1.}$
2	y_{21}	y_{22}	...	y_{2k}	$\bar{y}_{2.}$
.			...		.
.			...		.
.			...		.
b	y_{b1}	y_{b2}	...	y_{bk}	$\bar{y}_{b.}$
Treatment means	$\bar{y}_{.1}$	$\bar{y}_{.2}$	...	$\bar{y}_{\cdot k}$	$\bar{y}_{\cdot\cdot}$

The row mean is denoted by

$$\bar{y}_i = \frac{1}{k}\sum_{j=1}^{k} y_{ij}$$

and the column mean is denoted by

$$\bar{y}_{\text{i}} = \frac{1}{b}\sum_{\text{i}=1}^{k} y_{ij}$$

The randomised block design is perhaps the most frequently used experimental design. It can be used in very many cases and the researcher with some practical experience can easily judge its suitability or otherwise in a specific case.

The statistical model for the randomised block design is

$$y_{ij} = \mu + \alpha_i + \beta_j + e_{ij}$$

where

y_{ij} is the dependent variable,

μ is an overall mean,

α_i is the effect of the ith treatment

β_j is the effect of the jth block, and

e_{ij} is the random error term.

The treatment and block effects are defined as deviations from the overall mean. As a result

$$\sum_{i=1}^{k} \alpha_i = 0$$

and $$\sum_{j=1}^{b} \beta_j = 0$$

As we are interested in testing the equality of the treatment means, the relevant hypotheses are:

$$H_0 : \mu_1 = \mu_2 = \ldots = \mu_k$$

$$H_1 : \mu_1 \neq \mu_j$$

We now take a numerical example of this design.

Example 2

A firm is interested in an experiment to ascertain the effect of advertising on the sale of its product in different stores. It has devised four advertising treatments A, B, C and D. There are three blocks, each containing four stores of comparable sizes. As a result of the experiment, the following data emerge.

Table 17.4 Treatments

Block-stores	Advertisement A	Advertisement B	Advertisement C	Advertisement D	Total
Block I	20	24	28	26	98
Block II	32	40	48	50	170
Block III	35	41	52	55	183
Total	87	105	128	131	451

The firm is interested to know if advertisement treatments have a significant effect on the sale of the product.

$$\text{Correction Factor} = \frac{T^2}{N} = \frac{(451)^2}{12} = 16950.08$$

Sum of squares between advertisements

$$= \frac{(87)^2}{3} + \frac{(105)^2}{3} + \frac{(128)^2}{3} + \frac{(131)^2}{3} = -C$$

$$= \frac{7569}{3} + \frac{11025}{3} + \frac{16384}{3} + \frac{17161}{3} - 16950.08$$

= 17,379.67 – 16950.08 = 429.59

Sum of squares between stores

$$= \frac{(98)^2}{4} + \frac{(170)^2}{4} + \frac{(183)^2}{4} - C$$

$$= \frac{9604}{4} + \frac{28900}{4} + \frac{33489}{4} - 16950.08$$

= 17998.25 – 16950.08 = 1048.17

Total sum of squares

$$= [(20)^2 + (32)^2 + (35)^2 + (24)^2 + (40)^2 + (41)^2 + (28)^2 + (48)^2 + (52)^2 + (26)^2 + (50)^2 + (55)^2] - C$$

= 400 + 1024 + 1225 + 576 + 1600 + 1681 + 784 + 2304 + 2704 + 676 + 2500 + 3025 – 16950.08

= 18499 – 16950.08

= 1548.92

Residual or Remainder = Total sum of squares – Sum of squares between advertisements – Sum of squares between stores

= 1548.92 – 429.59 – 1048.17

= 71.16

Degrees of freedom for remainder

$= (c - 1)\,(r - 1)$

$= (4 - 1)\,(3 - 1) = 6$

Table 17.5 Analysis of Variable Table

Source of variation	Sum of squares	df	Mean squares	F
Between advertisements	429.59	3	143.20	12.07
Between stores	1048.17	2	524.08	44.19
Remainder or Residual	71.16	6	11.86	
	1548.92	11		

As the critical value of F (6, 3) with $\alpha = 0.05$ is 8.94 which is less than the calculated value of F = 12.07, we reject the null hypothesis that there is no significant difference between different levels of advertisement on the sale of the product. In other words, advertisement seems to have an effect on the sale of the product. Since the critical value of F (6, 2) with $\alpha = 0.05$ is 19.33 which is less than the calculated value of $F = 44.19$, we reject the null hypothesis that there is no significant difference in the sale of product in different stores.

LATIN SQUARES

A Latin square is one of the experimental designs which has a balanced two-way classification scheme. Take, for instance, the following 4×4 arrangement:

a	b	c	d
b	c	d	a
c	d	a	b
d	a	b	c

In this arrangement, each letter from a to d occurs only once in each row as also only once in each column. The balanced arrangement, it may be noted, will not get distorted if one row is interchanged with another. Thus, if we interchange row 1 with row 3, the following arrangement will result

c	d	a	b
b	c	d	a
a	b	c	d
d	a	b	c

In this case too, each letter occurs just once in each row as also just once in each column.

Since a Latin square is a balanced arrangement of data, it must have the same number of columns and rows. A Latin square of, say, k order, must possess k rows and k columns in such a way that each symbol or letter occurs just once in each row and in each column. As these symbols or letters can be arranged in a number of ways, several different Latin squares can be constructed.

The balanced arrangement achieved in a Latin square is its main strength. In a Latin square experimental design, comparisons among treatments will be free from both differences between 'rows' and between 'columns'. A Latin square thus removes two sources of extraneous variations, i.e., those associated with (a) rows and (b) columns. In case of a Latin square experiment, the magnitude of the experimental error is smaller than it would have been otherwise, when the Latin square is not used.

One of the earlier applications of Latin squares to marketing problems is found in a paper published by Brunk and Federer.[4] The authors have discussed some examples of carefully planned investigations in marketing reseawrch. One of these examples related the effect of different practices of pricing, displaying, and packaging of apples on their sale. Four stores participated in this experiment for a period of one week. The authors compared four merchandising practices indicated by letters A, B, C and D. To ensure that each store used each treatment, the experiment was conducted in four time periods. As the grocery order per customer would be larger at the weak-end than during the working days, the week was divided into two parts—Monday to Thursday, and Friday and Saturday. A 4×4 Latin square was constructed for each part of the week. These Latin square designs are shown in Table 17.6.

4 Brunk, M.E. and W.T. Federer, "Experimental Designs and Probability Sampling in Marketing Research" in *Journal of American Statistical Association*, Vol. 48, 1953, p. 440. Also briefly discussed by Cox, D.R., *op. cit.*, pp. 214–215.

Table 17.6 Latin Square Design in Marketing Research

Day	Store			
	1	2	3	4
First Part of Week				
Monday	B	C	D	A
Tuesday	A	B	C	D
Wednesday	D	A	B	C
Thursday	C	D	A	B
Second Part of Week				
Friday, a.m.	B	A	C	D
Friday, p.m.	C	D	B	A
Saturday, a.m.	A	B	D	C
Saturday, p.m.	D	C	A	B

Source: As given in footnote 4.

These Latin squares show that for each part of the week and experimental units were grouped into sets of 16 and classified by stores and by time periods. The observation for each experimental unit was the sale of apples for hundred customers in each store.

The model for a Latin square experiment is :

$$X_{ijk} = \mu + A_i + B_j + C_k + e_{ijk}$$

where

μ = population mean
A = treatment effect
B = row effect
C = column effect
e = error, assumed to be normally distributed with zero mean and unit standard deviation.
X_{ijk} = refers to a particular entry found in the treatment i, row j, and column k, with treament totals as $X_{i}..$; row total as $X_{.j}.$, column total as $X_{..k}$ and the overall total as $X...$

Steps Involved in Constructing a Latin Square

The construction of Latin square involves the following steps:

1. Computation of the correction factor (C) by squaring the grand total and dividing it by the number of observations.
2. Computation of the total sum of squares (TSS) by adding the squares of individual observations and subtracting the correction factor from this total.
3. Computation of the squares of row sums, dividing by the number of items in a row and by subtracting the correction factor.
4. Computation of the squares of column sums, dividing by the number of items in a column and by subtracting the correction factor.
5. Computation of the squares of the 'treatment' sums, dividing by the number of treatments and by subtracting the correction factor.

6. Computation of the experimental error sum of squares by subtracting the sum of figures obtained in steps 3, 4 and 5 from the figure obtained in step 2.
7. Preparation of the analysis of the variance table and computation of mean squares.
8. Application of an F-test by comparing the treatment mean square with the experimental error mean square.

These steps can be understood clearly by taking a numerical example of a Latin square design.

Example 3

Suppose a firm is interested to ascertain the effect of package colour on the sale of a particular product. At the same time, it is interested in time periods as well as store differences. For this purpose, it considers the use of three package colours in three time periods and in three stores. The firm randomly assigns the treatments to each experimental unit, as a result of which it obtains the following Latin square.

Table 17.7 A Latin Square

Time period	Store		
	1	2	3
I	A	B	C
II	B	C	A
III	C	A	B

In the above Latin square, letters A, B and C denote three different package colours. The firm has carried out the experiment for a week and noted the number of units sold of the product as shown below:

Table 17.8 Experimental Data

Time period	Store			Total
	1	2	3	
I	30	26	32	88
II	22	28	31	81
III	25	29	27	81
Total	77	83	90	250

The sales by package colours were as follows

Package Colours

	A	B	C	Total
	30	26	32	88
	31	22	28	81
	29	27	25	81
Total	90	75	85	250

The null hypothesis and the corresponding alternative hypothesis are:

(i) $H_o : \mu_A = \mu_B = \mu_C$
$H_a : \mu_A \neq \mu_B \neq \mu_C$

(ii) $H_o : \mu_I = \mu_{II} = \mu_{III}$
$H_a : \mu_I \neq \mu_{II} \neq \mu_{III}$

(iii) $H_o : \mu_1 = \mu_2 = \mu_3$
$H_a : \mu_1 \neq \mu_2 \neq \mu_3$

Let us now carry out the calculations in accordance with the steps mentioned earlier.

Calculations:

1. Correction factor

$$C = \frac{(250)^2}{9} = \frac{62500}{9} = 6944.44$$

2. Total sum of squares (TSS)

$$\begin{aligned} \text{TSS} &= (30)^2 + (22)^2 + \ldots + (27)^2 - C \\ &= 900 + 484 + 625 + 676 + 784 + 841 + 1024 + 961 + 729 - 6944.44 \\ &= 7024 - 6944.44 \\ &= 79.56 \end{aligned}$$

3. Between time period sum of squares (BTPSS)

$$\begin{aligned} BTPSS &= \frac{(88)^2}{3} + \frac{(81)^2}{3} + \frac{(81)^2}{3} - \text{C} \\ &= \frac{7744}{3} + \frac{6561}{3} + \frac{6561}{3} - 6944.44 \\ &= 6955.33 - 6944.44 \\ &= 10.89 \end{aligned}$$

4. Between store sum of squares (BSSS)

$$\begin{aligned} BSSS &= \frac{(77)^2}{3} + \frac{(83)^2}{3} + \frac{(90)^2}{3} - \text{C} \\ &= \frac{5929}{3} + \frac{6889}{3} + \frac{8100}{3} - 6944.44 \\ &= 6972.67 - 6944.44 \\ &= 28.23 \end{aligned}$$

5. Between package colour sum of squares (BPCSS)

$$\begin{aligned} BPCSS &= \frac{(90)^2}{3} + \frac{(75)^2}{3} + \frac{(85)^2}{3} - C \\ &= \frac{8100}{3} + \frac{5625}{3} + \frac{7225}{3} - 6944.44 \\ &= 6983.33 - 6944.44 \\ &= 38.89 \end{aligned}$$

6. Experimental error sum of squares (EESS)

$$EESS = TSS - (BTPSS + BSSS + BPCSS)$$
$$= 79.56 - (10.89 + 28.23 + 38.89)$$
$$= 79.56 - 78.01$$
$$= 1.55$$

7. **Table 17.9** Analysis of Variance Table

Source of variance	*df*	*SS*	*MS*
Between time periods	2	10.89	5.44
Between stores	2	28.23	14.11
Between package colours	2	38.89	19.44
Error	2	1.55	0.77
Total	8	79.56	

8. *F*-tests:

Time Periods

Calculated *F* value, $F = \dfrac{5.44}{0.77} = 7.06$

Critical *F* value, $F\,(2, 2)\,(0.05) = 19.00$

Since the calculated *F* value is less than the critical *F* value, we accept the null hypothesis, i.e., $\mu_{\text{I}} = \mu_{\text{II}} = \mu_{\text{III}}$. In other words, there is no significant difference in sales in different time periods.

Stores

Calculated *F* value, $F = \dfrac{14.11}{0.77} = 18.32$

Critical *F* value 19.00 (as earlier).

Here, too, we accept the null hypothesis, namely, $\mu_1 = \mu_2 = \mu_3$, i.e., we do not find any significant difference in sales in the three stores.

Package Colours

Calculated *F* value, $\text{F} = \dfrac{19.44}{0.77} = 25.25$

Critical *F* value 19.00 (as earlier).

Since the calculated F value exceeds the critical *F* value, we reject the null hypothesis and conclude $\mu_A \neq \mu_B \neq \mu_C$. In other words, package colours have a significant effect on the sale of the product in question.

Example 4

Another example of a Latin square design is cited from the *Journal of Advertising Research*. Richard W. Hansen and Thomas E. Barry[5] conducted an experiment in real-estate advertising. The authors wanted to know whether there was any relationship between the number of properties in a classified advertisement and the number of inquiries generated by the advertisement. For this purpose, they used the following Latin square design.

Table 17.10 Latin Square Design

Weeks	Broker Office			
	A	B	C	D
1	I	IV	II	III
2	IV	III	I	II
3	III	II	IV	I
4	II	I	III	IV

This Latin square design comprised four treatments, namely I—one property, II—two properties, III—three properties and IV—four properties. Four different broker offices (A, B, C and D) were used. Each office manager was asked to select four similar properties (price, location, type of dwelling) and six alternative replacement properties. Advertisements were given on Wednesday and Thursday of each week, which appeared in the morning newspaper. It was ensured that the nature and the amount of information for each advertised property was similar so that the results might not be biased.

The experiment was conducted for a period of four weeks. The hypothesis examined was H_o : there is no relationship between the number of properties in an advertisement and the number of inquiries generated by it. The ANOVA table pertaining to this experiment is given below:

Table 17.11 Analysis of Property Format and Response Generation

Source of variation	Sum of squares	Degree of freedom	Mean square	F-ratio	Significance level
Weeks	7.25	3	2.42	0.43	None
Offices	44.75	3	14.92	2.67	None
Treatments	180.25	3	60.08	10.77	0.01
Experimental error	33.50	6	5.58		
	265.75	15			

Source: As given in footnote 5.

From the figures given in Table 17.11, it is clear that the *F* ratio for treatments was significant at 0.01 significance level. In view of this, the null hypothesis that there would be no relationship between the number of properties in an advertisement and the inquiry-response level was rejected.

5 Hansen, Richard W. and Thomas E. Barry, "An Experiment in Real-Estate Advertising" in *Journal of Advertising Research*, Vol. 21, No. 3, June 1981, pp. 53–57.

The authors examined a few other relationships but these are not given here.

Example 5

Another example relates to an experiment conducted by Arch G. Woodside and Gerald L. Waddle.[6] The authors examined the following three hypotheses:

1. The presence of point-of-sale advertising is more effective in increasing the sales of a product than is a price reduction.
2. Consumers will buy more of a product at a reduced price than at the normal price with point-of-sale advertising present or absent in both instances.
3. Consumers will buy more of a product at the normal price when point-of-sale advertising is present than they will buy at the normal price when no point-of-sale advertising is present.

The experiment was conducted in four supermarkets for a period of four weeks, though a fifth week was also covered to ascertain if there were any carry-over effects of the treatments. The product involved in the experiment was instant coffee. A price reduction of about 20 per cent was chosen for the experiment. A simple, hand lettered sign attached to the normal shelf-space where instant coffee was displayed was the only point-of-sale advertising done.

The managers of the four supermarkets cooperated in conducting the experiment and allowed daily audits of coffee sales in their stores. In respect of the units sold at the reduced price, the managers were reimbursed for the difference between the normal price and the reduced price.

The results of the analysis of variance of the four by four Latin square treatment are shown in Table 17.12.

Table 17.12 Analysis of Variance Results of Latin Square Experiment

Source of variation	Sum of squares	Degrees of freedom	Mean square	F-ratio	Probability > F
Time period	281.1875	3	93.7291	2.1393	0.1965
Retail store	283.1875	3	94.3958	2.1545	0.1946
Direct treatment	7641.6875	3	2547.2291	58.1393	0.001
Residual error	262.8750	6	43.8125		
Total	8468.9375	15			

Source: As given in footnote 6.

It will be seen that the *F*-ratio, both for the variation between (a) time periods and (b) stores, was not significant. In both the cases, the variation could occur by chance along about 20 per cent of the time. In contrast, the *F*-ratio for direct treatment was significant, indicating that the treatments of the four possible combinations of price and point-of-sale advertising considerably affected the sale of instant coffee.

The authors further carried out an analysis of variance of the effects of the three components of the direct treatment—price, advertising and their interaction—on the sale of instant coffee. They found that all the three were significant beyond the 0.01 level. Finally, it may be noted that there was no significant carry-over effect on the sale of coffee during the period of the experiment.

6 Woodside, Arch G. and Gerald L. Waddle, "Sales Effects of In-store Advertising" in *Journal of Advertising Research*, Vol. 15, No. 3, June 1975, pp. 29–33.

One major advantage of a Latin square design is that it reduces the number of observations. A $3 \times 3 \times 3$ Latin square, as has been used in one of the preceding examples, can be used with only 9 instead of 27 observations. This technique can be effectively used especially at the time of test marketing when management is interested to know the effect of several variables such as packaging, advertising, pricing and time periods, on the sale of the product intended to be launched on a commercial basis. A properly designed Latin square experiment can result in a substantial decline in the experimental error.

FACTORIAL EXPERIMENTS

So far we have been concerned with one experimental factor at a time. However, experiments of this type will take a good deal of the researcher's time if general factors are to be considered, one at a time. Factorial experiments enable the researcher to evaluate the combined effect or the interaction effect of two or more variables used simultaneously in an experiment. In agriculture, for example, factors such as types of seeds and fertiliser composition are used as experimental treatments. Factorial experiments are classified by the number of levels or variations used for each factor, and the number of factors involved.[7] Thus, a 2^4 factorial experiment would use four different factors, each at two levels of intensity, say, a low level and high level. The levels can be either quantitative or qualitative. The treatments comprising the varying combinations of the test factors can be allocated to test units through different experimental designs such as randomised blocks or Latin squares.

While designing a factorial experiment, the researcher has to concern himself with a number of aspects such as identification of the factors relevant for inclusion in the experiment, specification of the levels of each factor to be induced, spacing of the levels of the factors, selection of experimental units, number of experimental units to be selected for each treatment combination, steps to be taken for controlling experimental error, selection of criterion measures for evaluating the effects of the treatment factors, etc.[8]

At this stage, we may briefly describe the salient features of a factorial experiment conducted by Wilkinson, Mason and Paksoy.[9] The experimental study aimed at assessing the impact of short-term supermarket strategy variables. For this purpose, three factors, viz. price level, display level and advertising level were used. With three price levels (regular price, cost price and reduced price), three display levels (normal display, expanded display and special display) and two advertising levels (advertising and no advertising), the factorial design called for 18 treatments.

Four products, namely, Camay soap, White house apple juice, Mahatma rice and Piggly Wiggly frozen pie shells were covered by the experiment conducted in one store of the Piggly Wiggly supermarket chain. For want of space, we shall be concerned here with only one product—Camay soap.

The experiment was run for 80 weeks. The competing brands and alternative sizes for the experimental product were ordered, stocked and shelved. These were maintained at regular price and normal display. Tables 17.13 showing average unit sales of Camay soap for treatment and main effects and Table 17.14 ANOVA results for Camay soap—are given below. For the ANOVA table, it is evident that both price level and display level have a strong impact on the sale of the soap.

7 Banks, Seymour, op. cit., p. 149.

8 Winer, B.J., *Statistical Principles in Experimental Design*, New York, McGraw-Hill Book Company, 1971.

9 Wilkinson, J.B. Mason, J. Barry and Christie H. Paksoy, "Assessing the Impact of Short-Term Supermarket Strategy Variables" in *Journal of Marketing Research,* Vol. XIX, February 1982, pp. 72–86.

Advertising level does not show any significant impact on the sale. Further, a three-way interaction of price, display and advertising is also significant. A two-way interaction between price and display level also is significant for this product. This experimental study suggests that price reductions and special display appear to provide a greater opportunity for augmenting sales as compared to newspaper advertising.

Factorial experiments are suitable particularly when the researcher undertakes an exploratory research to quickly find out the effects of a variety of factors. Also, when he is interested to know the interactions among several factors, such experiments will be suitable. Finally, where recommendations are to be applied over a wide range of conditions, factorial experiments will be appropriate.[10] In case of large factorial experiments, great care has to be exercised by the researcher especially with regard to the analysis of the data as they are too numerous and complex.

Table 17.13 Average Unit Sales for Treatment and Main Effects—Camay Soap

	No Advertising			Advertising		
	Regular price	**Reduced price**	**Cost price**	**Regular price**	**Reduced price**	**Cost price**
Regular shelf space	13.0	11.0	24.0	19.0	33.5	36.0
Expanded shelf space	42.5	12.5	39.0	32.0	26.5	40.5
Special display	66.5	89.0	87.5	44.0	44.0	142.5

Source: As given in footnote 9.

Price	
Treatment	Treatment means
Regular	36.00
Reduced	36.08
Cost	61.58
Display	
Treatment	Treatment means
Regular	22.75
Expanded	32.17
Special	78.75
Advertising	
Treatment	Treatment means
No advertising	42.67
Advertising	46.44

[10] Based on Cochran W.G. and G.M. Cox, op. cit., p. 152.

Table 17.14 ANOVA Results for Camay Soap

Source of variation	Sum of squares	*df*	Mean square	*F*	Significance of *F*
Main effects	26,926.222	5	5,385.244	15.798	0.000
Price	5,219.056	2	2,609.528	7.655	0.004
Display	21,578.722	2	10,789.361	31.651	0.000
Advertising	128.444	1	128.444	0.377	0.547
2-way interactions	6,465.889	8	808.236	2.371	0.061
Price/display	4,310.111	4	1,077.528	3.161	0.039
Price/advertising	1,685.056	2	842.528	2.472	0.113
Display/advertising	470.722	2	235.261	0.690	0.514
3-way interactions	4,222.778	4	1,055.694	3.097	0.042
Price/display/advertising	4,222.778	4	1,055.694	3.097	0.042
Explained	37,614.889	17	2,212.641	6.491	0.000
Residual	6,135.996	18	340.889		
Total	43,750.884	35	1,250.025		

Source: As given in footnote 9.
Multiple $R^2 = 0.615$ Multiple $R = 0.785$

There are a number of other designs of experiments but they are not so frequently used in marketing research as those discussed above. They are, therefore, not discussed here.Two examples using SPSS along with the interpretation of their respective results are given below.

Example Using SPSS

A marketing research organisation showed three different advertisements to five subjects who were asked to rank them according to truthfulness. The most truthful advertisement was to be ranked as 1. It obtained the following results:

Subjects	Advertisement		
	A	B	C
1	2	1	3
2	1	2	3
3	1	3	2
4	3	2	1
5	2	1	3

Conduct a test to ascertain whether the subjects perceived the three advertisements as having equal truthfulness. Use a level of significance of 0.05. What is your conclusion?

To perform ANOVA (One-Way) in SPSS:

From the Analyze menu

→ Choose “Compare Means”

→ And then choose "One-Way ANOVA…"

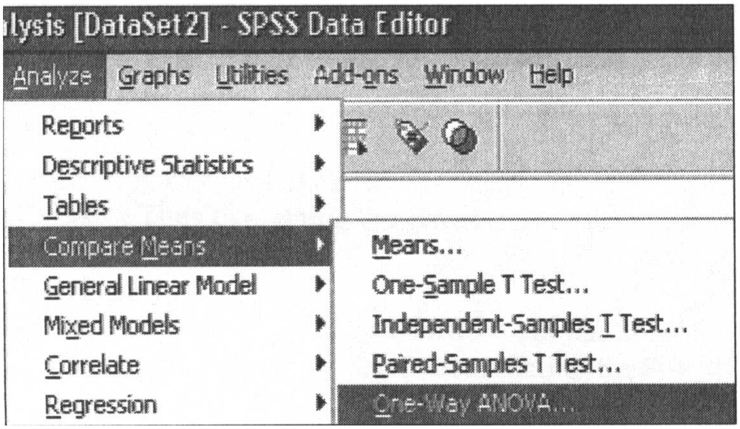

Fig. 17.2

The following is the One-way ANOVA Dialog Box:

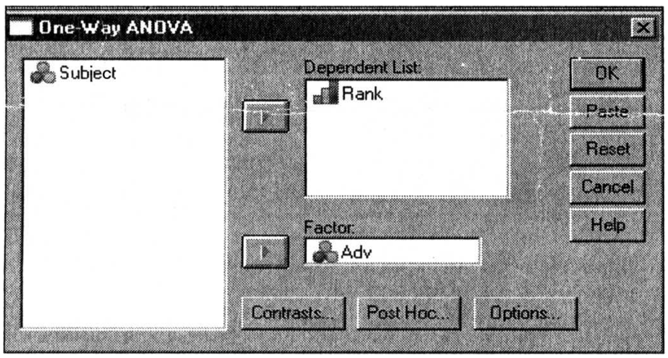

Fig. 17.3

- Ranking is the dependent variable
- Advertisement type is the Factor

To change the level of significance values go to the "Post hoc" sub dialog:

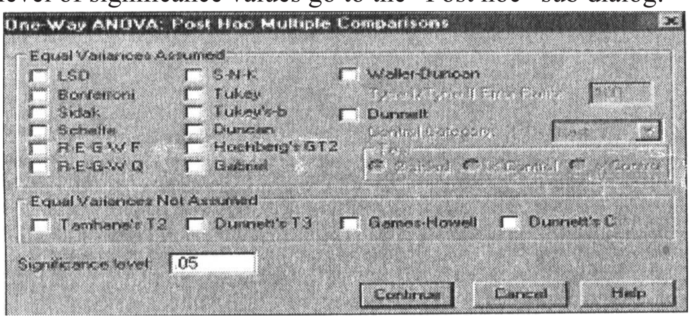

Fig. 17.4

Change the significance level to the specified level and click "**ok**"

Interpretations:

The ANOVA Table:

ANOVA

Rankings by Subjects

	Sum of Squares	*df*	Mean Square	*F*	Sig.
Between Groups	1.200	2	0.600	0.818	0.464
Within Groups	8.800	12	0.733		
Total	10.000	14			

Sum of Squares due to between Groups explains the significance of the factor in the Model used for ANOVA. Thus explaining the effect of the factor 'Advertisement type' on the 'Rankings'.

The Hypotheses set:

Null Hypothesis H_0: Advertisement has no effect on Ratings (Mean rating for A = Mean Rating for B = Mean Rating for C)

Alternative Hypothesis H_1: At least two types have different ratings
($MR_A \neq MR_B = MR_C$) or
($MR_A = MR_B \neq MR_C$) or
($MR_A \neq MR_B \neq MR_C$).

F Ratio = Mean Square (between Groups)/Mean Square (within Groups) is used to Reject or Accept the Null Hypothesis.

Here is nothing but *p*-Value of F-Statistic.

If Sig. Value is less than or equal to the level of significance (1.o.s) set up than we reject null hypothesis, otherwise we accept null hypothesis.

Conclusion:

Since the Sig. Value is > 0.05, we accept H_0 and conclude that the Advertisement type has no effect on the ratings.

Example Using SPSS

The following data pertain to the number of units of a product manufactured per day by five workmen from four different brands of machines:

Workman	Machine Brands			
	A	B	C	D
1	46	40	49	38
2	48	42	54	45
3	36	38	46	34
4	35	40	48	35
5	40	44	51	41

(i) Test whether the mean productivity is the same for the four brands of machine type.
(ii) Test whether five different workmen differ with respect to productivity.

To perform ANOVA (One-Way) in SPSS:

From the Analyze menu

→ Choose "Compare Means"

→ And then choose "One-Way ANOVA..."

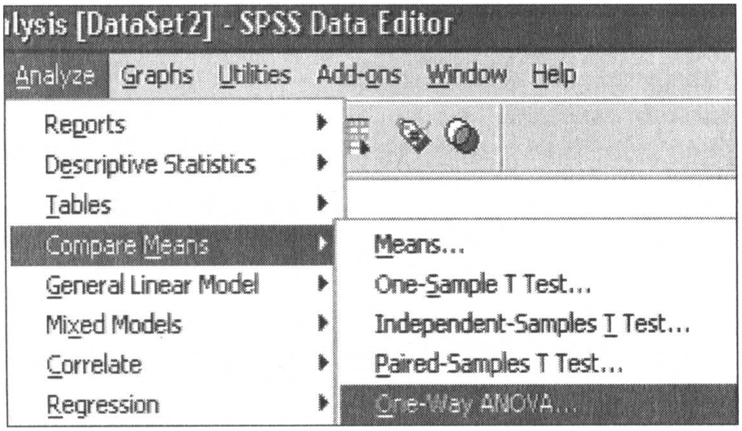

Fig. 17.5

The following is the One-Way ANOVA Dialog Box:

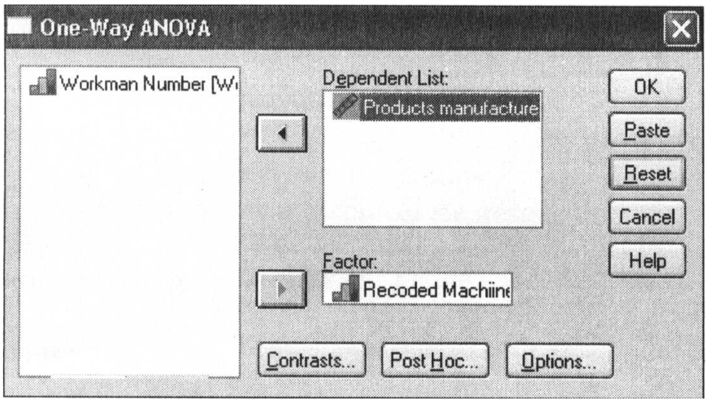

Fig. 17.6

- 'No. of units of product manufactured' is the dependent variable
- Factor: -
  - For part (a) 'Machine Brand (Recoded to numeric)' is the Factor
  - For part (b) 'Workman Number' is the Factor.

To change the level of significance values go to the "Post hoc" sub dialog:

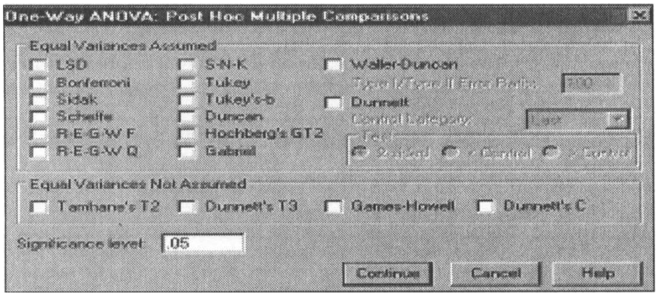

Fig. 17.7

Change the significance level to the specified level and continue.

Go to 'Options' and select Descriptives, Homogeneity of Variance test and Means Plot.

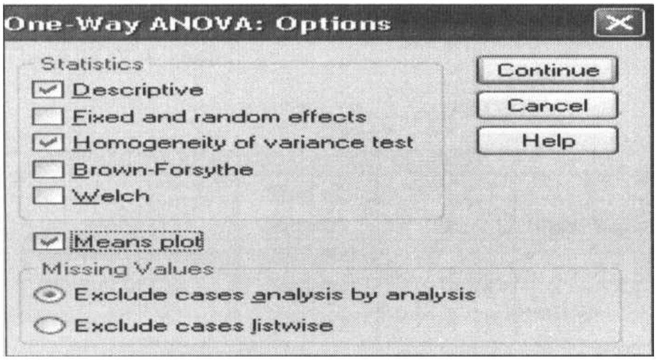

Fig. 17.8

Continue and click "**ok**"

- The descriptive Statistics contains Mean, S.D., S.E., Min, Max and Confidence Limits for Mean for each Factor level.
- Homogeneity of Variance Table gives Levene's Statistic and the Sig. Value to check the equality of variance between the groups.
- Mean plots are a graphical Representation of the Means for each level of the factors.

Interpretations:

Part (a)

Descriptives Statistics Table

Descriptives

Product manufactured (Number of Units)

					95% Confidence Interval for mean			
	N	Mean	Std. Deviation	Std. Error	Lower bound	Upper bound	Minimum	Maximum
1	5	41.00	5.831	2.608	33.76	48.24	35	48
2	5	40.80	2.280	1.020	37.97	43.63	38	44
3	5	49.60	3.050	1.364	45.81	53.39	46	54
4	5	38.60	4.506	2.015	33.01	44.19	34	45
Total	20	42.50	5.754	1.287	39.81	45.19	34	54

This table displays descriptive statistics for each group and for the entire data set.

The standard deviation indicates the amount of variability of the scores in each group. These values should be similar to each other for ANOVA to be appropriate.

The 95% confidence interval for the mean indicates the upper and lower bounds that contain the true value of the population mean 95% of the time.

Equality of Variance can be inspected via the Levene test as follows:

Test of Homogeneity of Variances

Products manufactured (Number of Units)

Levene Statistic	*df*1	*df*2	*Sig.*
2.621	3	16	.086

Hypothesis: H_0 = Variances of all the groups are equal.

If the Sig. Value is > 0.05 we accept H_0.

The ANOVA Table;

ANOVA

Units of product manufactured

	Sum of squares	**df**	**Mean square**	**F**	**Sig.**
Between Groups	353.800	3	117.933	6.857	.004
Within Groups	275.200	16	17.200		
Total	629.000	19			

Sum of Squares due to between Groups explains the significance of the factor in the Model used for ANOVA. Thus explaining the effect of the factor 'Machine Brand' on the 'Production'.

The Hypotheses set:

Null Hypothesis H_0: Machine Brand has no effect on the Production Rate (Mean Production from A = Mean Production from B = Mean Production from C)

Alternative Hypothesis H_1: At least two Brands have different Production Number

$(MP_A \neq MP_B = MP_C = MP_D)$ or

$(MP_A = MP_B \neq MP_C = MP_D)$ or ....

F Ratio = Mean Square (Between Groups)/Mean Square (Within Groups) is used to reject or accept the null hypothesis.

Here 'Sig.' is nothing but p-Value of F-Statistic.

If Sig. Value is less than or equal to the level of significance (1.o.s) set up, then we reject null hypothesis otherwise we accept null hypothesis.

Means Plot:

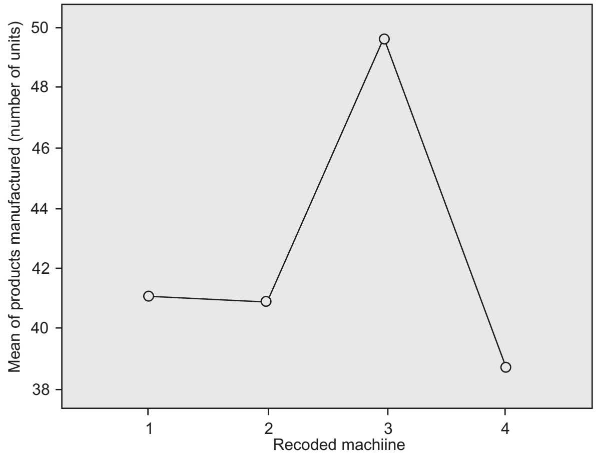

Fig. 17.9

Conclusion:

Since the Sig. Value is < 0.05, we reject H_0 and conclude that the Machine Brand has some effect on the Production Rate.

- **Part (b)**

Descriptives Statistics Table

Descriptives

Product manufactured (Number of Units)

	N	Mean	Std. deviation	Std. error	95% Confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
1	4	43.25	5.123	2.562	35.10	51.40	38	49
2	4	47.25	5.123	2.562	39.10	55.40	42	54
3	4	38.50	5.260	2.630	30.13	46.87	34	46
4	4	39.50	6.137	3.069	29.73	49.27	35	48
5	4	44.00	4.967	2.483	36.10	51.90	40	51
Total	20	42.50	5.754	1.287	39.81	45.19	34	54

Equality of Variance can be inspected via the Levene test as follows:

Test of Homogeneity of Variances

Products manufactured (Number of Units)

Levene Statistic	df1	df2	Sig.
.090	4	15	.984

Since the Sig. Value is > 0.05, we can say that variances of production are equal for each workman. The ANOVA Table:

ANOVA

Products manufactured (Number of Units)

	Sum of squares	df	Mean square	F	Sig.
Between Groups	201.500	4	50.375	1.768	.188
Within Groups	427.500	15	28.500		
Total	629.000	19			

Sum of Squares due to between Groups explains the significance of the factor in the Model used for ANOVA. Thus explaining the effect of the factor 'Workman type' on the 'Production'.

The Hypotheses set:

Null Hypothesis H_0: No difference in the production between the workmen (Mean Production by workman 1 = Mean Production by workman 2 = Mean Production by workman 3 = Mean Production by workman 4 = Mean Production by workman 5)

Alternative Hypothesis H_1: At least two of them are different in their Mean Production ($MP_1 \neq MP_2 = MP_3 = MP_4 = MP_5$) or ($MP_1 = MP_2 \neq MP_3 = MP_4 = MP_5$) or ....

Means Plot:

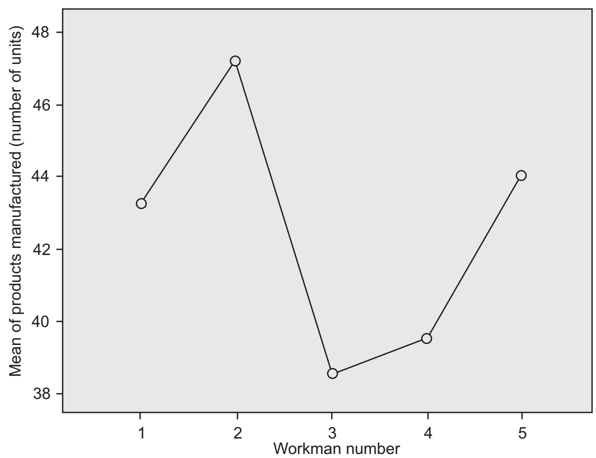

Fig. 17.10

Conclusion:

Since the Sig. Value is > 0.05 we accept H0 and conclude that there is no difference in the production between the Workmen.

Before we close this chapter, we should know what are the requirements for a good experiment. These are explained below.

REQUIREMENTS FOR A GOOD EXPERIMENT[11]

1. Absence of Systematic Error

A good experiment should be free from any systematic error. This is possible if experimental units receiving one treatment do not differ in a systematic manner from other experimental units given another treatment. This is achieved by randomisation.

2. Precision

A good experiment should have maximum precision. The indicator of precision is the magnitude of the standard error, which should be sufficiently small.

3. Range of Validity

To the extent possible, an experiment should be valid in a wide range of conditions so that the researcher can have a high degree of confidence in its results. An experimental technique that gives encouraging results in a certain setting may not give favourable results when conditions are different.

4. Simplicity

If an experiment is a complicated one, it will be difficult to carry it out properly without the help of trained and qualified personnel. It is, therefore, desirable for the experiment to have a simple design, particularly when it is to be performed by relatively unskilled people. Also, it is desirable to use relatively simple methods in the analysis of data.

5. The Calculation of Uncertainty

A good experiment should enable the researcher to calculate the uncertainty in the estimates of treatment differences. This would mean that he should be able to ascertain the statistical significance of the differences between the treatments.

NEED FOR PLANNING OF EXPERIMENTS

It may be emphasised that many experiments in marketing as also in other fields fail to fulfil their objective or objectives. This happens as sufficient thought is not given in their planning. The researcher should be clear as to the objectives of experimentation, the pros and cons of various designs available to him, the appropriateness of a particular design and the familiarity with the analysis of data emerging from the experiment. To the extent possible, the criteria for a good experiment should be fulfilled.

Finally, experimentation in marketing needs a high level of managerial commitment. If management becomes disenchanted with any experiment and if it is allowed to lapse without running its course or is handled half-heartedly by those who have to conduct it, all efforts will be in vain.

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[11] Based on Cox, D.R., *Planning of Experiments*, New York, John Wiley and Sons, Inc., 1958, pp. 5–12.

Summary

An experimental study involves manipulation of certain independent variables with a view to determining their effect on one or more dependent variables. After giving the definitions of certain terms, the chapter has mentioned a systems perspective in explaining the nature of an experiment. This is followed by an explanation of randomisation.

Since marketing researchers have used completely randomised, randomised block, Latin square and factorial designs more frequently than others these designs have been dealt with in the chapter. Of these, the completely randomised design is the simplest. A numerical example has been given to illustrate it. The randomised block design is perhaps the most frequently used experimental design. As in the preceding case, a numerical example has been given to explain its use. Then the discussion is focused on Latin squares. First, it has been emphasised that a Latin square is a balanced arrangement of data, having the same number of columns and rows – it is this characteristic which is its main strength. One of the earlier applications of this design has been cited. This is followed by an enumeration of the steps involved in constructing a Latin square. To illustrate the method, some numerical examples have been given. Finally, factorial experiments have been dealt with. The salient features of such experiments have been described . An example based on the recent literature on marketing research has been given.

The chapter contains two examples wherein SPSS has been used. It closes by specifying the requirements for a good experiment and by emphasising that experimentation in marketing needs a high level of managerial commitment.

Key Terms and Concepts

Experimental Treatments 351
Test Units 351
Extraneous Forces 351
Experimental Error 351
Experimental Design 352
Randomisation 353
Completely Randomised Design 353
Randomised Block Design 356
Latin Squares 359
Factorial Experiments 366
Concept of a Good Experiment 376

Questions

1. Define the following terms:
   (i) Experimental designs,
   (ii) Experimental treatments,
   (iii) Test units,
   (iv) Experimental error,
   (v) Extraneous forces.
2. Distinguish between field experiments and laboratory experiments.
3. What is randomisation? What are its objectives?
4. What is meant by a completely randomised design?
5. Under what conditions is the use of a completely randomised design suitable?
6. What is a randomised block design? When is it preferred to a completely randomised design?
7. What is a Latin square design?
8. What are the steps involved in constructing a Latin square?
9. "Latin square designs are used to eliminate any bias on account of order effects." Comment.
10. What is a 3×3 Latin square design?
11. What are the strengths and weaknesses of Latin square designs?
12. Suppose that the number of treatments is $r = 4$. How many Latin square designs would there be? For $r = 5$, what will be their number?
13. What is a factorial design?
14. What are the strengths and weaknesses of a factorial design?
15. What is a $2 \times 2 \times 3$ factorial design?
16. Suppose you are given three advertising themes for a new colour television set. How would you design and conduct an experiment to determine which of the themes is most effective?
17. Suppose that the Indian Medical Council is interested in finding out the association between smoking and lung cancer. You have been assigned this task. How would you plan an experimental study in this regard?
18. What are the requirements for a good experiment?
19. "The experimentation in marketing needs a high level of managerial commitment." Comment.

18 Multivariate Analysis I (Dependence Methods)

Learning Objectives

After reading this chapter, you should be able to understand:

- What is multivariate analysis?
- Multiple linear regression
- Non-linear regression
- Discriminant analysis

In the preceding chapter, the discussion was confined to simple correlation and simple regression analysis, dealing with only two variables. But, in marketing research, problems normally involve several variables. *For example*, the demand for television sets may depend not only on their price but also on income of households, advertising expenditure incurred by television manufacturers and other similar factors. Such problems require the use of multivariate techniques. In such cases, multiple regression will give more accurate predictions than the bivariate regression analysis.

Apart from multiple regression, there are several methods used in multivariate analysis. This chapter focusses on multiple regression and discriminant analysis.

WHAT IS MULTIVARIATE ANALYSIS?

Before discussing multivariate methods, we should clearly understand what a multivariate analysis is and how it differs from univariate and bivariate analyses. Multivariate analysis is the analysis of the simultaneous relationships among three or more phenomena. While in univariate analysis the focus is on the level (average) and distribution (variance) of the phenomenon, in a bivariate analysis the focus shifts to the degree of relationships (correlations or covariances) between the phenomena. In a multivariate analysis, the focus shifts from paired relationships to the more complex simultaneous relationships among phenomena.[1]

[1] Sheth, Jagdish N., "What is Multivariate Analysis?" in *Multivariate Methods for Market and Survey Research*, Chicago, American Marketing Association, (Second Printing), 1981, p. 3.

Figure 18.1 presents a classification of the multivariate methods. It is based on three judgements regarding the nature and utilisation of data that are to be made by the marketing researcher: (i) Are some of the variables dependent on others? (ii) If yes, how many variables are dependent? And (iii) Are the data qualitative (nonmetric) or quantitative (metric)? The use of a particular multivariate method will depend on the answers to these three questions.

Another approach to multivariate methods is to classify them into two broad categories: **functional methods** and **structural methods**. The functional methods, which are also called the dependence methods, provide directionality and the magnitude of relationship between one or more dependent variables and two or more independent variables. With the help of such methods, the marketing researcher can develop predictive model which can be used for forecasting. Some of the important functional multivariate methods are multiple regression analysis, discriminant analysis, multivariate analysis of variance and canonical analysis.

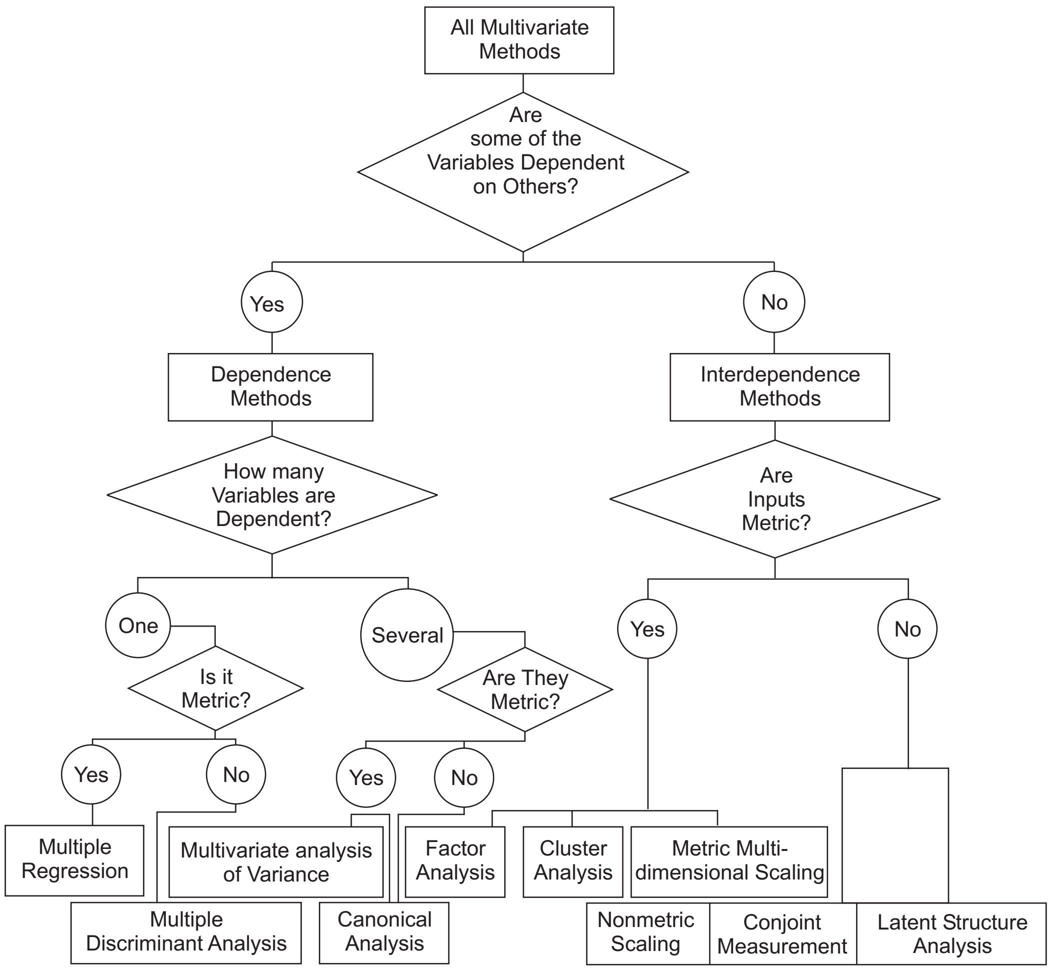

Fig. 18.1 A Classification of Multivariate Methods (Reproduced with permission from the American Marketing Association)

The structural methods, which are also called the interdependence methods, are essentially descriptive and are not useful for predictive purposes. They are helpful in reducing large and complex data into meaningful groups and in bringing out relationships which are not otherwise apparent. Some of the structural multivariate methods are factor analysis, cluster analysis, multi-dimensional scaling, conjoint analysis and latent structure analysis.

This chapter discusses two major dependence methods, viz., multiple linear regression and discriminant analysis.

MULTIPLE LINEAR REGRESSION

While many formulae can be used to ascertain the relationships among more than two variables, the most frequently used method amongst social scientists is that of linear equations. The multiple linear regression takes the following form

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + ... + b_kX_k$$

where Y is the dependent variable which is to be predicted, X_1, X_2, X_3, … and X_k are the k known variables on which predictions are to be based and a, b_1, b_2, b_3, … and b_k are parameters, the values of which are to be determined by the method of least squares.

An example will make the method in respect of multiple regression clear. Table 18.1 gives data on sales of a product, advertising expenditure and personal selling (number of selling agents) in respect of eight sales territories.

Table 18.1

Sales territory	Sales (Lakh Rs)	Advertising ('000 Rs)	Personal selling (No. of selling agents)
	(Y)	(X_1)	(X_2)
1	100	40	10
2	80	30	10
3	60	20	7
4	120	50	15
5	150	60	20
6	90	40	12
7	70	20	8
8	130	60	14

The three normal equations for a linear regression are:

$$\Sigma Y = na + b_1\,\Sigma X_1 + b_2\,\Sigma X_2 \qquad \text{(i)}$$

$$\Sigma X_1Y = a\,\Sigma X_1 + b_1\,\Sigma X_1^2 + b_2\,\Sigma X_1X_2 \qquad \text{(ii)}$$

$$\Sigma X_2Y = a\,\Sigma X_2 + b_1\,\Sigma X_1X_2 + b_2\Sigma X_2^2 \qquad \text{(iii)}$$

Table 18.2 Worksheet for Calculation of Multiple Regression Coefficients

X_1	X_1^2	X_2	X_2^2	X_1X_2	Y	X_1Y	X_2Y
40	1600	10	100	400	100	4000	1000
30	900	10	100	300	80	2400	800
20	400	7	49	140	60	1200	420
50	2500	15	225	750	120	6000	1800
60	3600	20	400	1200	150	9000	3000
40	1600	12	144	480	90	3600	1080
20	400	8	64	160	70	1400	560
60	3600	14	196	840	130	7800	1820
320	14600	96	1278	4270	800	35400	10480

The totals of column contained in Table 18.2 can be written with notations as follows:

$$\Sigma X_1 = 320 \qquad \Sigma X_1X_2 = 4270$$

$$\Sigma X_1^2 = 14600 \qquad \Sigma Y = 800$$

$$\Sigma X_2 = 96 \qquad \Sigma X_1Y = 35400$$

$$\Sigma X_2^2 = 1278 \qquad \Sigma X_2Y = 10480$$

Substituting these values in the normal equations, given earlier:

$$800 = 8a + 320b_1 + 96b_2 \qquad \text{(i)}$$

$$35400 = 320a + 14600b_1 + 4270b_2 \qquad \text{(ii)}$$

$$10480 = 96a + 4270b_1 + 1278b_2 \qquad \text{(iii)}$$

Multiplying (i) by 40 and then subtracting (ii) from the resultant

$$32000 = 320a + 12800b_1 + 3840b_2 \qquad \text{(iv)}$$

$$35400 = 320a + 14600b_1 + 4270b_2$$

$$- \quad - \quad - \quad -$$

$$-3400 = \quad -1800b_1 \quad -430b_2$$

or

$$340 = 180b_1 + 43b_2 \qquad \text{(v)}$$

Multiplying (i) by 12 and then subtracting (iii) from the resultant,

$$9600 = 96a + 3840b_1 + 1152b_2 \qquad \text{(vi)}$$

$$10480 = 96a + 4270b_1 + 1278b_2$$

$$- \quad - \quad - \quad -$$

$$-880 = \quad -430b_1 \quad -126b_2$$

or

$$440 = 215b_1 + 63b_2 \qquad \text{(vii)}$$

Multiplying (v) by 43 and (vii) by 36,

$$14620 = 7740b_1 + 1849b_2 \qquad \text{(viii)}$$

$$15840 = 7740b_1 + 2268b_2 \qquad \text{(ix)}$$

$$\underline{- \qquad - \qquad -}$$

$$-1220 = -419\, b_2 \qquad \text{(By subtracting (ix) from (viii))}$$

$$\therefore \quad b_2 = \frac{1220}{419} = 2.9116945$$

Substituting the value of $b_2 = 2.9116945$ in (vii) above,

$$440 = 215b_1 + (2.9116945 \times 63)$$

$$215b_1 = 440 - 183.43675$$

$$\text{or} \quad b_1 = \frac{256.56325}{215} = 1.1933174$$

Substituting the value of $b_1 = 1.933174$ and $b_2 = 2.9116945$ in (i) above,

$$800 = 8a + (1.1933174 \times 320) + (2.9116945 \times 96)$$

$$\text{or} \quad 800 = 8a + 381.86156 + 279.52267$$

$$\text{or} \quad 8a = 800 - 661.38423$$

$$\text{or} \quad a = \frac{138.61577}{8} = 17.326971$$

$\therefore$ The regression equation is

$$Y = 17.327 + 1.193\, X_1 + 2.912\, X_2 \quad \text{(Rounding the values to 3 decimal places)}$$

On the basis of this regression, we can ascertain the likely value of sales for a given expenditure on advertising and a specific number of selling agents. Suppose we are interested in knowing the sales when advertising expenditure is Rs 80,000 and when 25 selling agents employed in a territory. Symbolically,

$$Y = a + b_1X_1 + b_2X_2$$

$$= 17.327 + (1.193 \times 80) + (2.912 \times 25)$$

$$= 17.327 + 95.44 + 72.8$$

$$= 185.567$$

Thus, we can say that when the firm spends Rs. 80,000 on advertising and deploys a team of 25 selling agents in a territory, it is likely to sell the product worth Rs. 185.6 lakh in that territory.

Interpretation of the Regression Equation

The regression equation in the above example was

$$Y_c = 17.327 + 1.193\ X_1 + 2.912\ X_2$$

The b's are called partial regression coefficients and indicate the average change in Y for a unit change in X, holding the other X's constant. In the above equation, for example, $b_1 = 1.193$ shows that sales increase by 1.193 units for every one thousand rupees of expenditure on advertising; $b_2 = 2.912$ shows that sales increase by 2.912 units for every one person employed as a selling agent. Of the two variables, personal selling is far more important than advertising for increasing sales.

It may be noted that all the above calculations were carried out with absolute values. An alternative method based on deviations from the mean can be used in deriving the regression equation.

The coefficient of multiple determination (R^2) for this multiple linear regression can be calculated by the following formula:

$$R^2 = \frac{\Sigma\,(Y_i - \bar{Y})^2 - \Sigma\,(Y_i - Y_c)^2}{(Y_i - \bar{Y})^2}$$

where R^2 = Co-efficient of multiple determination

Y_i = Value of ith item in Y seies

$\bar{Y}$ = mean of the Y series

Y_c = computed value of ith item in Y series on the basis of the regression

It has the same meaning and interpretation here as it has in the case of simple regression. The coefficient of determination is the ratio of the explained variation to the total variation. In the above formula, the term $\Sigma\ (Y_1 - \bar{Y})^2$ shows total variation and the second term $\Sigma\ (Y_i - \bar{Y}_c)^2$ shows the explained variation. The above formula is now applied to the foregoing example. The worksheet is given in Table 18.3.

Table 18.3 Worksheet for Computing Co-efficient of Determination

X_1 ('000 Rs)	X_2 No. of selling agents	Y	Y_c	$Y–Y_c$	$(Y – Y_c)^2$	$(Y – \bar{Y})$	$(Y – \bar{Y})^2$
40	10	100	94	6	36	0	0
30	10	80	82	– 2	4	– 20	400
20	7	60	62	– 2	4	– 40	1600
50	15	120	121	– 1	1	20	400
60	20	150	147	3	9	50	2500
40	12	90	100	– 10	100	– 10	100
20	8	70	64	6	36	– 30	900
60	14	130	130	0	0	30	900
		800			190		6800

$$\bar{Y} = \frac{800}{8} = 100$$

$$R^2 = \frac{\Sigma\,(Y_i - \bar{Y})^2 - \Sigma\,(Y_i - Y_c)^2}{\Sigma\,(Y_i - \bar{Y})^2}$$

$$= \frac{6800 - 190}{6800} = 0.972 \text{ approx.}$$

The value of $R^2 = 0.972$ shows that 97.2 per cent of the total variation observed in the sales is explained by the regression equation. In other words, merely 2.8 per cent of the total variation in the dependent variable, Y, remains unexplained by the regression equation.

It may be recalled that in Chapter 16, the coefficient of determination (R^2) in a bivariate series was computed from the data contained in Table 16.8. In that example of simple linear regression, only one independent variable, namely, expenditure on advertising was used as a predictor of sales. The value of R^2 calculated was 0.944. With the introduction of another independent variable, namely, personal selling (number of selling agents), the value of R^2 has increased to 0.972. This means that the introduction of another variable accounts for some improvement in explaining the variations in the dependent variable. It is because of this that the multiple linear regression is regarded as a superior analytical tool compared to the simple linear regression.

As can be seen, the adjusted R^2 is less than R^2. Note that both are higher than bivariate r^2 (0.944). This clearly indicates that the introduction of another variable accounts for some improvement in explaining the variations in the dependent variable.

It may be noted that R^2 would be larger when the correlation between the independent variables is low. In case the independent variables are uncorrelated then R^2 would be the sum of bivariate r^2 of each independent variable with the dependent variable. R^2 cannot decrease when more independent variables are added to the regression equation. However, after already having some variables the inclusion of additional independent variables hardly makes much of a contribution to the regression equation. For this reason, R^2 is adjusted by using the following formula:

$$\text{Adjusted } R^2 = R - \frac{K(1-k^2)}{n-k-1}$$

where k is the number of independent variables and n is the sample size. Applying this formula, we get

$$\text{Adjusted } R^2 = 0.972 - \frac{2(1-0.972)}{8-2-1}$$

$$= 0.972 - \frac{2 \times 0.028}{5}$$

$$= 0.972 - \frac{0.056}{5}$$

$$= 0.972 - 0.0112$$

$$= 0.9608$$

THE STANDRED ERROR ESTIMATE

It may be recalled that in Chapter 17, while dealing with the bivariate distribution, the standard error of estimate was calculated after coefficients of regression were worked out. To measure the dispersion around the multi-regression plane, the following formula is used:

$$S_e = \sqrt{\frac{\Sigma(Y - \hat{Y})^2}{n-k-1}}$$

where S_e = standard error of estimate

y = corresponding estimated value of Y from the regression equation

n = number of observations

k = number of independent variables

The denominator in the above formula $n - k - 1$ shows that the standard error has $n - k - 1$ degrees of freedom. This shows that the degrees of freedom are reduced by the number of variables $(k) + 1$ that have been estimated from the same sample.

In our preceding exercise, we set up a worksheet (Table 18.3), where we have calculated $y - \hat{Y}$ for each individual observation in the series. The next column in the worksheet calculates $(Y - \hat{Y})^2$ for each individual item. The total of this item is 190. We can now apply the formula

$$S_e = \sqrt{\frac{\Sigma(Y - \hat{Y})^2}{n - k - 1}} = \sqrt{\frac{190}{8 - 2 - 1}}$$ $k = 2$ as X_1 and X_2 are the two independent variables

$$= \sqrt{\frac{190}{5}} = \sqrt{38} = 6.164$$

As was done in the case of simple linear regression we can use the standard error of estimate and the t distribution to calculate an *approximate confidence interval* around our estimate value $\hat{Y}$. The regression equation for this problem was

$$\hat{Y} = 17.327 + 1.193X_1 + 2.912X_2$$

Suppose we are interested to know what will our sales be if X_1 = Rs 70,000 and X_2 15. We apply these values in the above equation.

$$\hat{Y} = 17.327 + (1.193 \times 70) + (2.912 \times 15)$$

$$= 17.327 + 83.510 + 43.680$$

$$= 144.517$$

Suppose we want to be 95 percent confident that the actual sales of the product should be within ± 1 standard error of estimate from $\hat{Y}$. Further, as our $n = 8$, we have $n - k - 1$ degrees of freedom, that is, $8 - 2 - 1 = 5$. The critical value of t for 5 degrees of freedom at 95 per cent level of significance is 2.571.

$$\hat{Y} + t\,(S_e) = \text{Rs } 144.517 + (2.571 \times 6.164) = 160.036 \text{ or } 160$$

$$\hat{Y} - t\,(S_e) = \text{Rs } 144.517 - (2.571 \times 6.164) = 128.669 \text{ or } 129$$

Since sales figures are given in lakh rupees, these values are Rs 129 lakh and Rs 160 lakh. We can be 95 per cent confident that the sales of the product will be between Rs 129 lakh and Rs 160 lakh.

TESTING THE SIGNIFICANCE OF MULTIPLE REGRESSION

In order to test the overall significance of multiple regression, we perform a test of hypothesis using the F test. We want to know whether the value of R^2 really shows that the independent variables explain the dependent variable Y, or it might have happened by chance. In order words, we are trying to find whether the regression as a whole is significant. To ascertain this, our two hypotheses would be

$H_0 : B_1 = B_2 = ... B_k = 0$ (This means that Y does not depend on X's.)

H_1 : At least one $B_i \neq 0$ (This means that Y depends not depend on X's.)

In order to examine the null hypothesis, we have to look at the following three terms:

SST = Total sum of squares (i.e. the explained part) = $\Sigma\,(Y - \overline{Y})^2$

SSR = Regression sum of squares (i.e. the explained part) = $\Sigma\,(\hat{Y} - \overline{Y})^2$

SSE = Error sum of squares (i.e. the unexplained part) = $\Sigma\,(Y - \hat{Y})^2$

These three terms are related by the equation

SST = SSR + SSE

This equation shows that the total variation in Y can be split into parts, viz. the explained part and the unexplained part.

Another point to note relates to the degrees of freedom. Each of these three has some degrees of freedom. SST has $n - 1$ degrees of freedom. SSR has k degrees of freedom, as there are k independent variables that are used to explain Y. Finally, SSE has $n - k - 1$ degrees of freedom on account of our having used n observations to estimate $k + 1$ constants, a, b_1, b_2, ... b_k. On the basis of the three terms and the respective degrees of freedom, we can obtain F ratio as follows :

$$F = \frac{\text{SSR}/k}{\text{SSE}/(n-k-1)}$$

If this F ratio is larger than the critical value of F at a given level of significance (obtained from the Appendix Table 5), the null hypothesis is to be rejected. The rejection of null hypothesis implies that the regression as a whole is significant.

Having explained our approach to verify the null hypothesis, let us take an example to illustrate its application. We use the data given in Table 18.3, which also contains the original data earlier given in Table 18.2.

SST = $\Sigma\,(Y - \overline{Y})^2$ 6,800

SSR = $\Sigma\,(\hat{Y} - \overline{Y})^2$ = 6,610

SSE = $\Sigma\,(Y - \hat{Y})^2$ = 190

We have to calculate F-statistic to test the significance of regression.

Table 18.4 Calculation of Test Statistic

Source	Sum of Squares (SS)	Degrees of Freedom (DF)	Mean Sum of Squares (MS)
SSR	6,610	2	3,305
SSE	190	5	38
Total	6,800	7	971.4

$$F = \frac{\text{SSR}/k}{\text{SSR}/(n-k-1)} \text{ or } \frac{\text{MSR}}{\text{MSE}}$$

$$F = \frac{6{,}610/2}{190/5} = \frac{3{,}305}{38} = 86.97$$

For 2 numerator degrees of freedom and 5 denominator degrees of freedom, the Appendix Table 5 shows the values of $F = 13.27$. This is the upper limit of the acceptance region for a significance level of $\alpha = 0.01$. Since our calculated F value of 86.97 is much higher than 13.27 the null hypothesis is rejected. This means that the multiple regression $Y = 17.327 + 1.193X_1 + 2.912X_2$ (obtained earlier) is higly significant.

PARTIAL AND MULTIPLE CORRELATION

The discussion so far was confined to multiple regression. We now discuss partial and multiple correlation.

The partial correlation shows the relationship between two variables, excluding the effect of other variables. In a way, the partial correlation is a special case of multiple correlation. It may be noted that there is a difference between a simple correlation and a partial correlation. The simple correlation does not include the effect of other variables as they are completely ignored. There is almost an implicit assumption that the variables not considered do not have any impact on the dependent variable. But such is not the case in the partial correlation, where the impact of other independent variables is held constant.

Let us take our previous example where three variables are involved, viz sales, advertising expenditure and personal selling, that is, number of selling agents. Obviously, here sales is the dependent variable and the other two are independent variables. Let us give notations to these variables:

Say X_1 = Sales

X_2 = Advertising expenditure

X_3 = Number of selling agents

r = Coefficient of correlation

Here, $r_{12.3}$ shows the relation between sales (X_1) and advertising expenditure (X_2), excluding the effect of number of selling agents (X_3). In the same manner, $r_{13.2}$ shows the coefficient of correlation between sales (X_1) and number of selling agents (X_3), excluding the effect of advertising expenditure (X_2). The third partial correlation will be $r_{23.1}$, showing the coefficient of correlation between advertising expenditure (X_2) and number of selling agents (X_3), excluding the effect of sales (X_1). It should be obvious that this relationship would not be proper as sales (X_1) cannot be taken as an independent variable that would have an impact on the other two variables.

As regards notations, it should be noted that the subscripts on the left of dot (.) indicate the variables related, while the subscript on the right of dot indicates the variables excluded.

Partial Correlation Coefficient

If we denote $r_{12.3}$ as the coefficient of partial correlation between X_1 and X_2, holding X_3 constant, then

$$r_{12.3} = \frac{r_{12} - r_{13}r_{23}}{\sqrt{1 - r_{13}^2}\sqrt{1 - r_{23}^2}}$$

Likewise,

$$r_{13.2} = \frac{r_{13} - r_{12}r_{23}}{\sqrt{1 - r_{12}^2}\sqrt{1 - r_{23}^2}}$$

shows $r_{13.2}$ is the coefficient of partial correlation between X_1 and X_3, holding X_2 constant

Similarly,

$$r_{23.1} = \frac{r_{23} - r_{12}r_{13}}{\sqrt{1-r_{12}^2}\sqrt{1-r_{13}^2}}$$

where $r_{23.1}$ is the coefficient of partial correlation between X_2 and X_3 holding X_1 constant. Thus, we find that when three variables X_1 X_2 and X_3 are given, there will be three coefficients of partial correlation. Each of these coefficients of partial correlation will give the relationship between two variables while the third is held constant. It may also be noted that the squares of coefficients of partial correlation are called coefficients of partial determination. For example, if $r_{12.3} = 0.7$ then $r^2_{12.3}$ is 0.49. This means that 49 per cent of the variation is explained by this relationship when the third variable X_3 is held constant.

Partial correlation coefficient is helpful in deciding whether an additional variable is to be included or not. On the basis of the number of independent variables held constant, we distinguish between varying orders of coefficients of correlation. When only two variables X and Y are involved, there is no independent variable held constant, as such this is called as *zero-order correlation coefficient*. When one independent variable is held constant, then it is called *first-order correlation coefficient*. Likewise, when two independent variables are held constant, then it is known as the *second-order correlation coefficient*, and so forth.

It may also be noted that a coefficient of a given order can be expressed in terms of the next lower order. For example, a problem of first-order partial coefficient of correlation (involving three variables) can be expressed in terms of zero-order correlation, that is, simple correlation. This enables us to simplify the computations involved in case of three or more independent variables.

MULTIPLE CORRELATION

Unlike the partial correlation, multiple correlation is based on three or more variables without excluding the effect of anyone. It is denoted by R as against r, which is used to denote simple bivariate correlation coefficient. The subscripts are used in the same manner as in the case of partial correlation.

In case of three variables X_1, X_2 and X_3, the multiple correlation coefficients will be:

$R_{1.23}$ = Multiple correlation coefficient with X_1 as a dependent variable while X_2 and X_3 as independent variables.

$R_{2.13}$ = Multiple correlation coefficient with X_2 as a dependent variable while X_1 and X_3 as independent.

$R_{3.12}$ = Multiple correlation coefficient with X_3 as a dependent variable while X_1 and X_2 independent variables.

It may be recalled that the concepts of dependent and independent variables were non-existent in case of simple bivariate correlation. In contrast, the concepts of dependent and independent variables are introduced here in multiple correlation.

Symbolically, the multiple correlation coefficient can be shown as follows:

$$R_{1.23} = \sqrt{\frac{r_{12}^2 + r_{13}^2 - 2r_{12}r_{13}r_{23}}{1-r_{23}^2}}$$

$$R_{2.13} = \sqrt{\frac{r_{21}^2 + r_{23}^2 - 2r_{12}r_{13}r_{23}}{1 - r_{13}^2}}$$

$$R_{3.12} = \sqrt{\frac{r_{31}^2 + r_{32}^2 - 2r_{12}r_{13}r_{23}}{1 - r_{12}^2}}$$

As is the case with simple bivariate correlation, the coefficient of multiple correlation lies between 0 and 1. As R becomes closer to 0, it shows the relationship is becoming more and more negligible. In contrast, as it moves closer to 1, it shows that the relationship is becoming more and more strong. If R is 1, the correlation is called perfect. It may be added that when R is 0 showing the absence of a linear relationship, it is just possible that there may be a non-linear relationship among the variables. Another point to note is that multiple coefficient of correlation is always positive. This is in contrast to simple bivariate coefficient of correlation, which may vary from – 1 to + 1.

We can obtain the coefficient of multiple determination by squaring the multiple coefficient of correlation $R_{1.23}$.

MULTICOLLINEARITY IN MULTIPLE REGRESSION

At times, we come across a problem in multiple-regression analysis that is known as multicollinearity. This problem arises on account of a high degree of correlation between the independent variables, which reduces the reliability of the regression coefficients. Suppose that our data set consists of three variables – Y is production of steel, X_1 is the index of industrial production, and X_2 is the GNP (Gross National Product). It should be obvious that industrial (X_1) and GNP (X_2) are not independent of each other as industrial production is one of the components in GNP. In case both these variables have a perfect correlation between them, then it is unnecessary to use both of them. Only one variable can be used and that will give a better result.

Multicollinearity is a problem of degree. When the degree of correlation is minor among independent regression variables, the effect of multicollinearity may not be serious. In contrast, when there is a strong correlation, then the effect of multicollinearity is serious on the regression as it affects it adversely. In such cases, it is advisable to find out the extent of multicollinearity existing in regression.

One of the methods used for this purpose is a correlation matrix of the independent regression variables. It is an array of pairwise correlation coefficients between the independent variables X_i.

Table 18.5 is an example of a correction matrix based on hypothetical data.

Table 18.5 A Correlation Matrix

Variables	X_1	X_2	X_3	X_4
X_1	1			
X_2	0.8	1		
X_3	0.7	0.6	1	
X_4	0.6	0.5	0.9	1
.				
.				
.				

It can be seen from the correlation matrix that we can find out as to which independent variables are highly correlated with one another and thus pose the problem of multicollinearity when they both are included in the regression equation. In our example, we find that variables X_3 and X_4 are highly correlated having 0.9 correlation. Again, variables X_1 and X_2 with 0.8 correlation coefficient are highly correlated. A high degree of correlation suggests that the variables contain more or less the same information about Y that gives rise to multicollinearity when both the variables are included in the regression equation. It may be mentioned that correlation is shown as 1 in the correlation matrix whenever the same variable is involved, which is obvious as relationship between X_1 and X_1 will always be one. Same is the case with other variables. When correlation is 1 between say, X_1 and X_2, it is advisable to drop one variable from the regression equation.

In conclusion, it may be said that problem of multicollinearity is an important one. Whenever we come across a case of multicollinearity or we suspect that it exists on the basis of information available, we should try to solve it . The simplest method of solving such a problem is to remove the closely related variables from the regression equation. Alternatively, it is advisable to collect additional information to resolve this problem.

Apart from the problem of multicollinearity that we have explained above there are two other problems that should be taken care of while using multiple regression. These are discussed below.

Interpretation of Coefficients

Sufficient care must be exercised in interpreting coefficients. Consider the following regression equation:

$$\hat{Y} = 50 + 0.06X_1 + 0.06\,X_2$$

where $\hat{Y}$ = sales estimate

X_1 = advertising expenditure in ’000 Rs.

X_2 = expenditure on Sales force in Rs.

At first glance, it appears that a rupee spent on advertising and a rupee spent on the salesforce would have an identical effect on sales. However, this is not true as the units of measurement are different in two cases (thousand rupees in one case and rupee in the other). This means that an increase of rupees one thousand would have the equal effect of rupee one increase in salesforce expenditure. This example suggests that one must be careful in interpreting coefficients.

Causation

At times, one is likely to commit a mistake in assuming that levels of predictor variables cause the level of the criterion variable. What they indicate is evidence of causation, which cannot be taken as proof. Take an example, sales and advertising. Can we say that increase in advertising expenditure leads to increased sales? It could be put in a very different way. In view of improved sales performance business firms may set aside more funds for advertising. Thus, we find that it would be wrong to conclude that advertising causes sales. The correct approach would be to say that there is a strong association between sales as the criterion variable and advertising as one of the predictor variables.

This example clearly suggests that while interpreting regression coefficients, one should ensure that there is a strong or theoretical relationship between the criterion and predictor variables. If it is not, then the relationship should be treated as evidence of causation.

Identification of Variables for Multiple Regression Analysis

The marketing researcher using multiple regression analysis is often at a loss to determine how many and which variables he should use in a multiple linear regression analysis. Suppose, there are four independent variables (X_1, X_2, X_3 and X_4) in addition to the dependent variable Y. As a first step, the researcher should calculate r^2 separately for each of the four independent variables to ascertain which variable yields the maximum value of r^2. In this way, he will be able to identify the variable which explains the maximum variation in the dependent variable. Assuming that in this example, X_2 explains most of the variation in the dependent variable, he should then find out which variable in combination with X_2 results into the largest value of r^2. If that variable is X_3, then it becomes the second independent variable which ought to be selected for the regression equation. This procedure should continue until the researcher finds that r^2 cannot be increased significantly any longer. At this point, it will be futile for him to add any more independent variables in the regression equation.

This whole procedure for the identification and inclusion of relatively more important independent variables in the regression equation is known as stepwise multiple regression. In case the number of independent variables is large, this exercise can be carried out with the help of a computer without any difficulty.

Stepwise multiple regression assumes that no independent variables are entered in the regression equation at the beginning. It is only when an independent variable explains a relatively large variation in the dependent variable then it is chosen as a variable in the regression equation.

The selection of independent variables on the basis of stepwise multiple regression has been criticised by some on the ground that it might be misleading at times. Consider, for example, a hypothetical case where there are ten independent variables involved. For a given sample, the data may indicate, say, variables 9 and 10 as the most important. But, if the researcher draws another sample of the same size and from the same population, the data based on the second sample may show that independent variables say, 2 and 6, are relatively more important in explaining the variation in the dependent variable. In such a case, the researcher will get confused as to which variables are to be entered in the regression equation. However, such a situation is likely to arise only when a very small sample is chosen. The sample size should, therefore, be sufficient and as a practical expedient the number of observations in the sample should be at least ten times the number of variables involved.

Another problem that may arise in the case of multiple linear regression is that some of the independent variables may have a high degree of correlation among themselves. This is the problem of multicollinearity which may render the regression equation unrealistic and wrong. To avoid this, great care has to be exercised in the selection of independent variables. In the case of stepwise multiple regression, which is programmed in a computer, each time such an independent variable is chosen for the regression equation, it explains the greatest variation in the total variation in the dependent variable. This is to say, it brings about the greatest reduction in the error sum of squares. In fact, the researcher is advised to use the *F*-test[2] of significance for each variable. The independent

[2] This was discussed in Chapter 16.

variable to be entered into the regression will be one which has the highest value of *F*. In general, the higher the value of *F*, the less is the multicollinearity present in the series.

It may be noted that regression analysis has certain **limitations**. *First*, it assumes that the relationship between the two variables has not changed since the regression equation was obtained. *Second*, sometimes the relationship indicated by the scatter diagram may not remain the same if the regression equation is extended and applied to values beyond those covered in obtaining it. *Third*, it becomes extremely difficult to determine which variable is dependent on the other and indicates a causal relationship. *Finally*, there is the problem of measurement error. In case the values of the independent variable have some measurement error, then the sample regression coefficient will not be an unbiased estimator of the population regression coefficient.

NON-LINEAR REGRESSION

Thus far our discussion has remained confined to linear regressions—simple and multiple. However, one may find that for a given data, the non-linear or curvilinear regression model is more appropriate. An important type of curvilinear regression model is the polynomial regression model. Such a model may contain one, two, or more than two independent variables. *For example*, a polynomial regression model having one independent variable may take the following form

$$Y_i = a + b_1 x_i + b_2 x_i^2$$

where the independent variable *x* appears in the second degree. A third degree model with one independent variable takes the following form

$$Y_i = a + b_1 x_i + b_2 x_i^2 + b_3 x_i^3$$

Here, the independent variable *x* appears in the third degree. In the same manner, a higher degree of polynomial regression model can be written, depending upon the number of degrees which the independent variable takes. However, such models are hardly used as it becomes extremely difficult to interpret coefficients for such models. Moreover, extrapolations in such cases may be extremely erratic.[3]

Polynomial regression models with two or more independent variables can also be used. As the number of independent variables increases, such models become highly complicated. Perhaps on account of this reason such models are not frequently used. We should remember that the researcher uses these models because they would give a better prediction than other alternative, through simpler, models. Such models are highly sophisticated and their detailed discussion is beyond the scope of this book.[4]

DISCRIMINANT ANALYSIS

When the data are non-metric, i.e., not measurable on quantitative scales of numbers, it is not possible to determine the quantitative relationship between variables. In such cases, since correlation and regression techniques cannot be applied, the researcher has to use other techniques such as discriminant analysis.

[3] Neter, John and William Wasserman, *Applied Linear Statistical Methods*, Homewood, Illinois, Richard D. Irwin, Inc., 1975, p. 276.

[4] Ibid., A good discussion on polynomial regression is provided in Chapter 8.

A discriminant analysis enables the researcher to classify persons or objects into two or more categories. *For example*, consumers may be classified as heavy and light users. With the help of such a technique, it is possible to predict the categories or classes which are mutually exclusive in which individuals are likely to be included. In many cases, the classification will be dichotomous such as users and non-users, high and low, and so on.

In discriminant analysis, a scoring system is used on the basis of which an individual or object is assigned a score. This, in its turn, forms the basis for classifying an individual in the most likely class or category. Suppose an individual is 25 years of age, earns an annual income of Rs 60,000 and has undergone formal education for a period of 17 years. Each of these three variables is given a weight, indicating its relative importance. Symbolically,

$$Y = b_1(25) + b_2\,(60{,}000) + b_3\,(17)$$

where Y is a dependent variable, say, in this case, credit score or rating. A certain limit is fixed of the value of Y below which all values will be classified in Group I and all the others in Group II. The values of b_1, b_2 and b_3 indicate their importance. The numerical value of Y can be transformed into the probability of the individual being creditworthy.

It may be noted that in the linear discriminant, the 'b' coefficients are similar to the regression coefficients. However, the main difference is that while the regression coefficients are used to predict the value of the dependent variable, the discriminant coefficients are used to classify correctly as many individuals or objects as possible.

One major **advantage** of linear discriminant analysis is that it enables the researcher to know, by a simple device, whether an individual is likely to belong to one or the other category on the basis of his overall score. In this context, it is not only the values of the discriminant coefficients but also their positive or negative signs that are equally relevant. Given a certain minimum value of Z as creditworthiness, it should be clear that the higher the values of the independent variables, provided the discriminant coefficients are positive, the more chances there are for the individual to be classified under this category. The analysis on the basis of linear discriminant coefficients is simple but it becomes complex in case of a non-linear discriminant function such as $Y = a + b_1X + b_2X^2$. In such a case, interpretation becomes more difficult.

Example

An example will make the technique of linear discriminant analysis clear. Assume that a firm has developed a new industrial process which is a distinct improvement over the existing one. The firm would like to know which industrial units would be interested to buy this process. Obviously, some units which can be identified as innovators and early adopters would go in for the new process. The firm thinks that the two most important determinants for the demand for the new process would be the net profit of industrial units and their memberships of trade associations and technical societies. The latter is regarded as a practical proxy for technical progressiveness. Let us assume that data in respect of these two determinants are available.

Let us assume that X represents net profit (in rupees lakhs) of industrial units and Z represents the number of memberships of trade associations and technical societies held by companies. Table 18.4 shows hypothetical data on X and Z for 20 companies[5]. Of the 20 companies for which

[5] The example is on the same lines as given in Wentz, Walter B., *Marketing Research: Management, Methods and Cases*, New York, Harper and Row Publishers, 1979, pp. 531–533.

the data are given, 12 turn out to be buyers of the new industrial process and 8 are hesitant to use the new process and they are, therefore, classified as non-buyers.

We have to determine a linear discriminant function

$$Y_i = C_x X_i + C_z Z_i$$

and a boundary function

$$Y_c = k$$

where Y_i = the discriminant value of the ith observation in the population
C_x = a parameter specifying the relationship between Y and X
C_z = a parameter specifying the relationship between Y and Z
X_i = an explanatory variable
Z_i = an explanatory variable
Y_c = the critical value which is the boundary between the two categories
K = a constant

The parameter C_x is specified by the following equation:

$$C_x = \frac{S_{zz} d\bar{x} - S_{xz} d\bar{z}}{S_{zz} S_{xx} - (S_{xz})^2}$$

The parameter C_z is specified by the following equation

$$C_z = \frac{S_{xx} d\bar{z} - S_{xz} d\bar{x}}{S_{zz} S_{xx} - (S_{xz})^2}$$

In order to apply these equations, it is necessary to get the values of S_{xx}, S_{zz}, S_{xz} as also $d\bar{x}$ and $d\bar{z}$. The first three of these are sample moments which can be obtained by the following equations:

$$S_{xx} = \sum_{i=1}^{n} (X_i - \bar{X})^2$$

$$S_{zz} = \sum_{i=1}^{n} (Z_i - \bar{Z})^2$$

$$S_{xz} = \sum_{i=1}^{n} (X_i - \bar{X})^2 (Z_i - \bar{Z})$$

where X_i = the value of the independent variable x for observation i
$\bar{X}$ = the mean of all observations of X series
Z_i = the value of the independent variable Z for observation i
$\bar{Z}$ = the mean of all observations of Z series.

The value of $d\bar{x}$ and $d\bar{z}$ can be obtained by the following equations:

$$d\bar{x} = \bar{x}^* - X^\circ$$

and

$$d\bar{z} = \bar{z}^* - z^\circ$$

where $d\bar{x}$ = the difference between the means of X in the two categories
$d\bar{z}$ = the difference between the means of z in the two series $\bar{x}$ and $\bar{z}$ are as defined earlier * and ° represent the two categories.

With this explanation of notations used, let us now apply the different formulas to the data given in Table 18.4.

Table 18.4 Sample Calculations for Linear Discriminant Analysis

Obsevations	Behaviour Buy or do not buy	Net Profit (Rs. lakhs)	Deviations of X	Square of deviations of X	Membership of trade associati ons, etc.	Deviations of Z	Square of deviations of Z`	Product of X and Z deviations
(*i*)	(*B* or *N*)	*X*	$(X - \bar{X})$	$(X - \bar{X})^2$	*Z*	$(Z - \bar{Z})$	$(Z - \bar{Z})^2$	$(X - \bar{X})(Z - \bar{Z})$
1	N	8	– 8	64	0	– 3	9	24
2	N	10	– 6	36	1	– 2	4	12
3	N	9	– 7	49	2	– 1	1	7
4	B	16	0	0	4	1	1	0
5	B	15	– 1	1	3	0	0	0
6	B	17	1	1	2	– 1	1	– 1
7	N	10	– 6	36	1	– 2	4	12
8	B	17	1	1	3	0	0	0
9	B	15	– 1	1	4	1	1	– 1
10	B	20	4	16	5	2	4	8
11	N	16	0	0	2	– 1	1	0
12	B	20	4	16	4	1	1	4
13	B	19	3	9	3	0	0	0
14	N	13	– 3	9	2	– 1	1	3
15	N	12	– 4	16	2	– 1	1	4
16	B	20	4	16	6	3	9	12
17	N	18	2	4	3	0	0	0
18	B	24	8	64	6	3	9	24
19	B	22	6	36	4	1	1	6
20	B	19	3	9	3	0	0	0

$\Sigma X = 320$ $\quad \Sigma (X - \bar{X})^2 = 384$ $\quad \Sigma Z = 60$ $\quad \Sigma (Z - \bar{Z})^2 = 48$ $\quad \Sigma (X - \bar{X})(Z - \bar{Z}) = 114$

$\bar{X} = 16$ $\quad \bar{Z} = 3$

$$S_{xx} = \sum_{i=1}^{n} (X_i - \bar{X})^2$$

$$= 384$$

$$S_{zz} = \sum_{i=1}^{n} (Z_i - \bar{Z})^2$$

$$= 48$$

$$S_{xz} = \sum_{i=1}^{n} (X_i - \bar{X})(Z_i - \bar{Z})$$

$$= 114$$

$$d\bar{x} = \bar{X}^* - \bar{X}^{\circ}$$ where * indicates buyer companies

$$= 18.67 - 12$$ and ° non-buyer companies

$$= 6.67$$

$$d_z = \bar{Z}^* - \bar{Z}^{\circ}$$

$$= 3.92 - 1.62 = 2.30$$

The parameter C_x can be obtained by the following equation:

$$C_x = \frac{S_{zz}\, d\bar{x} - S_{xz}\, d\bar{z}}{S_{zz}\, S_{xx} - (S_{xz})^2}$$

$$= \frac{48\,(6.67) - 114\,(2.30)}{48\,(384) - (114)^2}$$

$$= \frac{320.16 - 262.2}{18432 - 12996}$$

$$= \frac{57.96}{5436} = 0.0107 \text{ approx.}$$

The parameter C_z can be obtained by the following equation:

$$C_z = \frac{S_{xx}\, d\bar{z} - S_{xz}\, d\bar{x}}{S_{zz}\, S_{xx} - (S_{xz})^2}$$

$$= \frac{384\,(2.30) - 114\,(6.67)}{48\,(384) - (114)^2}$$

$$= \frac{883.2 - 760.38}{18432 - 12996}$$

$$= \frac{122.82}{5436} = 0.0226 \text{ approx.}$$

On the basis of these calculations, the linear discriminant function in this case is $Y_i = 0.0107\, X_i + 0.0226\, Z_i$.

This discriminant function provides maximum discrimination. Since X and Z stand for net profit and the number of memberships of trade associations, etc., respectively, we find that both these variables contribute to discrimination. In order to ascertain the relative impact of the two variables in the discrimination function, the parameters C_x and C_z must be multiplied by their respective standard deviations. This is shown below:

Standard deviation of series X is $\sqrt{\dfrac{\Sigma(X-\bar{\mathbf{X}})^2}{n}}$

$$= \sqrt{\frac{384}{20}} = \sqrt{19.2} = 4.38$$

Standard deviation of series Z is $\sqrt{\dfrac{\Sigma(Z-\bar{Z})^2}{n}}$

$$= \sqrt{\frac{48}{20}} = \sqrt{2.4} = 1.55 \text{ approx.}$$

$$\therefore \qquad \frac{\text{The discriminating effect of X}}{\text{The discriminating effect of Z}} = \frac{0.0107 \times 4.38}{0.0226 \times 1.55}$$

$$= \frac{0.46866}{0.035030} = 1.34 \text{ approx.}$$

It is evident from this result that the variable X indicating net profit has a greater effect on the discriminating function than the other variable Z which indicates the number of memberships or trade associations, etc.

We have now to determine the critical value of Y (i.e., Yc). For this purpose, we have first to calculate the discriminant value for each pair of values of X and Z, the two independent variables from the discriminant function,

$$Y_i = 0.0107X_i + 0.0226Z_i$$

This is shown in Table 18.5.

It should be noted that Table 18.5 gives an array of twenty companies in descending order—the highest discriminant value shown by company No. 18 which is on the top of the table and the lowest discriminant value shown by company No. 1 which is at the bottom of the table. Now, to determine the critical value of Y, we locate the two adjoining items where there is a change from one category to the other. In Table 18.5, we find that the first change from category B to N occurs from company No. 4 to company No. 17. Then again there is a change from category N to B, i.e., from company No. 17 to company No. 9. The two adjoining items relevant for our purpose are company 6 and company 11. We use a judgemental approach in this regard and decide the boundary as being mid-way between the two categories. The mid-way between the two discriminant values .2271 and .2164 is .22175 or .2217 approximately. This is the value of Yc in our example.

Table 18.5 An Array of Twenty Companies on the Basis of a Linear Discriminant Model

Company No. (i)	Discriminant value (Y_i)	Actual behaviour (buy or do not buy)	Category predicted by model buyer
18	.3924	B	
16	.3496	B	
10	.3270	B	
19	.3258	B	
12	.3044	B	
20	.2711	B	
13	.2711	B	
4	.2616	B	
17	.2604	N	(Misclassification)
9	.2509	B	
8	.2497	B	
5	.2283	B	
6	.2271	B	
	Boundary (Yc)		
11	.2164	N	
14	.1843	N	
15	.1736	N	
3	.1415	N	
7	.1296	N	
2	.1296	N	
1	.0856	N	Non-buyer

A confusion matrix or classification matrix[6] is used to test the accuracy of a discriminant analysis. Such a matrix shows the actual classification along with the predicted classification arrived at on the basis of discriminant analysis. In case of our example, the confusion matrix would be as follows:

Table 18.6 Confusion Matrix of Actual versus Predicted Buyer/Non-buyer categories

Actual classification	Predicted classification		Total
	Buyers	Non-buyers	
Buyers	12	0	12
Non-buyers	1	7	8

6 See Richardson, S.C., "Assessing the Performance of a Discriminant Analysis" in *Journal of the Market Research Society*, 1982, pp. 65–67.

From the confusion matrix, it is evident that there is one mis-classification according to the discriminant model. Company No. 17 which has a discriminant value of .2604 (Table 18.5) is a non-buyer of the new industrial process but gets included in the buyer category because of the high discriminant value. Thus, the discriminant model mis-classifies only one out of twenty companies. In other words, the success rate of the model is 95 per cent. In view of this, it can be very useful in distinguishing between good and bad prospects so that the company can deploy its sales force as also other resources more efficiently.

There are other methods that can be used in discriminant analysis. But the method used in this chapter is the simplest one and was first adopted by Massy.[7] However, one major limitation of this method is that it is applicable only for two-level models with two independent variables.

This discussion related only to two-way classification—in this case buyer and non-buyer categories. Sometimes, the dependent variable may have three or more levels of classification. For example, prospective buyers may have their preference for a particular car out of several models that are available. In such cases, the linear discriminant analysis becomes extremely difficult. Although with the help of computer programmes such as the Statistical Package for Social Sciences,[8] such problems can be handled, the interpretation of multi-level problem output obtained from the computer becomes highly complicated. A high level of proficiency is needed in the interpretation of such data.

Discriminant analysis has been increasingly used by marketing researchers in recent years. To mention a few major problems where discriminant analysis has been used are: Determining early adopters of fashion, identifying new product buyers, determining brand loyalty among consumers, assessing the relationship between demographic factors and the choice of radio stations. Morrison[9] cautions that some of these studies contain some methodological errors, particularly in the areas of validation and chance criterion. As such, the reader must be sufficiently careful so that he may not be carried away by "spuriously impressive results".

It may be emphasised that the utility of linear discriminant analysis lies in its strength in segregating two groups to the maximum extent.[10] If it does so, then the ratio of the difference between the specific means to the standard deviation within the groups will be maximum. It may also be noted that a linear discriminant function will give an identical result as in the case of multiple regression, when the dependent variable is dichotomous.

Example Using SPSS

ABC Company manufactures a special toothpaste and sells it through various retailers. It operates in 10 territories and is interested in finding out the relationship between sales and other variables—target population and per capita income.

[7] Massy, William F., "Statistical Analysis of Relations between Variables" in R.E. Frank, A.A. Kuchn and W.F. Massy, Eds: *Quantitative Techniques in Marketing Analysis*, Homewood, III., Irwin, 1962, pp. 95–100.

[8] The Statistical Package for the Social Sciences (SPSS) is a statistical analysis package which has especially been designed for the social scientists. It is a unified and comprehensive package and enables them to analyse data in several different ways in a simple and convenient manner. It is not necessary that the user of SPSS must have previous programming experience. As the package meets several needs of social scientists in respect of data analysis and as it facilitates them substantially in this task, it has become very popular amongst them. In this text, too, SPSS has been used to a limited extent in three chapters.

[9] Morrison, D.G., Discriminant Analysis in *Handbook of Marketing Research,* op. cit., p. 2–456.

[10] op. cit. p. 238.

The table, given below, presents territory-wise data on sales, target population and per capia income.

Territory	Sale ('000 grams)	Target population ('000)	Per Capita income (Rs.)
	Y	X_1	X_2
A	10	120	600
B	12	130	750
C	14	148	800
D	9	80	530
E	11	109	700
F	18	205	900
G	20	210	980
H	16	190	780
I	8	90	500
J	15	175	800

Fit a linear regression

$$Y = a + b_1 x_1 + b_2 x_2$$

where Y = sales, x_1 = target population and x_2 = per capita income. If a certain territory has the target population of 2.3 lakh and per capita income of Rs 1000, what is likely to be the sale of its toothpaste?

How would you measure the predictive ability of the model?

To perform Linear Regression in SPSS

From the Analyze menu

→ Choose "Regression"

→ And then choose "Linear"

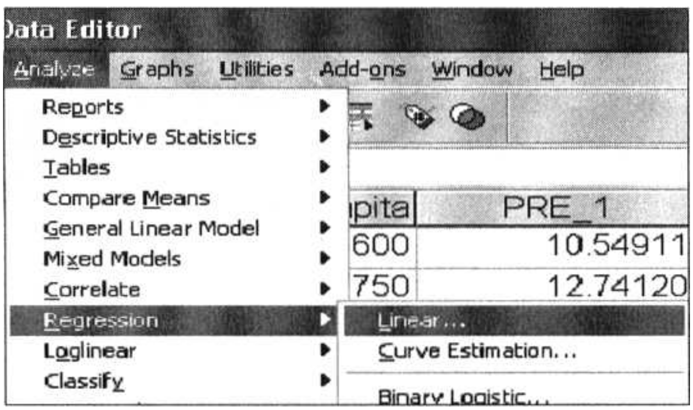

Fig. 18.2

The following is the Discriminant Analysis Dialog Box:

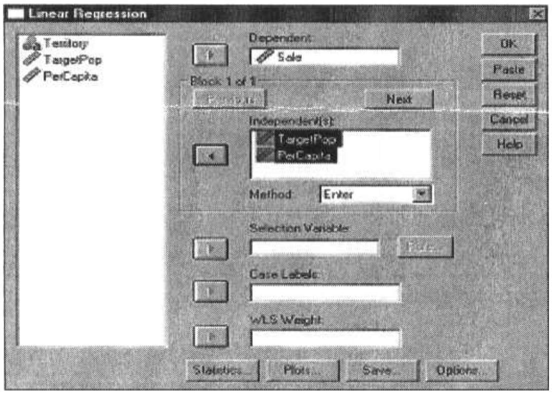

Fig. 18.3

- 'Sales' is the dependent variable
- 'Target population' and 'Per capita income' are the independent variables.

Using the following Sub-dialog boxes you can request for:

Statistics:

- For Regression Coefficients
- For Residuals
- And others like Model fit, R-square Change, Descriptive statistics, Correlations and Collinearity Diagnostics.

Plots:

Includes Scatter between- y, predicted y, errors (both standard and unstandardized)

Save:

Can save new columns to the dataset like–predicted y, residuals, predictive intervals, coeff stats, influence stats and can also save the model as a template.

Options:

Other options like – Constant, F-value, Prob (of F-value) and missing values.

Interpretations:

(i) Regression Fit:

The following table gives the regression coefficients in the model (estimated by least squares principle)

Regression Coefficients Table:

Table 18.7 Regression Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	–2.001	1.316		–1.521	.172
Target population ('000)	.047	.012	.563	3.878	.006
Per Capita Income Rs.)	.011	.004	.445	3.069	.018

[a] Dependent Variable: Sale in ('000 grams)

**The corresponding predicted values are directly stored in the data editor.

The regression equation then becomes:

$$Y^{\wedge} = -2.001 + 0.011^{*} X_1 + 0.047^{*} X_2$$

Using this regression equation we can predict Y when $X_1 = 2.3$ lakh and $X_2 = 1000$

$$Y^{\wedge} = -2.001 + 0.011(230) + 0.047(1000)$$

$$Y^{\wedge} = 47.529 = 48$$

Conclusion:

A territory having the 'target population of 2.3 lakh and 'per capita income' of Rs 1000 is likely to have a **sale** of 48000 grams of the toothpaste.

(ii) Predictive Ability of the model

Model Summary Table:

Table 18.8 Model Summary

Model	R	R Square	Adjusted R Square	Std Error of the Estimate
1	.989[a]	.978	.972	.668

a. Predictors: (Constant), Per Capita Income (Rs.), Target population ('000)

- R, multiple correlation coefficient (range 0 to 1), is the correlation between the observed and predicted values of the dependent variable. Larger values of R indicate stronger relationships.
- R-Square is the proportion of variation in the dependent variable explained by the regression model (range 0 to 1). Small values indicate that the model does not fit the data well.

Using 'R-Square' we can measure the predictive ability of the model.

Conclusion:

From the table R square is = 0.978

This explains that **97.8%** of the variation in Sales is explained when we use the model. Hence the predictive ability of the model is very high.

**The corresponding predicted values are directly stored in the data editor.

Example Using SPSS

Given the following data, calculate the regression equation of Y on X_1, X_2 and X_3 and interpret the results.

Table 18.9

Year	X_1 No. of stores	X_2 Average store size ('00 omitted sq. ft.)	Y Total revenue (Rs.Lakh)	X_3 No. of employees ('000 omitted)
1996	30	70	430	5.0
1997	40	80	580	7.0
1998	60	92	700	8.0
1999	72	96	765	9.2
2000	80	110	820	10.6
2001	95	120	905	11.0
2002	110	135	1013	12.3
2003	125	140	1270	14.6
2004	152	146	1400	15.2
2005	180	160	1490	16.5

To perform Linear Regression in SPSS
From the Analyze menu
→ Choose "Regression"
→ And then choose "Linear"

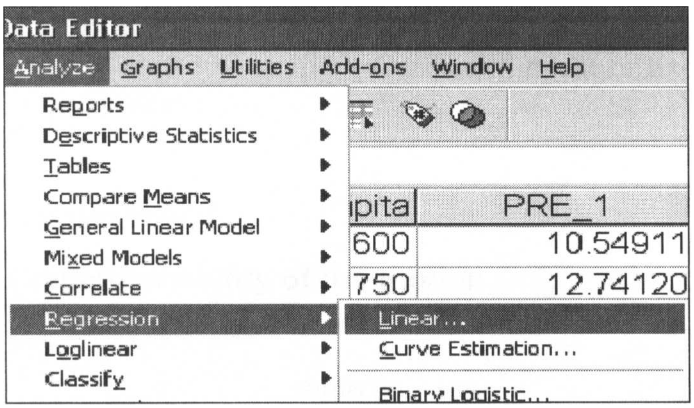

Fig. 18.4

The following is the Regression Analysis Dialog Box:

- 'Total Revenue' is the dependent variable
- 'No. of Stores', 'Average Store Size' and 'No. of Employees' are the independent variables.

Using the following sub-dialog boxes you can request for:

Statistics:

- Regression Coefficients
- Residuals

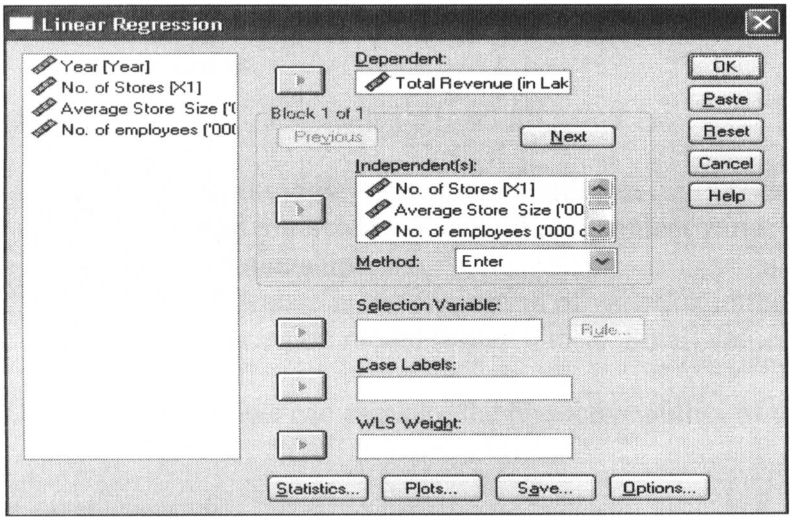

Fig. 18.5

- And other like Model fit, R-square change, Descriptive statistics, Correlations and Collinearity diagnostics.

Plots:

Includes Scatter between- y, predicted y, errors (both standard and unstandardized)

Save:

Can save new columns to the dataset like – predicted y, residuals, predictive intervals, coeff stats, influence stats and can also save the model as a template.

Options:

Other options like – Constant (include or exclude), F-value, Prob (of F-value) and missing values.

Interpretations:

Predictive Ability of the model:

Model Summary Table:

Table 18.10 Modal Summary

Model	R	R Square	Adjusted R Square	Std Error of the Estimate
1	.997[a]	.993	.990	35.875

[a] Predictors: (Constant), No. of employees ('000 omitted), Average Store Size ('00 omitted sq. ft.), No. of Stores

- R, multiple correlation coefficient (range 0 to 1), is the correlation between the observed and predicted values of the dependent variable. Larger values of R indicate stronger relationships.
- R-Square is the proportion of variation in the dependent variable explained by the regression model (range 0 to 1). Small values indicate that the model does not fit the data well.

Using 'R-Square' we can measure the predictive ability of the model.

Conclusion:

From the table R square is = 0.993

This explains that **99.3%** of the variation in Sales is explained when we use the model. Hence the predictive ability of the model is very high.

Regression Fit:

The following table gives the regression coefficients in the model (estimated by least squares principle) Regression Coefficients Table:

Table 18.11 Regression Co-efficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	294.417	131.268		2.243	.066
	No. of Stores	6.057	1.996	.762	3.035	.023
	Average Store Size					
	('00 omitted sq. ft.)	–5.740	2.883	–.491	–1.991	.094
	No. of employees					
	('000 omitted)	67.892	25.966	.722	2.615	.040

[a] Dependent Variable: Total Revenue (in Rs Lakh)

The regression equation then becomes:

$$Y = 294.417 + (6.057 * X_1) – (5.740 * X_2) + (67.892 * X_3) + e.$$

Conclusion:

Using this regression equation we can predict Y when X_1 = x1, X_2 = x2 and X_3= x3 as

$$\hat{Y} = 294.417 + 6.057(x1) – 5.740(x2) + 67.892(x3).$$

**The corresponding predicted values are directly stored in the data editor.

Example Using SPSS

A company, dealing in black and white and colour televisions, feels that income, family size and the attitude of the head of the family toward the television programme are the determinants of the ownership of televisions. It has collected data from ten families, each owning a television and another ten families not owning it. Each head of the family was asked to show his position on a 1–10 scale regarding his attitude towards the present television programmes—point 1 indicating that he is utterly dissatisfied with the television programmes and point 10 indicating that he is extremely happy with the programmes.

The data from these families are as follows:

Table 18.12

Families owning television

Average income per month (Rs)	Family size	Attitude rating
3,000	5	5
4,000	6	7
5,000	3	6
2,500	2	6
7,000	4	8
6,500	3	7
3,500	2	6
10,000	4	8
12,000	5	10
9,700	3	8

Families not owning television

Average income per month (Rs)	Family size	Attitude rating
5,600	4	5
4,800	3	4
2,500	6	2
3,000	5	3
2,200	6	5
1,700	3	5
3,500	7	3
2,000	6	1
4,000	4	4
3,100	5	3

(i) Compute a linear discriminant function using the above data.

(ii) On the basis of the discriminant function computed in (i) classify the families into two categories, namely owning television, and not owning television. Compare this classification with the data given in this exercise and find out the percentage of families correctly classified.

To perform Discriminant Analysis in SPSS:

From the Analyze menu

→ Choose "Classify"

→ And then choose "Discriminant"

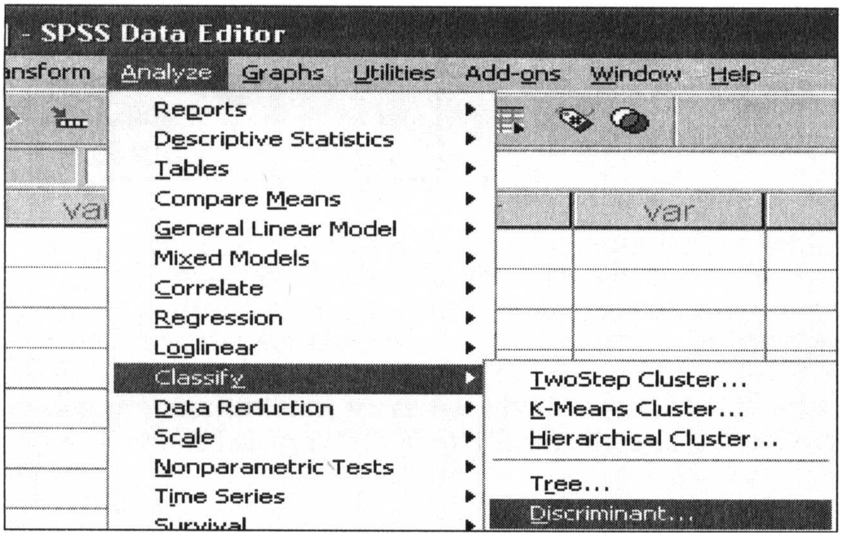

Fig. 18.6

The following is the Discriminant Analysis Dialog Box:

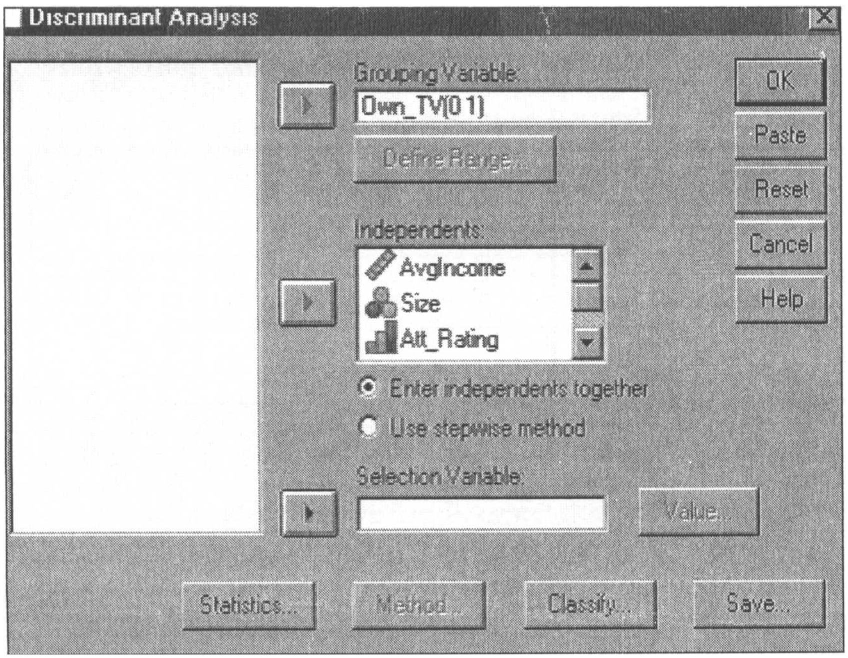

Fig. 18.7

- The dependent variable will be the TV ownership.
- Define range: minimum=0 and maximum=1.
- Independent variables are: - Average Income, Size of the family and attitude rating.

Interpretations:

(i) Computation of Discriminant Function:

The following table gives the discriminant function coefficients.

Table 18.13 Standardized Canonical Discriminant Function Coefficients

	Function
	1
Average Income Per Month	–.376
Family Size	–.160
Attitude Rating	1.187

The numbers corresponding to each independent variable are their respective importance in the model (their role in the discrimination of the subjects).

Here the attitude rating has the highest contribution to the discrimination function when compared to the family size or average income of the household.

Hence the discriminant score for case j can be calculated as

Fj = (Average Income) $_j$*(–0.376) + (Family Size) $_j$*(– 0.160) + (Attitude Rating) $_j$* (1.187).

(ii) Classification and the validity:

Using SPSS the probabilities with which an observation belongs to a particular group can be saved to the data file, which helps us in predicting the group membership.

Classification Table:

Table 18.14 Classification Results[a]

			Predicted Group Membership		
		Owning/Not Owning TV	*0*	*1*	*Total*
Original	Count	0	9	1	10
		1	1	9	10
	%	0	90.0	10.0	100.0
		1	10.0	90.0	100.0

a. 90.0% of original grouped cases correctly classified.

From classification table we can interpret that 90% of the data classification is correct using the above analysis.

**The corresponding predicted values are directly stored in the data editor.

Summary

This chapter has discussed some important multivariate techniques that are increasingly being used in marketing research. To begin with, the chapter has explained what multivariate analysis is and has indicated two ways on the basis of which multivariate techniques can be classified. The chapter has dealt with multiple regression analysis and linear discriminant analysis.

The multiple regression analysis is explained and the regression equation interpreted. The evaluation of independent variables as also identification of variables for inclusion in multiple regression have been dealt with. This is followed by a brief account of non-linear regression. In addition, two examples using SPSS have been given in regression analysis. At the end, the chapter emphasizes the need to be extremely careful in interpreting coefficients in regression analysis.

As regards discriminant analysis, the chapter first indicates the purpose of its use. Two examples of linear discriminant analysis (one of which has used SPSS) have been given. Discriminant function has been computed followed by validity of the results.

Key Terms and Concepts

Multivariate Analysis 379
Multiple Linear Regression 381
Non-Linear Regression 393
Discriminant Analysis 393
Confusion Matrix 399
Multicollinearity 390
Coefficient of Multiple Determination 384

Questions

1. What is multivariate analysis?
2. What are functional multivariate methods?
3. What are structural multivariate methods?
4. What is multiple regression? How does it differ from bivariate regression?
5. What are the main assumptions involved in multiple linear regression?
6. Identify some research problems where multiple regression can be effectively applied.
7. What is multicollinearity? What problems can arise on account of multicollinearity?
8. What is stepwise multiple regression? What is its purpose?
9. What is the coefficient of multiple determination?
10. ABC Company manufactures a special toothpaste and sells it through various retailers. It operates in 6 territories and is interested in finding out the relationship between sales and other variables—target population and per capita income.
    The table, given below, presents territory-wise data on sales, target population and per capita income.

Territory	Sale ('000 grams)	Target population ('000)	Per Capita Income (Rs.)
	Y	X_1	X_2
A	10	120	600
B	12	130	750
C	14	148	800
D	9	80	530
E	11	109	700
F	18	205	900

Fit a linear regression

$$Y = a + b_1X_1 + b_2X_2$$

where Y = sales, X_1 = target population and X_2 = per capita income. If a certain territory has the target population of 3.3 lakh and per capita income of Rs 2000, what is likely to be the sale of its toothpaste?

How would you measure the predictive ability of the model?

11. A firm is interested in finding out whether or not there is some relationship between its sales and advertising expenditure and expenditure incurred on point of purchase displays. It has collected monthly data which are shown as follows:

Months	Sale (Y) ('000 Rs)	Advertising expenditure (X_1) ('000 Rs)	Expenditure on point of purchase displays (X_2) ('000 Rs)
1	80	10	6
2	100	17	8
3	114	20	10
4	68	8	6
5	138	20	15

12. What purposes does multiple regression serve? How is it useful in marketing research?
13. What problems can arise in interpreting the coefficients in a multiple regression equation?
14. What is a partial regression coefficient?
15. What is the standard error of estimate?
16. Discuss the relationship of causation to multiple regression analysis.
17. What is the purpose of stepwise regression?
    (i) Fit a linear regression $Y = a + b_1X_1 + b_2X_2$ and determine the values of a, b_1 and b_2.
    (ii) Estimate the expected sales when the advertising expenditure is Rs 25,000 and expenditure on point of purchase displays is Rs 18,000.
    (iii) Calculate the coefficient of multiple determination. What does it indicate?

18. What is discriminant analysis? What is it used for?
19. Identify a few problems where the application of discriminant analysis would be suitable.
20. What are the steps involved in conducting discriminant analysis?
21. Having conducted a discriminant analysis, how would you determine the statistical significance of the result?
22. What is a confusion matrix?
23. How does the purpose of discriminant analysis differ from that of regression analysis?

19 Multivariate Analysis II (Inter-Dependence Methods)

Learning Objectives

After reading this chapter, you should be able to understand:

- Factor analysis
- Cluster analysis
- Approaches to multidimensional scaling
- Conjoint analysis
- Guidelines for the use of multivariate analysis

This chapter discusses some Interdependence methods in multivariate analysis. It first discusses Factor analysis followed by Cluster analysis Multi-dimensional scaling and Conjoint analysis. At the end, the chapter provides some guidelines for the use of multivariate analysis.

FACTOR ANALYSIS

Factor analysis was first used by Charles Spearman. Psychologists use it as a technique of indirect measurement. When they test human personality and intelligence, a set of questions and tests are developed for this purpose. They believe that a person given this set of questions and tests would respond on the basis of some structure that exists in his mind. Thus, his responses would form a certain pattern. This approach is based on the assumption that the underlying structure in answering the questions would be the same in the case of different respondents.

Although it is in the field of psychology that factor analysis has its beginning, it has since been applied to problems in different areas including marketing. Its use has become far more frequent as a result of the introduction of high-speed computers.

In regression analysis, the problem is to predict the value of a dependent variable on the basis of one or more independent variables. Unlike the regression analysis, factor analysis is not based on the usual distinction between dependent and independent variables, instead it rather considers all the variables simultaneously.

There are two objects of factor analysis. *First*, it simplifies the data by reducing a large number of variables to a set of a small number of variables. *Second*, it analyses the interdependence of interrelationships among a total set of variables.

In marketing research, factor analysis can be useful in several ways. *First*, it can bring out the hidden or latent dimensions relevant in the relationships among product preferences. Sometimes, the product characteristics influencing the consumer preferences are not clear. In such cases, factor analysis can be helpful by revealing more important characteristics of the product, underlying the relationships among product preferences. *Second*, factor analysis can also be used to find out certain relationships among observed values which, though they exist, are obscure. *Third*, it is extremely useful when a large mass of data is to be simplified and condensed. *Finally*, it can be used in clustering of products or people.

Two examples of factor analysis are given below. The second example uses SPSS and as such it is more elaborate.

Example 1

This example of factor analysis has been cited from Wells and Sheth.[1] A sample of 850 homemakers was taken. Nine occupations were mentioned and each respondent was asked to rate on a five point scale each of the nine occupations on the basis of how well she would be able to fit in that line. On the basis of their responses, inter-correlations, as shown in Table 19.1, were computed.

It will be seen from Table 19.1 that the first three variables are closely related as the values of correlation coefficients are relatively high in their case. Likewise, variables 4, 5 and 6 have something common as also variables 7, 8 and 9. This indicates that these nine variables can be reduced to three factors. Table 19.2 shows the results of a factor analysis performed to this set of data by principal-components analysis with varimax rotation—a method which is very frequently used in factor analysis.

The table shows the factor loadings in columns *A*, *B* and *C*. These factor loadings clearly show the close relationship of the nine variables with the three underlying factors. Thus, heavy loadings of 90, 89 and 69 against the variables 1, 2 and 3 show that Factor A represents general interest in literary things. Factor *B* represents a close relationship with variables 4, 5 and 6; these are the occupations showing an interest in figures. Factor C shows a close relationship with the remaining three variables. It represents an interest in the medical field. It may be noted that factor loadings in this case are negative but, while interpreting these data, the minus sign is to be ignored. It does not affect the interpretation.

Table 19.1 Correlation Coefficients among Nine Variables (Decimals omitted)

Variable	Correlations among variables								
	1	2	3	4	5	6	7	8	9
1. Author, fiction		76	48	20	08	25	05	28	18
2. Author, children's books	76		47	19	07	25	10	30	21
3. Newspaper reporter	48	47		22	13	22	09	31	26
4. Computer programmer	20	19	22		42	53	00	20	33
5. Book-keeper	08	07	13	42		36	–01	09	18
6. College math teacher	25	25	22	53	36		08	31	33
7. Nurse	05	10	09	00	–01	08		45	34
8. Doctor	28	30	31	20	09	31	45		48
9. Laboratory technician	18	21	26	33	18	33	34	48	

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[1] Wells, William D. and Sheth, Jagdish N., "Factor Analysis" in *Handbook of Marketing Research,* op. cit., pp. 2.459–2.463.

Table 19.2 Factor Loadings on Nine Variables (Decimals omitted)

Variable	Loadings on factors			h^2 (Communality)
	A	B	C	
1. Author, fiction	90	08	– 05	82
2. Author, Children's books	89	07	– 10	80
3. Newspaper reporter	69	15	– 17	53
4. Computer programmer	14	81	– 08	69
5. Book-keeper	– 01	76	03	57
6. College math teacher	20	73	– 20	62
7. Nurse	– 02	– 13	– 83	70
8. Doctor	28	14	– 77	69
9. Laboratory technician	13	36	– 68	61
Sum of squares (eigen value)	223	197	183	603

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The last column of Table 19.2 shows communality, i.e., how much each variable is accounted for by the three underlying factors together. A small communality figure shows that the factors taken together do not account for the variable to an appreciable extent. On the contrary, large communality figure is an indication that much of the variable is accounted for by the factors.

Finally, the last row in the table shows the sum of squares (eigen-value), i.e., the relative importance of each factor in accounting for the particular set of variables. The total sum of squares as shown in the last row is 603 (decimal omitted) Since there are in all 9 variables, this figure may be divided by 9. This will yield $0.603 \div 9 = 0.067$. This is an index showing how well factors account for all the variables taken together. A low value of the index shows that the variables are unrelated with each other and vice versa.

An important issue in the factor analysis approach is how long one should go on and when one should stop factoring. The first factor analysis will indicate the largest combination of variables, the next factor will show a smaller combination, and so on. If the analysis is carried on still further, the combination will become still smaller. It may not be advisable to carry out the analysis beyond a certain stage as the results would not be commensurate with the amount of calculations involved.

Example 2 Using SPSS

A company engaged in publishing textbooks at the college level in different subjects has employed a number of salesmen. It is keen to identify the determinants of a successful salesman. It maintains information in respect of its salesmen.

The table given below shows the data pertaining to ten salesmen. The data relate to seven variables. The company would like to get these seven variables reduced to three so that it can have a proper appreciation of the problem.

Table 19.3

Sales person	Height (x_1)	Weight (x_2)	Education (x_3)	Age (x_4)	No. of children (x_5)	Size of household (x_6)	IQ (x_7)
3	71	170	14	32	1	3	111
4	70	160	16	25	0	1	115

Contd.

Sales person	Height (x_1)	Weight (x_2)	Education (x_3)	Age (x_4)	No. of children (x_5)	Size of household (x_6)	IQ (x_7)
5	72	180	12	36	2	4	108
6	69	170	11	41	3	5	90
7	74	195	13	30	1	2	114
8	68	160	16	32	1	3	118
9	70	175	12	46	4	6	121
10	71	180	13	24	0	2	92
11	66	145	10	39	2	4	100
12	75	210	16	26	0	1	109

To perform Factor Analysis in SPSS:
From the Analyze menu
→ Choose "Data Reduction"
→ And then choose "Factor…"

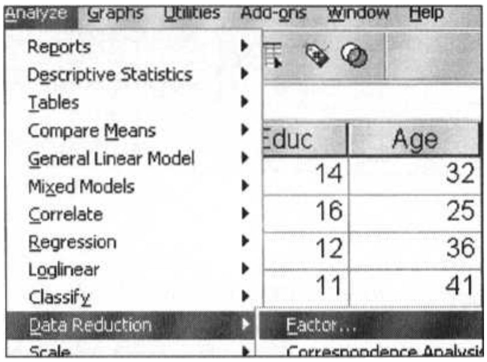

Fig. 19.1

The following is the Factor Analysis Dialog Box:

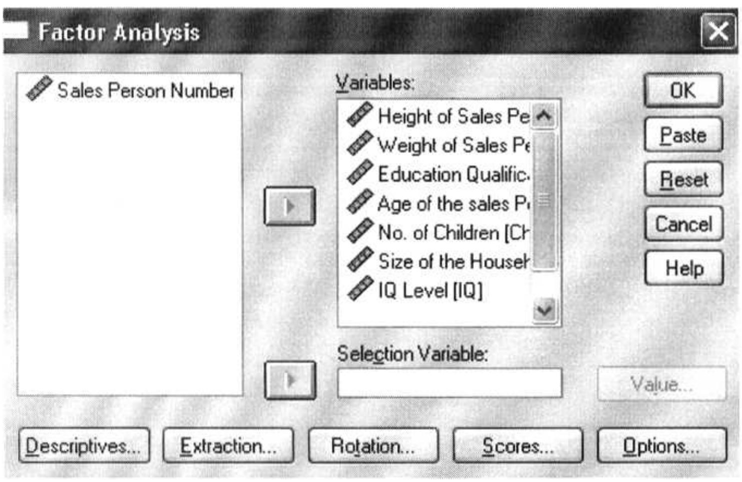

Fig. 19.2

- Select Variable X_1 through X_7 as the Variables to be reduced.

Click on Extraction to specify the number of factors (components) to be produced. It also allows you to request for a Scree plot, which again helps you in confirming the number of factors needed to represent the data.

SPSS provides you with seven methods for extracting the factor as shown in the figure below.

- Select Method as Principal components
- Type 3 in the number of factors box
- Check the Scree plot in display options
  Continue

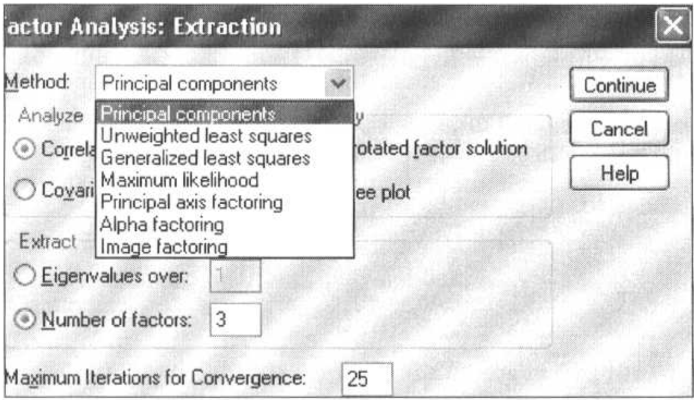

Fig. 19.3

Factor Rotation:

Since the factors generated by the Extraction methods provided above contribute the maximum variation in the data in increasing order (i.e., Contribution of factor1 <Contribution of factor2 < and so on), we can rotate the factors thus extracted above so that each factor contributes equal amount of variation (in other words, these rotated factors represent variables that are canonically uncorrelated).

The following are the five Factor Rotation methods provided by SPSS:

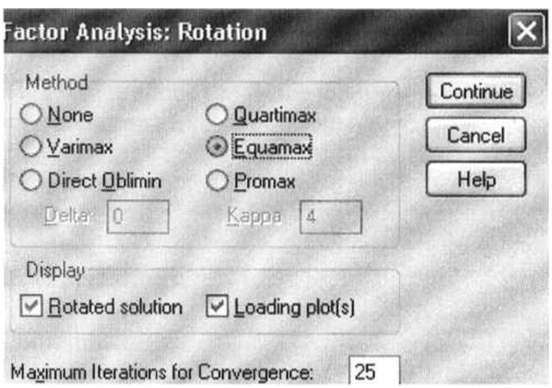

Fig. 19.4

Varimax: An orthogonal rotation method that minimizes the number of variables that have high loadings on each factor. This method simplifies the interpretation of the factors.

Quartimax: A rotation method that minimizes the number of factors needed to explain each variable. This method simplifies the interpretation of the observed variables.

Equamax: A rotation method that is a combination of the varimax method, which simplifies the factors, and the quartimax method, which simplifies the variables. The number of variables that load highly on a factor and the number of factors needed to explain a variable are minimized.

Direct Oblimin: A method for oblique (nonorthogonal) rotation. When delta equals 0 (the default), solutions are most oblique. As delta becomes more negative the factors become less oblique. To override the default delta of 0, enter a number less than or equal to 0.8.

Promax: An oblique rotation, which allows factors to be correlated. This rotation can be calculated more quickly than a direct oblimin rotation, so it is useful for large datasets.

Loading plot(s): Three-dimensional factor loading plot of the first three factors. For a two-factor solution, a two-dimensional plot is shown. The plot is not displayed if only one factor is extracted. Plots display rotated solutions if rotation is requested.

Select *Equamax method* for rotation

Check *Loading plot(s)* in display options

Continue…

In the Options dialog box select *Sorted by size* in *Coefficient Display Format*

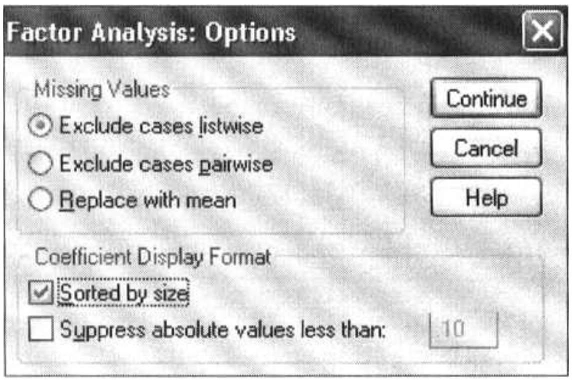

Fig. 19.5

This will produce the factor loadings in the increasing order on the variables, which will ease the interpretation.

Continue…

'OK'

Interpretations:

Communalities:

Table 19.4 gives the initial and the extracted communalities.

Communalities indicate the amount of variance in each variable that is accounted for.

Initial communalities: Estimates of the variance in each variable accounted for by all components or factors.

Extraction communalities: Estimates of the variance in each variable accounted for by the factors (or components) in the factor solution.

Table 19.4 Communalities

	Initial	Extraction
Height of Sales Person	1.000	.981
Weight of Sales Person	1.000	.982
Education Qualification	1.000	.894
Age of the Sales Person	1.000	.983
No. of Children	1.000	.987
Size of the Household	1.000	.966
IQ Level	1.000	.965

Extraction Method: Principal Component Analysis.

Small values indicate variables that do not fit well with the factor solution, and should possibly be dropped from the analysis.

Table 19.5 gives eigenvalues, variance explained, and cumulative variance explained for your factor solution.

Table 19.5 Total Variance Explained

	Initial Eigenvalue			Extraction sums of squared loadings			Rotation sums of squared loadings		
Component	Total	% of variance	Cumu-lative %	Total	% of variance	Cumul-ative %	Total	% of variance	Cumulative %
1	4.099	58.563	58.563	4.099	58.563	58.563	3.329	47.562	47.562
2	1.450	20.718	79.281	1.450	20.718	79.281	2.056	29.377	76.939
3	1.209	17.272	96.553	1.209	17.272	96.553	1.373	19.613	96.553
4	.175	2.497	99.050						
5	.032	.461	99.511						
6	.023	.331	99.842						
7	.011	.158	100.000						

Extraction Method: Principal Component Analysis.

The first panel gives values based on initial eigenvalues.

The Extraction Sums of Squared Loadings group gives information regarding the extracted factors or components.

The "Total" column gives the amount of variance in the observed variables accounted for by each component or factor.

- In a good factor analysis, there are a few factors that explain a lot of the variance.

Scree Plot:

The following Scree Plot explains the change in variation at each factor

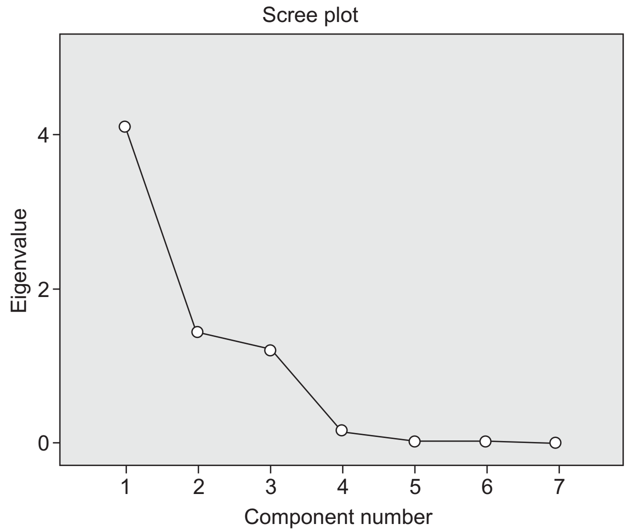

Fig. 19.6

The Scree plot suggests that the 3 factor solution contributes the larger part of the data since at component number 4 the eigenvalue is showing almost zero and carried the same to the factors following it with a little change in the variation contributed.

Component Matrix:

This is the table that is required to interpret (summarize the results)

Table 19.6 Rotated Component Matrix[a]

	Component		
	1	2	3
No. of Children	.982	–.150	–.017
Age of the Sales Person	.960	–.247	–.023
Size of the Household	.943	–.259	–.100
Education Qualification	–.693	.169	.621
Weight of Sales Person	–.116	.983	.039
Height of Sales Person	–.237	.952	.136
IQ Level	.071	.060	.978

Extraction Method: Principal Component Analysis.
Rotation Method: Equamax with Kaiser Normalization.
a. Rotation converged in 4 iterations.

This table reports the factor loadings for each variable on the components or factors after rotation. Each number represents the partial correlation between the item and the rotated factor.

Transformation Matrix:

The factor transformation matrix describes the specific rotation applied to your factor solution.

Table 19.7 Component Transformation Matrix

Component	1	2	3
1	.843	–.487	–.230
2	.532	.818	.218
3	.082	–.306	.949

Extraction Method: Principal Component Analysis.
Rotation Method: Equamax with Kaiser Normalization.

Conclusion:

From Rotated Component Matrix:

- Component 1 is highly loaded on No. of Children, Age of the salesperson and Size of the house-hold. So size of the family is the one, which better represents this group.
- Component 2 is highly loaded on Weight and Height of the sales person, which represent the physical fitness of the person, but the loading on Weight is more compared to that of height, so weight is a better representative of these two variables.
- The third component is highly loaded on IQ level.
    - o An interesting thing here is that Education Qualification is highly (we look at the absolute values) loaded with both component 1 and component 3 making it difficult to associate with any of the components. But since our common sense tells that this is some thing very close to the mental ability of the person we can club this with IQ level and can make IQ level as the representative of the third component.

Component Plot in Rotated Space:

The following is a graphical representation of the variables in the component space.

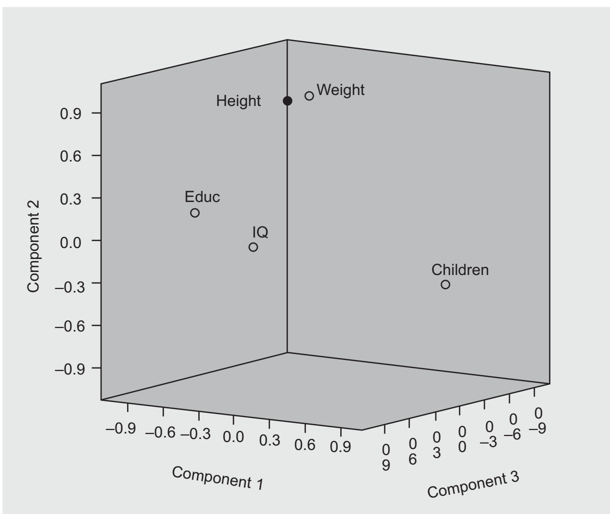

Fig. 19.7

Limitations of Factor Analysis

The technique of factor analysis does not necessarily lead to the discovery of 'fundamental' or 'basic' categories in a field of investigation. Sometimes, more relevant factors may be left out.

Factor analysis is a complicated tool and should be used by the researcher only when he has a good understanding of the technique. An exercise in factor analysis involving a large number of variables, say 50, is much bothersome and costly.

Another problem with factor analysis is that the reliability of results is sometimes questionable. A factor analysis carried out from one-half of the data might give quite different results from those obtained from the second-half of the data.

Yet another limitation of this technique is that its utility depends to a large extent on the judgment of the researcher. He has to make a number of decisions as to how the factor analysis will come out. Even with a given set of decisions, different results will emerge from different groups of respondents, different mixes of data as also different ways of getting data. In other words, factor analysis is unable to give a unique solution or result.[2]

In view of the foregoing limitations, the exploratory nature of factor analysis becomes clear. As Thurstone[3] mentions the use of factor analysis should not be made where fundamental and fruitful concepts are already well formulated and tested. It may be used especially in those domains where basic and fruitful concepts are essentially lacking and where crucial experiments have been difficult to conceive.

It will thus be seen that factor analysis can be used with advantage in the case of exploratory research. Many a time factor analysis is used just because it exists, without examining its suitability.

CLUSTER ANALYSIS

Cluster analysis is used to classify persons or objects into a small number of mutually exclusive and exhaustive groups. There should be high internal (within-cluster) homogeneity and high external (between-cluster) heterogeneity. In marketing research, cluster analysis has been increasingly used because of its utility in resolving the problem of classifying consumers, products, etc. At the end of our discussion on cluster analysis, its several uses in marketing will be specified.

Hypothetical Example of Cluster Analysis

Cluster analysis is illustrated by a hypothetical example of the type of vacations taken by 15 individuals—A to O. A two-dimensional perceptual map[4] has been drawn on the basis of data relating to (i) number of vacation days, and (ii) expenditure on vacations during a given year.

---

[2] For misapplications of factor analysis, *see*, Stewart, David W., "The Application and Misapplication of Factor Analysis in Marketing Research", *Journal of Marketing Research*, Vol. XVIII, February 1981, pp. 51–62.

[3] Thurstone, L.L., *Multiple-Factor Analysis*, Chicago, The University of Chicago Press, 1947, p. 56.

[4] Adapted from Zikmund, William G.: *Exploring Marketing Research*, Chicago, The Dryden Press, 1985, p. 687.

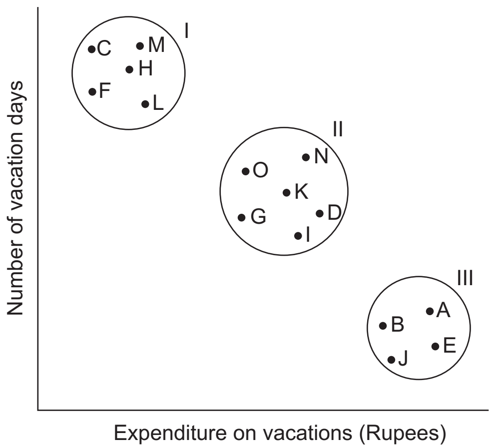

Fig. 19.8 Cluster Analysis

It will be seen that there are three distinct clusters. The first cluster comprising five individuals C, F, H, L and M shows that although these individuals take too many vacations they do not spend much on their vacations. The second cluster comprising six individuals D, G, I, K, N and O shows that they take vacations moderately and also spend moderately—neither too much nor too less. Finally, the third cluster comprising four individuals A, B, E and J shows that they have relatively few vacation days but spend substantially more on their vacations. On the basis of this perceptual map, the utility of classifying individuals into clusters becomes apparent. It will be seen that the points included in a cluster are close to each other and the points falling in two or more clusters are at a good distance from each other. This is the essence of cluster analysis, i.e., to classify individuals or objects on the basis of their similarity or distance from each other. Distance is an inverse measure of similarity, i.e., the shorter the distance, the greater is similarity and vice versa.

It may also be pointed out that in reality clustering of individuals will not be as simple as suggested by the foregoing example. This is because it has taken only two dimensions or attributes into consideration whereas in real life several attributes of individuals or objects may be relevant for their classification.

Matching Measures

Sometimes the researcher may have to satisfy himself with the nominally scaled data. In such cases he has to use attribute matching coefficients. Let us look at an example.

Suppose there are five attributes 1 to 5 on which we are judging two objects A and B. Then the existence of an attribute may be indicated by 1 and its absence by 0. In this way, two objects are viewed as similar if they share common attributes. This is illustrated with the help of Table 19.8.

Table 19.8

Object	**Attributes**				
	1	*2*	*3*	*4*	*5*
A	1	0	0	1	0
B	0	0	1	1	1

The table shows that object A possesses attributes 1 and 4 while object B possesses attributes 3, 4 and 5. A glance at the above figures will indicate that objects A and B are similar in respect of attributes 2 (0 and 0) and 4 (1 and 1). In respect of the other three attributes there is no similarity between A and B. We can now arrive at a simple matching measure by (i) counting up the total number of matches—either 0, 0 or 1, 1; (ii) dividing this number by the total number of attributes. Symbolically,

$$S_{AB} = \frac{M}{N}$$

where S_{AB} denotes the measure of similarity between objects A and B
M denotes the number of attributes held in common (matching 1′s or 0′s); and
N denotes the total number of attributes

Thus, in our above example,

$$S_{AB} = \frac{2}{5} = 0.4$$

This measure varies between zero and one.

It may be noted that the foregoing example is a simple one as the attributes are confined to dichotomies. In practice, however, they may be polytomies as well as consist of mixed scales—nominal, ordinal and interval.[5]

Measurement of Distance

In the two-dimensional figure, the distance between two points, say A and B in the diagram given earlier, would be calculated as

$$d_{A,B} = \sqrt{(X_{A1} - X_{B1})^2 + (X_{A2} - X_{B2})^2}$$

where X_{A1}, for example, represents the coordinate of individual A on the first dimension (in this case expenditure on vacation) and X_{A2} represents the coordinate of individual A on the second dimension (in this case number of vacation days in a given year). In three dimensions, the expression of distance between A and B would be

$$d_{A,B} = \sqrt{(X_{A1} - X_{B1})^2 + (X_{A2} - X_{B2})^2 + (X_{A3} - X_{B3})^2}$$

To generalise, the distance between any two objects i and j for n dimensions or attributes would be

$$d_{ij} = \left[\sum_{k=1}^{n} \left(X_{ik} - X_{jk}\right)^2\right]^{½}$$

where k stands for the dimensions or attributes being considered for classification.

Sometimes, average straight-line (Euclidean) distance is used in cluster analysis. For example, in our previous example two dimensions or attributes are covered. As such average Euclidean distance with respect to two points A and B would be

$$d_{A,B} = \frac{D_{A,B}}{n} = \frac{d_{A,B}}{2}$$

It may be noted that the average Euclidean distance would not make any change in the clus-

[5] For details *see*, Green Paul E. and Donald S. Tull, *Research for Marketing Decisions*, New Delhi, Prentice-Hall of India Pvt. Ltd., 1986, pp. 444–445.

ters formed earlier. Another point to note is that when several dimensions or attributes are to be considered, there would be a larger number of separate distances. If there are 10 dimensions, than $1 \times \frac{(10-1)}{2}$ = 45 separate distances are to be measured. Thus, for n dimensions, there would be $\frac{n(n-1)}{2}$ separate distances. This also explains why the use of a computer is necessary when a large number of dimensions or attributes are to be considered.

As our purpose is only to introduce the technique of and methods used in cluster analysis, the actual mathematical procedures for deriving the clusters are not discussed here.

Methods of Cluster Analysis

Various methods used in cluster analysis can be classified into two major groups—**hierarchical and non-hierarchical methods.** In the case of hierarchical methods, either the 'top-down' or the 'bottom-up' approach is used. In the case of the former, all N entities are grouped in one cluster and then divided into two sub-clusters on the basis of highest average within-cluster distance. This process is carried on until each entity is a separate cluster. In case of the 'bottom-up' approach, first, there are single-point clusters. Then the two most similar points are placed in a cluster. At each subsequent stage, the proximity matrix is re-calculated in order to obtain the relationship of the new clusters with the remaining entities. This process is continued until all single-point clusters are grouped into one large cluster.

Non-hierarchical methods can also be used for clustering. The simplest of these methods would be to first define 'typical' members of each cluster and then allocate objects to the cluster they are most similar to. This assumes that the researcher has a prior conception of what clusters exist. Such a method may not be useful for initial investigations. In essence, the non-hierarchical methods take a fixed number of clusters and then attempt to find the best solution by ensuring that cluster means are maximally different. This is done by using an ANOVA-type test.[6]

Of these two methods, though the hierarchical method is simpler it is more unstable and unreliable. On the other hand, the non-hierarchical method is more reliable but it is extremely difficult to interpret the series of clusters generated by it.

How Many Clusters?

An important question in cluster analysis is how many clusters should be formed? Several alternatives are available in this regard. *First*, the number of clusters may be fixed by the researcher in advance. This may be possible either on theoretical reasons or on practical considerations. *Second*, one may specify the level of clustering with regard to cluster criterion. This would enable deciding a certain level which would indicate the number of clusters. *Third*, one may decide the number of clusters from the cluster pattern generated by the programme.

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[6] For a detailed discussion of the various procedures, see, Punj, Girish and David W.S. Stewart, "Cluster Analysis in Marketing Research: Review and Suggestions for Application" in *Journal of Marketing Research*, Vol. 20, May 1983, pp. 138–148.

Limitations of Cluster Analysis[7]

There are some limitations of this method. These are: *First*, the lack of specificity has resulted into several methods of cluster analysis. As a result of this, the marketing researcher is frequently at a loss to choose a particular method. *Second*, cluster analysis lacks standard statistical tests. This means that one is unable to ascertain statistical significance when clusters are found. Different people may use different clusters from the same set of data. In other words, several decisions are made somewhat arbitrarily both in regard to the number of clusters and their composition. *Third*, cluster analysis requires a good deal of computational time almost as much as factor analysis needs.

Uses of Cluster Analysis in Marekting[8]

One of the important uses of cluster analysis in marketing is market segmentation. Marketing managers are often required to identify similar segments so that marketing programmes can be formulated to meet special requirements of each market segment. The main task involved in segmentation is to classify people, materials, etc., into groups based on certain common characteristics.

Cluster analysis also provides a better understanding of buyer behaviour. This is possible by identifying homogeneous groups of buyers.

Cluster analysis can also be used in the development of potential new products. For example, a firm can determine the elements of competition by clustering brands or products within the larger market structure.

In the area of test market selection cluster analysis may enable the researcher to identify homogeneous test markets. As the finding of one test market can be applied to another test market or markets belonging to the same cluster, it will help reduce the number of test markets required. A study by Green, Frank and Robinson showed the use of cluster analysis in the selection of test markets. A large number of cities in the United States were grouped into 18 clusters on the basis of their similarities.[9]

Finally, cluster analysis may be used as a technique for reducing a large mass of data into meaningful aggregates which are far more manageable than a large number of individual observations. Obviously such an aggregation facilitates the researcher in his task.

MULTIDIMENSIONAL SCALING

In Chapter 9 on Scaling Techniques, we discussed attitude measurement. A number of scales, which are considered to be unidimensional, were discussed. Such scales measure consumers' perceptions or preferences in terms of a single dimension or attribute, such as superior or inferior quality, attractive, unattractive, etc. We concluded that the use of multidimensional scale would be more appropriate than unidimensional scale. This is because consumers generally prefer a particular brand of a product not on the basis of one attribute but on a number of attributes. We briefly discuss multidimensional scaling here.

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[7] Based on Klastorin, T.D., "Assessing Cluster Analysis Results" in *Journal of Marketing Research*, Vol. XX, February 1983, pp. 92–98.

[8] Based on Punj, Girish and David W. Stewart, op. cit., pp. 138–148.

[9] Green, Paul E., Ronald E. Frank and Patrick J. Robinson, "Cluster Analysis in Test Market Selection" in *Management Science*, April 1967, pp. 387–400.

Basic Concept

Multidimensional scaling (MDS) is a data reduction technique, the primary purpose is to uncover the "hidden structure" of a set of data.[10] It enables us to represent the *proximities* between *objects* spatially as in a map. The term 'proximities' means any set of numbers that express the amount of similarity or difference between pairs of objects. The term 'objects' refers to things or events. The main purpose of MDS is to map the objects in a multidimensional space such that their relative positions in the space show the degree of perceived proximity or similarity amongst them.[11]

MDS involves two aspects. *First*, it helps in the identification of attributes on the basis of which consumers perceive or evaluate products or brands. Second, it enables the positioning of different products or brands on the basis of these attributes. It helps generate a perceptual map, indicating the location of the brands on the basis of attributes.

APPROACHES TO MULTIDIMENSIONAL SCALING

There are two sets of approaches that can be used for analysing multidimensional data. One set of approaches involves the measure of attributes while the other considers proximity or preference between objects, ignoring individual attributes as factors. Regardless as to which approach is used, the results of both sets enable us to identify market clusters and their sizes. We give below an example of each of these two sets of approaches.

Attribute-Based Example

Let us assume that only two dimensions or attributes are involved in this example which pertains to the preferences of students of the MBA courses offered by some universities. The dimensions are: prestigious course and quantitative content. This can be shown as given in Figure 19.9.

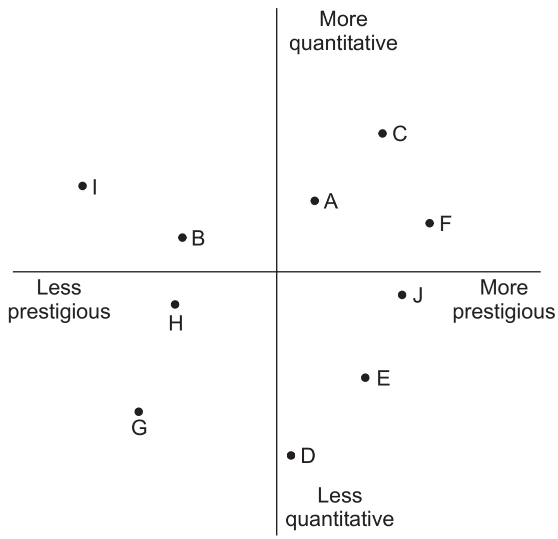

Fig. 19.9 Perceptual Map of Selected Business Schools

[10] Dillon, William R. and Mathew Goldstein, *Multivariate Analysis—Methods and Applications*, New York, John Wiley and Sons, 1984, p. 107.

[11] *Ibid.*, p. 108.

The points indicated by letters A to J show a student's comparison in the MBA programmes in ten different universities. The vertical dimension indicates the relative quantitative content of the MBA course while the horizontal dimension shows the relative prestige of the course. It will be seen from this perceptual map that points which are close to each other show similarity in the student's perception. In contrast, the points which are wide apart from each other show that the student has perceived that the MBA course of the concerned universities is very different on the basis of the two dimensions under reference.

Non-Attribute Based Example

Sengupta[12] has given a non-attribute based example. The data were obtained in a survey conducted in Calcutta. A sample of 50 housewives was selected for this purpose. They were asked to make a paired comparison for four high- and medium-priced detergents—Surf, Sunlight, Gnat and Key. The data obtained are shown in the Table 19.9.

Table 19.9

Preferred Brand	Preferred to			
	Surf	**Sunlight**	**Gnat**	**Key**
Surf	—	25	40	50
R = Sunlight	25	—	35	45
Gnat	10	15	—	30
Key	0	5	20	—

The table shows paired comparisons. For example, 25 out of 50 respondents preferred Sunlight to Surf and 10 preferred Gnat to Surf.

These absolute figures were then *converted* into a matrix of similarities. This was done by using the following formula:

$$S_{ij} = \frac{r_{ij} \times r_{ji}}{N}$$

where S_{ij} stands for the matrix of similarity between *i* and *j*: r_{ij} stands for the number of respondents who preferred brand *i* to brand *j*: r_{ij} stands for the number of respondents who preferred brand *j* to brand *i*; and *N* stands for the total sample size.

The matrix of similarities was as follow:

$$S = \begin{array}{l} \\ \text{Surf} \\ \text{Sunlight} \\ \text{Gnat} \\ \text{Key} \end{array} \begin{array}{c} \begin{array}{cccc} \textit{Surf} & \textit{Sunlight} & \textit{Gnat} & \textit{Key} \end{array} \\ \begin{bmatrix} — & 12.5 & 8.0 & 0.0 \\ — & — & 10.5 & 4.5 \\ — & — & — & 12.0 \\ — & — & — & — \end{bmatrix} \end{array}$$

As the matrix is symmetric, only the elements above the diagonal need be written.

The next step was to obtain the matrix of dissimilarities for which a simple approach of ranking was used. Thus, the metric data were converted into nonmetric.

[12] Sengupta, Subroto: *Brand Positioning*, New Delhi, Tata McGraw-Hill Publishing Co. Ltd., 1990, pp. 248–252. Reproduced with permission.

$$\hat{D} = \begin{array}{ll} & \begin{array}{cccc} \textit{Surf} & \textit{Sunlight} & \textit{Gnat} & \textit{Key} \end{array} \\ \begin{array}{l} \text{Surf} \\ \text{Sunlight} \\ \text{Gnat} \\ \text{Key} \end{array} & \begin{bmatrix} — & 1 & 4 & 6 \\ — & — & 3 & 5 \\ — & — & — & 2 \\ — & — & — & — \end{bmatrix} \end{array}$$

The above two matrices indicate that surf and sunlight are closest and surf and key are farthest. This means that the first two brands of detergent are most similar and the other two are most dissimilar.

Figure 19.10 shows an initial plot of the four brands in two dimensions. Using Euclidean distances, the matrix of distances became

$$D_1 = \begin{array}{ll} & \begin{array}{cccc} \textit{Surf} & \textit{Sunlight} & \textit{Gnat} & \textit{Key} \end{array} \\ \begin{array}{l} \text{Surf} \\ \text{Sunlight} \\ \text{Gnat} \\ \text{Key} \end{array} & \begin{bmatrix} — & 1.58 & 4.47 & 6.50 \\ & — & 2.92 & 4.92 \\ & & — & 2.06 \\ & & & — \end{bmatrix} \end{array}$$

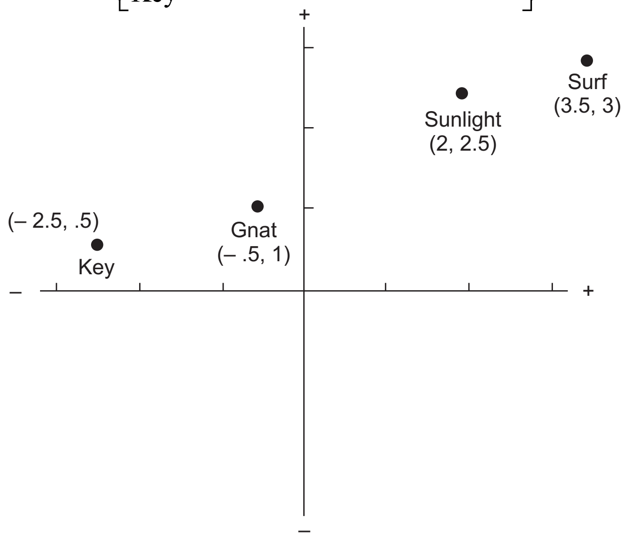

Fig. 19.10 This solution cannot be regarded as 'Ideal' because the stress is much higher than zero (Reproduced from Sengupta, S., *Brand Positioning: Strategies for Competitive Advantage*, Tata McGraw-Hill, 1990, with permission)

Using the forula $1 - \dfrac{\Sigma \hat{d}_{ij}^2}{\Sigma d_{ij}^2}$, the initial stress value was calculated as 0.10 or 10 per cent. It may be pointed out that this solution though satisfactory could not be regarded as ideal because the stress value was not zero. Normally the stress value should be zero.

The process would continue until the stress value reached below the specified level. A possible solution could be arrived at by shifting the position of surf slightly towards the left side of the horizontal axis, as is shown in Fig. 19.11.

Using the Euclidean distances, a new matrix of distance, as shown below, could be arrived at

$$D_2 = \begin{bmatrix} & \textit{Surf} & \textit{Sunlight} & \textit{Gnat} & \textit{Key} \\ \text{Surf} & — & 1.12 & 4.03 & 6.04 \\ \text{Sunlight} & & — & 2.92 & 4.49 \\ \text{Gnat} & & & — & 2.06 \\ \text{Key} & & & & — \end{bmatrix}$$

This gave the revised stress as zero.[13]

Requirements for MDS

In order to use MDS, two requirements must be met. First, a set of numbers, called proximities, must be available. Second, a computer-based alogorithm[14] must be available. A number of computer programmes are now available to implement an MDS analysis.

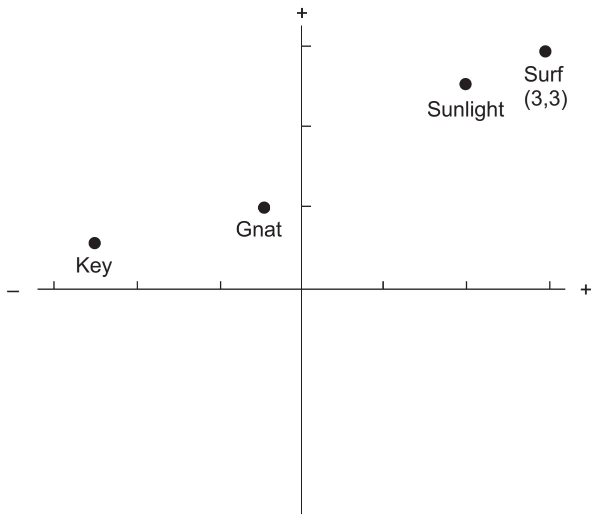

Fig. 19.11 This is a better solution as the revised matrix of distances leads to a stress value of zero. (Reproduced from Sengupta, S., *Brand Positioning: Strategies for Competitive Advantage*, Tata McGraw-Hill, New Delhi, 1990, with permission.)

Limitations

There are some major limitations of MDS which are mentioned below. *First*, the concepts of similarity and preferences are not very clear. As such the respondents' perceptions of similarity and preferences may differ. *Second*, there are empirical limitations. For example, the selection of various attributes or dimensions which are regarded important to respondents is subjective. One may question this selection. *Third*, it becomes extremely difficult to interpret the results of MDS. This is especially true when interpretation involves relating physical changes in products to psychological changes in perceptual maps. *Fourth*, different computer programmes often produce different results. This makes the task of interpretation of MDS results all the more difficult, apart from being confusing.

[13] For additional examples of perceptual mapping with MDS, reference may be made, *Ibid.*, pp. 252–258.

[14] A solution system.

At the end, it may be mentioned that MDS approach is being increasingly used by researchers. It is particularly suited for product life cycle analysis, market segmentation, vendor evaluation, measuring advertising effectiveness, test marketing, sales representative and store image research, brand-switching research and attitude scaling.[15] The practical utility of MDS becomes most apparent when a set of data is large. In such cases MDS maps the data. It is much easier to understand the picture than the data themselves. However, the researcher must have a good understanding of MDS before he decides to use it.

CONJOINT ANALYSIS[16]

Conjoint analysis is concerned with the measurement of the joint effect of two or more attributes that are important from the viewpoint of the consumer. In a situation where a company would like to know the most desirable attributes or their combinations for a new product or service, the use of conjoint analysis will be most appropriate. For example, an airlines corporation would like to know which is the most desirable combination of attributes to a frequent traveller –punctuality in the operation of flights or the quality of food served on the flight.

The use of conjoint analysis involves a number of steps that are discussed here.

Step 1: Selection of Attributes

The first step in conjoint analysis involves the identification of the relevant product or service attributes. In order to identify product attributes, several approaches are available to the researcher. He may interview a number of consumers directly. Alternatively, he may conduct focus group interviews with consumers. Yet another option available to the researcher is to contact the product managers and retailers who are well-informed in that particular field.

While selecting the attributes, the researcher should ensure that they are actionable as well as important to consumers. The former consideration suggests that the company is well-equipped both in terms of technology and financial resources. This is necessary in case consumer preferences suggest certain changes so that these can be carried out by the company. The number of attributes thus identified should not be too many as it will create problems in collecting enormous data. As such, the number of attributes should be within reasonable limits.

Step 2: Specification levels of attributes

Having identified the attributes, the next step is to specify the actual levels of each attribute. Here, the researcher should be aware of the relationship between the number of levels used to measure an attribute and preference of the respondent for that attribute. In case a large number of levels of attributes are chosen, it will put a great burden on the respondents.

Step 3: Specific Combinations of Attributes

The next step in the process of conjoint analysis involves the specific combinations of attributes that will be used. The number of possible combinations is given by the product of number of attributes and the number of levels. For example, if there are four attributes at three levels each, it would require $3 \times 3 \times 3 \times 3 = 81$ combinations. The researcher has to ask whether the respondent would be able to provide meaningful rank-order judgments in 81 cases. It is therefore advisable to use only a few combinations of the attributes.

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[15] Green, Paul E., " Marketing Applications of MDS: Assessment and outlook" in *Journal of Marketing*, vol. 39, January 1975, pp. 24 – 31.

[16] This section is based on Churchill, Gilbert A. Jr. and Dawn Iacobucci: *Marketing Research: Methodological Foundations*, Thomson Asia Pte. Ltd. Singapore, 2002, pp. 748–752.

Step 4: Selection of Form of Stimuli

Coming to data collection procedure, the 'trade off' approach or the 'full profile' approach may be used. The first approach involves the consideration of only two attributes at a time by the respondents. They are asked to rank each combination of levels of attributes from the most preferred to the least preferred. Respondents are directly given cards with an example how to complete them. In contrast, the full-profile approach involves the consideration of all the attributes at the same time. Respondents are given complete description of the product on the relevant attribute. A number of choices are used to provide as much information as possible about the product. These can be cards, drawings, pictures, advertisements for the product, etc. The respondents are asked to rank all the alternatives. Alternatively, they are asked to rate each item on a scale of 1–10 or 1–100, indicating their preference or intention to purchase. The rating scale approach is more popular as compared to rank order approach.

There are some distinct advantages of the full-profile approach. First, as all, characteristics are considered at the same time, the description of the concept is more realistic than in the trade-off approach which considers only two attributes at one time. Second, either a ranking or rating scale can be used for the concept evaluation task. Third, respondents have to make fewer judgments than in case of trade-off approach. As against these advantages, a major limitation of the 'full-profile' approach is that as the number of attributes increases, the task of judging the individual profiles becomes more and more complicated.

Step 5: Aggregation of Judgments

This step in conjoint analysis process involves deciding how the responses from individual consumers should be aggregated. Conjoint studies produce part-worths utility for each respondent for each level of each attribute. However, these should not be averaged across individuals to determine the average utility for each level of each attribute. Before calculating such averages, the researcher should ensure that segments with unique utilities do not exist. He should be sure that he has homogeneous groups before averaging across respondents. This can be done by first using cluster analysis which has been discussed earlier in this chapter.

Step 6: Selection of Analysis Technique

This is the final step concerned with the analysis of input data. Here, the question is: which technique should be used for analysis? Although a variety of approaches are available for analysing conjoint data, regression analysis is very frequently used. Of course, this is particularly helpful when preference model is linear or smooth nonlinear. In case of an irregular preference model, dummy variables in regression may be used. Alternatively, the analysis of variance technique may be used.

Usefulness of Conjoint Analysis

Conjoint analysis is very helpful to manufacturers of products and those who provide any type of service. The former are always interested to know the combination of features that would be most appealing to the consumers. In case a new product brought in the market does not get adequate response from the consumers, it would be a heavy loss of money and time to the manufacturer concerned. As such, conjoint analysis is especially used for product design and concept evaluation. Its application can be found in several industries /areas such as airlines, transportation, pharmaceuticals, credit cards, etc. In addition, conjoint analysis has been used in determining consumer preferences for attributes of health organisations.

Limitations of Conjoint Analysis

First, it is used in predicting sales and market share. But, as its applications are not large, it is not as perfect and convincing as it should be.

Second, there is a problem about the appropriateness of the levels or features used for each attribute in the conjoint analysis.

Third, sometimes the models of conjoint analysis fail to capture utility functions and decision rules.

GUIDELINES FOR THE USE OF MULTIVARIATE ANALYSIS

In this chapter, some important methods of multivariate analysis have been discussed. At this stage it may be emphasised that sufficient care must be exercised in using multivariate methods. Sheth[17] offers a number of guidelines to the marketing researcher who intends to use multivariate methods, to guard against their indiscriminate use. These guidelines are briefly given below:

1. The marketing researcher should not try to be technique-oriented. If he develops a fancy for one or two particular techniques and uses them indiscriminately without checking their suitability in a given case, it will harm the interests of marketing research. It may also bring about the downfall of multivariate methods.
2. He should not be carried away in building models, disregarding the fact that multivariate models are information inputs to facilitate management in the process of decision-making.
3. He should remember that multivariate methods are not substitutes for his skills and imagination in the design of research. These are necessary in conceptualisation of the problem.
4. He should not overlook the need for lucid communication with management. A first rate study using sophisticated techniques may go waste if management is unable to understand it.
5. He should not make statistical inferences about the parameters of multivariate models. Such inferences are not possible on account of the sizeable existence of non-sampling or measurement errors in the data in the social sciences. Such techniques should be seen as descriptive statistical techniques for reducing large data to a summarised and meaningful form.
6. Sometimes, the researcher may be carried away by a random relationship among the variables and put substantive meanings into the data, which may not be true. This is especially true of some multivariate methods such as cluster analysis, multidimensional scaling and conjoint measurement as there is no sampling theory behind them and therefore, these are heuristics. To guard oneself against the error, it may be advisable to use at least two different techniques.
7. Finally, he should exploit the complementary relationship inherent in the structural and functional multivariate methods. In other words, he should substantiate a number of judgements which he has to make with structural multivariate analysis of data. For example, it is advisable to use cluster analysis first to specify mutually exclusive groups before using a multiple discriminant analysis.

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[17] Based on Sheth, Jagdish N., "Seven Commandments for Users of *Multivariate Methods*" in *Multivariate Methods for Market and Survey Research*, Chicago, American Marketing Association, 1977, pp. 333–335.

These guidelines are suggestive of the fact that many marketing researchers make indiscriminate use of multivariate methods in their research. Ferber[18] also feels that "multivariate methods are widely known but that not many people are familiar with their use, even fewer people have accepted their use, and these methods are certainly not used on a widespread basis. The problem is essentially of communication at all levels." He then specifies these levels. The first and the most important level is to communicate to the people that we are living in a multivariate world and that the nature of our problems is also multivariate or multidimensional. Not only this, even the approaches to the solutions to such problems are likely to be multivariate. The second level relates to people working in particular areas of multivariate methods. He feels that these experts should give up the narrow specialists' view and develop a broader understanding of the different multivariate methods as well as their interrelationships. The third level indicates those experts who are engaged in further developing the field of multivariate methods. They should communicate their experience with other experts engaged in the same area. Finally, the fourth level relates to those who understand and use one or more of the multivariate methods. They must communicate the utility of such methods to the marketing people. Such a communication is necessary as most of the marketing people are either ignorant or doubtful about the usefulness of multivariate methods in marketing.

Summary

This chapter has covered four inter-dependence methods in multivariate analysis. These are: Factor analysis, cluster analysis, multi-dimensonal scaling, and conjoint analysis.

As regards factor analysis, its two objects have been specified and its usefulness in marketing research has been brought out. The examples of factor analysis have been provided and its limitations enumerated.

The concept of cluster analysis has been explained with the help of a hypothetical example. Its uses as also limitations have been brought out.

As regards multi-dimensional scaling, after explaining its basic concept, the chapter has focused on its technique. With the help of both attribute-based and non-attribute based examples, the technique has been explained. This is followed by major limitations of multi-dimensional scaling.

As regards conjoint analysis, the chapter has first explained the concept. This is followed by a detailed discussion on steps involved in a conjoint study. The chapter then points out the usefulness of conjoint analysis as well as problems involved in such a study.

As many researchers have developed a fancy for multivariate techniques that are used regardless of their suitability in a given case, the chapter provides broad guidelines for the use of multivariate techniques.

Key Terms and Concepts

Factor Analysis 413
Factor Rotation 417
Component Matrix 420

[18] Ferber, Robert, "Antecedent Conditions for Diffusion of Multivariate Methods" in *Multivariate Methods for Market and Survey Research, Ibid.*, pp. 329–332.

Questions

1. What is factor analysis? What is it used for?
2. Is factor analysis based on the usual distinction between dependent and independent variables?
3. "Factor analysis is particularly useful in those situations where no prior knowledge of the relationships between the variables is involved." Comment.
4. Suggest three problems in marketing where factor analysis can be effectively used.
5. What are the limitations of factor analysis?
6. What is cluster analysis? What is it used for?
7. The Xerox Company where you are national sales manager has asked you to cluster its present and potential accounts. How would you go about it?
8. A large firm of stockbrokers operating in the Bombay Stock Exchange has approached you to help it in segmenting its accounts. How could cluster analysis be used for this purpose?
9. What is the multidimensional scaling? What is it used for?
10. How many objects should be included in MDS study?
11. What is the difference between metric and non-metric MDS?
12. What are the advantages and limitations of multi-dimensional scaling?
13. What is conjoint analysis? Explain the steps involved in its use.
14. How do you decide whether conjoint analysis is the appropriate technique for a given problem?
15. How would you select the attributes to include in a conjoint study?
16. What is the difference between 'full profile' and 'pair wise' conjoint analysis? Which is superior? Why?
17. Give an example of a situation where each of the following techniques can be used:
    - (i) Factor analysis
    - (ii) Cluster analysis
    - (iii) Multidimensional scaling
    - (iv) Conjoint analysis
18. Why should a researcher prefer the use of multivariate analysis to univariate or bivariate analysis?
19. How do dependence methods differ from interdependence methods?

20 Interpretation and Report Writing

Learning Objectives

After reading this chapter, you should be able to understand:

- Interpretation
- Report writing
- Oral reporting
- Written reports
- Preparation of the report
- Evaluation of the research report

In the preceding chapters, we have discussed almost all aspects that a marketing researcher needs to know in order to carry out his assignment successfully. At this stage, it may be mentioned that the analysis of data, to which Chapters 14 to 19 were devoted, by itself does not provide the answers to research questions. This suggests that something beyond analysis is necessary. Before the marketing researcher prepares his report on the research done by him, he has to draw specific conclusions from the data analysed earlier. This brings us to the interpretation of data.

INTERPRETATION

Interpretation means explanation or finding out the meaning. It involves drawing inferences from the analysis of data. Interpretation and analysis are closely interlinked. Analysis of data often includes a simultaneous interpretation of the results. *For example*, when the researcher calculates a coefficient of correlation, he concludes not only on the presence or otherwise of a relationship between two or more variables but also whether this relationship, if existing, is statistically significant. Further, he will also be interested to know about the implications of such an inference in so far as that particular marketing activity/problem is concerned.

Interpreting data in proper perspective is very important. In order to do so, the researcher should possess a high degree of skill and exercise the utmost care and objectivity. For errors of interpretation, if committed, can nullify even the best research.

To begin with, the researcher must ensure that the data collected are reliable and adequate for drawing inferences. If the data suffer from inadequacies, then even the best of the methods used in analysis and interpretation would be rendered useless.

Any research that is based on sampling is naturally subject to a sampling error. In a sample survey, there is a general tendency on the part of the researcher to jump to conclusions or generalisations on the basis of too small a sample. *For example*, survey results based on a sample of 20 to 30 households cannot be regarded as a representative of the household population and applied to a city having a population of two lakhs. In addition, there may be non-sampling errors such as interviewer bias, defective instruments for data collection, etc. These aspects have been discussed in this book.

Further, one should ensure that appropriate statistical methods have been used in analysing data. One can use univariate, bivariate and multivariate analysis and several methods within the last two categories. It is advisable to take help of experts in selecting one or more appropriate methods of data analysis. A frequent source of interpretative inadequacy is the neglect of measurement problems. The marketing research must ensure that the measures used are reliable and valid. Absence of this check may lead to a serious mistake.

A fallacy in interpretation of data arises when the researcher thinks that all differences in numbers are really meaningful. This is the area of statistical significance, a concept which is not understood by a large number of readers. Particularly in those cases where the difference in numbers is not large, the researcher must indicate whether this is statistically significant or not. In the absence of such a statement, inconsequential differences will be interpreted as real differences thereby leading to erroneous conclusions.

Further, negative or inconclusive results are more difficult to interpret than positive ones. When results are positive and are in conformity with an established theory, it is far easier to interpret them. However, when they are negative, then they may be so on account of wrong methodology, inadequate or poor measurement, faulty analysis and incorrect hypothesis or theory. In such a situation, one has to scrutinize the negative results very carefully to identify the real cause. If one is satisfied with the methodology, the measurement as also the analysis, then one can be confident that the hypothesis or theory is not correct. This in itself may be a definite contribution to scientific advance.

Finally, it must be remembered that the data analysed related to a single point of time in the past. As such, the situation might have undergone a change and one must not be rigid in adhering to the same results where the situation is dynamic one.

These are some of the major flaws that might occur in the interpretation of data. The problems specified above are merely illustrative. The marketing researcher should take care to avoid such mistakes otherwise he would reach wrong conclusions. Having emphasised the need for proper interpretation of data, we now turn to report writing. The rest of this chapter provides broad guidelines for the preparation of research reports.

REPORT WRITING

After the data have been analysed and the conclusions reached, the marketing researcher has to report his findings to the management. The reporting has to be done in a clear manner so that the chances of any misunderstanding can be minimised.

Oral and Written Reports

Reports can be, broadly speaking, of two types: oral and written. Although research reports are mostly written ones, we shall briefly discuss oral reports here.

An oral report is any presentation of information through the spoken word. There are three major differences between oral and written reports:[1] First, oral reports lack visual advantages. Charts, diagrams or pictures can be used to a limited extent, though, to stress particular points in oral presentation, the reporter can use pauses and volume emphasis. Second, the pace of presentation cannot be controlled and regulated by any one from an audience, who is being presented an oral report. In contrast, whenever a certain point is not clear in a written report the reader can read it two or more times, if need be slowly and more carefully. This advantage is not available to one who is receiving the report through oral presentation. Third, since a written report is bound to receive considerable attention and scrutiny from the readers the report-writer is likely to work hard to produce an accurate report of a high quality. In contrast, an oral report will not be so precise nor will the reporter give as much time in its presentation since it cannot be subjected to the same degree of scrutiny as written reports because of the extremely limited time at the disposal of the audience for indicating its reaction. Also, established standards for oral presentation are far less rigid than for written reports.

ORAL REPORTING

If the researcher has been asked to make an oral presentation of his research findings, he should bear in mind a few major considerations.

First, he should know the audience to whom he is to report. If it has any special characteristics such as highly qualified or specialised in a certain subject, these must be noted down.

Another consideration in oral reporting is that it should be properly planned. To begin with, the reporter should be clear about the objectives of the report. Does he want to inform the audience of his results? Does he want to persuade the listeners to agree with his viewpoint? Does he want to recommend a certain course of action based on his study? In each of these cases, the oral presentation will be different.

After the reporter has decided the objective of his report, he should gather the necessary information. If he has not already done any research, he may be required to collect data uniformly. He may have to approach some people to get the requisite information or he may collect it on the basis of his own observations.

Once the information is ready, the reporter has to organise it in a logical manner. The subject matter should be divided into meaningful and comparable parts. Simple ideas should precede complex and difficult ones. There should be a logical and coherent approach in presenting the subject matter before an audience.

Another point worth considering is the suitability of language. The reporting should be done in a simple and convincing manner. In order to make the communication effective, it may be advisable for the reporter to use visual aids such as charts, diagrams, tables, pictures, posters, blackboards, slides and movies. However, excessive use of visual aids may sometimes spoil the overall quality of presentation, therefore, it is necessary to ensure their judicious use.

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[1] Based on Lesiker, Raymond V., *Report Writing for Business*, Homewood, Ill., Richard D. Irwin, Inc., 1977. pp. 222–223.

Sometimes, it may be advisable to distribute a handout containing statistical data or charts to the audience. This would facilitate both the listener and the reporter. The latter can refer to the figures or charts in the handout as he proceeds with his reporting.

When an oral summary of a written report is to be presented, the reporter should exercise great care in the preparation of the summary. All major points must be covered and excessive details avoided otherwise the focus will be lost. The reporter should ensure that within the time allotted to him, he covers all major points including his recommendations.

WRITTEN REPORTS

Types of Reports

Various authors have classified reports differently. These classifications indicate the variation in their approaches to the subject. One basis of classification is the time interval. The reports could be daily, weekly, monthly, quarterly, or annual. However, all reports are not regularly brought out. There are some which are prepared for a special assignment and are known as special reports.

Reports are also classified on a functional basis, according to which there could be three types of reports—informational, examination, and analytical (also known as problem-solving). The informational report is a factual report on a particular subject and it neither contains an analysis nor conclusions. The examination report goes a step further. In addition to giving facts on a subject matter, it analyses these facts. It does not specify conclusions or recommendations though the reader can draw these on the basis of the factual information and analysis contained in the report. The analytical report goes a step further than the examination report. It not only presents and analyses data but it also draws conclusions and, if necessary, makes recommendations. This is, obviously, the most comprehensive report.

Reports can be classified on the basis of their subject matter or field. Since there are innumerable subjects, the types of reports within a certain subject will be different from those in another. For example, reports on economics could be classified by various subjects covered within its scope such as a report on monetary reforms.

Reports can be classified on the basis of their physical form or make-up. The two usual forms are short-form and long-form. For example, memoranda, letters and progress reports may follow a short-form, whereas information and examination reports may follow a long-form.

Reports have also been classified on the basis of the relationship between the reader and writer. Such reports are described as administrative, professional and independent. An administrative report is written within an organisation, while professional report is submitted by an outside expert to an organisation. Independent reports are generally prepared by non-profit research organisations and published for the benefit of the public. These reports are not written for any particular group.

Reports are sometimes classified on the basis of the employment status of their authors. Reports prepared in a business organisation are known as private reports while those prepared in a government or public institution are known as public reports. Here, too, there may be independent reports which are prepared by individuals without any authorisation either by a public or private agency.

Yet another basis of classification of reports is their formality. On this basis, the reports may be either formal or informal. The dividing line between the two types is rather hazy. A formal report is written befitting the requirements of a formal occasion. An informal report, on the other hand, may be worded to suit an informal occasion. A report prepared by one employee for the information of his colleagues may be an example of an informal report. In contrast, a report prepared by an executive for the top management may be a formal report.

These are the major bases of classification of reports though it may be noted that these are not mutually exclusive. Thus, a research report may be a special report, a long report, an analytical report and a private report at one and the same time. This indicates that there are different ways—which are not mutually exclusive of classifying reports on account of the different viewpoints or approaches involved.

PREPARATION OF THE REPORT

Having decided on the type of report, the report writer should now concern himself with its preparation. This can best be done when he is clear about what aspects or points are to be covered by it. Let us first consider the format of the research report.

Research Report Format

A research report can be written in a number of ways. However, three formats are generally followed. First, the report may use a logical pattern, which implies that the findings are presented in inductive order, i.e., moving from specific to general. Second, the report may follow a psychological pattern which is almost inverse of the preceding pattern. In this format, the most critical information, i.e., the conclusion, is provided first, after which follow the findings supporting the conclusion. Third, the report may use a chronological format wherein information is given along the time dimension, i.e., things which happened earlier precede those which happened later. This form is generally combined with other formats. The chronological format is the least popular though in respect of problems of a historical nature, it is the most appropriate.

Having decided the format to be used in a research report, the researcher has now to prepare the report outline in accordance with that format.

Report Outline

Before attempting to write any report, the researcher must prepare a report outline. Without any outline his report is bound to be haphazard and clumsy. An outline to the writer is what the blueprint is to the construction engineer or what the pattern is to the dressmaker.[2] The outline will not only guide the writer as to the order of presentation of ideas but will also enable him to think before writing. This will lead to clarity in his presentation.

While preparing an outline, it must be noted that it should not be restrictive and rigid. There should be flexibility built into it so that if subsequently a change is needed, it can be easily introduced. Too frequent changes should be avoided. If they seem to be necessary, they will only indicate that the task of outlining the report was not done properly. It should also be noted that a change of one point in the outline may involve one or more related changes elsewhere for that point may have a bearing on one or more other points contained in the ouline.

> Changing one point may mean that other points are thrown out of sequence or out of context, so consider the relationship of a changed point to the rest of the piece and, where necessary, make changes in the other parts of the outline.[3]

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[2] Lesikar, Raymond V., op. cit., p. 79.

[3] Anastasi, Thomas E., *Desk Guide to Communication*, Reading, Massachusetts, Addison-Wesley Publishing Company, 1974, p. 77.

The writer should, therefore, satisfy himself that all related changes as a sequel to one particular change have been carried out in the outline.

A typical report outline based on the logical format is as follows:

1. Title page
2. Letters of transmittal and authorisation
3. Table of contents, statistical tables, charts and illustrations
4. Introduction
5. Methodology
6. Findings
7. Limitations
8. Summary and Conclusions
9. Recommendations
10. Appendices
11. Bibliography
12. Index

Title Page

The title page should indicate the topic on which the report has been prepared, the person or agency who has prepared it, the person or agency for whom it has been prepared and the date of submission (or completion) of the report.

Letter of Transmittal and Authorisation

This indicates the official who has authorised or sponsored the research and the official to whom the report is addressed.

Table of Contents

Unless the report is extremely brief, it should contain a table of contents to guide the reader as to what it contains. The table of contents should indicate the main parts, divisions or sections of the report, the chapter headings along with the page numbers. When a report contains a number of statistical tables, charts, figures or illustrations, a separate table for each of these categories should be given immediately after the table of contents.

Introduction

The introduction deals with the genesis of the report. It explains why the study was undertaken, the statement and formulation of the problem, formulation of hypotheses, if any, and the scope of the study. It is desirable to give a review of the related studies done earlier so that the reader may take the present report in the proper perspective.

Methodology

The report should describe the methodology used in studying the problem. If a sample survey has been undertaken, the report should indicate the type of sample design used, its size and the procedure used to draw the sample, the number of research workers employed in the field work, supervisors, the extent of precision achieved and the methods used for handling any special problems during the course of the study. It is necessary for the researcher not only to specify the method used but also its suitability vis-a-vis other methods. If the report is to be written for people not familiar with various statistical concepts, the researcher should explain the methodology in very simple language, confining himself only to the broader aspects. The more intricate aspects can be given separately in the form of an appendix. In a way, this is the most difficult part for the researcher as he has to communicate various concepts, methods and procedures to executives who are not deeply interested in research methodology and who are not familiar with the technical aspects.

Findings

This section of the report contains the result of the research and is perhaps the largest section of the report. The researcher should ensure that the findings are presented in proper sequence and in such a manner that the reader has no difficulty in understanding them. The researcher should also ensure that only the major findings are given as too many will be confusing to the reader. It is desirable to present the related data and exhibit as near the write-up on the findings as possible.

Limitations

The report should also point out the main limitations of the research report therein. This will be helpful to the reader who can form his own opinion as to how far the results are reliable. In addition, it will be useful to researchers who subsequently undertake a study on the same or a related theme.

Summary and Conclusions

This section contains a summary of the report as well as the main conclusions. The latter part is based on the findings given earlier. To facilitate the reader, the conclusions reported in this section should give references to pages, paragraphs or tables in the findings section.

Recommendations

It may not be necessary for all reports to contain recommendations. However, when a study has been commissioned by management which expects that the researcher will recommend certain measures, it is necessary that these be made in clear language.

Appendices, Bibliography and Index

This is the last section of the report. An appendix gives supplementary information which supports the body of the report but which cannot be given within it. If it is given within the main report, it may distort the focus on the main theme and confuse the reader. Generally, large and complex statistical tables, technical notes, copies of the questionnaires used, instructions to field staff and any other material used as supporting evidence for the write-up in the report are given in the form of appendices. Each appendix should pertain to one particular aspect.

Further, most of the research reports also contain a bibliography, showing the title of the books/reports used in their preparation, names of authors, publishers, the year of publication and, if possible, the page numbers. In addition, similar information is given in respect of articles/papers. The bibliography should be arranged in an alphabetical order.

Finally, an index showing the various topics and the relevant page numbers in the report, should also be given. It should be prepared on an alphabetical basis. However, an index may not be necessary in case the report is very short.

Writing of the Report

Having prepared a good outline of the report, the researcher has to prepare the report. While preparing the report, he or she has to keep in mind several factors. First, as managers are extremely busy, they are generally not interested in technical and logical aspects of a research problem. They are more interested in the conclusions reached in the research study. Another fact that should not be lost sight of is that managers are not well versed in research methodology and terminology. Further, like any ordinary readers, managers too would prefer an interesting report to one which is very boring. Finally, a research report is not written for one or two managers, it is to be read by a number of concerned managers. They are likely to differ due to their academic background, training and interests. The researcher should keep these aspects in mind while writing the report. In addition, he or she has to follow accepted guidelines at the time of report writing. These are briefly discussed below.

First, reports must be written objectively. Objectivity is a prerequisite of good research work. Absolute words such as 'always' and 'never', for example, should be avoided. The researcher should not impose his viewpoint on the reader; he should narrate the facts and draw such inferences as can be drawn.

Second, the report must be written in a concrete style. It must contain necessary statistics to support the thesis. One should avoid the use of such vague words as 'several people', 'a large number of respondents', 'a few interviewees' and 'often'.

Third, the report must be organised and coherent, which can be ensured by formulating a research outline prior to writing the report. Different sections of the report must be given in a proper sequence so that the reader is taken logically from beginning to end.

Fourth, a research report or any formal report should be written in the impersonal style, avoiding the use of the first-person. This would also help the writer to remain more objective.[4]

Fifth, there must be absolute clarity in the presentation of ideas. Clarity in writing is not possible in just one draft. The writer may have to revise the draft once, twice or even several times to make it lucid and understandable. A point that needs emphasis is that writing a research report is different from writing an essay or literary piece. As such, the writing should be plain and simple as the use of elegant words and syntax variation is not needed in a research report. However, the report need not be dull.

Sixth, the report should be neat and tidy. Wherever possible, charts and diagrams should be given. The write-up should be divided into different paragraphs and suitable headings should be provided. If necessary, paragraphs may be numbered to facilitate easy reference.

[4] Based on Rosenblatt, S. Bernard, T. Richard Cheatham, and James T. Watt, *Communication in Business*, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1977, pp. 298–300.

Britt[5] has emphasised the importance of writing good research reports. As an advice to the report-writer, he says that he should be careful about three things:

(i) The writer, i.e., sender of the message, (ii) the receiver of the message, and (iii) the message itself. The writer should engage in clear thinking before he sits down to write. As he rightly says that this clear thinking "does not come in the early period of incubation of thoughts" "but only after lots of trial and error and thinking and re-thinking." As regards the receiver of the message, Britt advises the report-writer to know his audience or audiences for whom the report is intended so that it can be prepared accordingly. Finally, Britt emphasizes that the message must be understandable to the concerned audience. The writer should be careful in his language and terminology and should plan a proper organisation of his report. It may be interesting here to reproduce an example of incomprehensible writing given by Britt:

> The use of analytical techniques of the behavioural sciences will gradually revolutionise the communication arts by predicating their practice upon a body of demonstrably general principles which will be readily available to creative people for increasing their knowledge of consumer response to advertising communication.[6]

The above sentence is not only very long but also most incomprehensible. It is difficult to understand what the writer wants to convey. The ideas contained in this long sentence could have been expressed far better in two or three short sentences and in simple language. Obviously, the researcher should avoid such writing or else his report will become unreadable.

Last but not the least is the question regarding the length of the research report. While a lengthy report may not be favoured by busy executives, a short report may, on the other hand, omit some important aspects of the study. Although short reports are generally preferred by executives, it may be emphasised that this by itself is not a virtue. Neither the long report nor the short report is necessarily a good one merely because it is long or short. What is important is the quality of communication and inclusion of all major and relevant aspects of the study. A short report containing a difficult and incomprehensible write-up is an inferior report to a long but comprehensible report. The writer should, therefore, lay great emphasis on the comprehensibility of the report and if that demands an increase in size, it should be done.

A final advice to the researcher in this regard is "Read, Think, Plan, Write and Re-write." If he follows this advice and critically examines his earlier draft report, he will be in a position to write a good final report.

This chapter has not dealt with the physical presentation of a written report. The physical presentation covers a variety of things such as choice of paper and the cover page, page layout, form of typing, numbering of pages, display of captions and binding of the document. The reader interested in these aspects should refer to Lesikar's work.[7]

Guidelines for the Use of Tables

In order to make the reader understand better certain data and their interpretation, tables and graphs are used. Here, we give some broad guidelines on the use of tables.

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[5] Britt, Steuart Henderson, "The Writing of Readable Research Reports" in *Journal of Marketing Research*, Vol. VIII, No. 2, May 1971, pp. 262–266.

[6] Ibid.

[7] Lesikar, Raymond V., *op. cit.*, Chapter 11.

1. The table should not be overloaded with data and it should be as simple as possible. If too much data are given in one table alone, it will defeat the very purpose of its construction. It will be too difficult to understand and interpret the data.
2. The table should serve the purpose or objective of the investigation.
3. The table should be complete in all respects including the unit of measurement, the time period for which the data relate, abbreviations used, footnote and source note, if necessary.
4. The data presented in the table should be free from any inconsistency or inaccuracy. It is desirable to go over the data again to ensure that they are accurate and properly recorded from the raw data.
5. The table should contain, as far as possible, totals, ratios and percentages, which will provide a better understanding of the data shown in it.
6. Finally, the table should not be made in a hurried and haphazard manner. Care should be taken to ensure that the format of the table is appropriate with reference to the nature of the data to be presented therein. Further, it should be made attractive so that the reader feels interested to go through it.

We now turn to the use of graphic aids in the preparation of a research report.

WHICH TYPE OF GRAPH OR DIAGRAM TO BE USED

There are several ways be which statistical data can be presented. These techniques will be discussed shortly. But before we do so we should know how to choose a particular technique from amongst several of them. In choosing a proper technique we should be guided by the following considerations.

Purpose

A major consideration while choosing a particular technique is the purpose of presenting the data. The purpose may be merely the presentation of results, or illustration or analysis. For example if we are dealing with the time series, the graphic device will be most suitable where we may measure time period on the horizontal scale and the concerned variable on the vertical scale. If the presentation is made for the use of the general public, the choice should be in favour of a very simple graph or diagram. In case the presentation is made before professional people or technologists the technique could be comprehensive and more refined.

Circumstances of Use

Another consideration is the circumstances under which a diagram is to be used. There are several ways in which it can be put to use. For instance it may be used during the course of a lecture using a computer and power point slides, or it may be included in a book or report. Other possible uses could be to hang it on a wall or to put it on a table or to show it on a TV progamme or in the movie. In all such cases the choice will depend on the specific use as well as on the level of uncertainty of the user.

Subject-matter to be Presented

The choice is also guided by the nature of the data to be presented. If original data are to be presented a simple graph can be a proper choice, but if the data ate in the form of ratios of change, then an appropriate device would be a semi-logarithm graph. Again, for discrete and continuous series, the techniques of presentation should be different. This apart, the magnitudes of data should be taken into consideration. When the data consist of wide differences, the two or three-dimensional charts would be more suitable than other techniques. Likewise, on the nature of the data will depend whether one has to use a simple bar, a multiple bar or a component bar diagram.

Time and Resources Available

Some charts are such that need a lot of time before they can be used. They also need more resources. A map or a multi-coloured pictorial presentation would need far more resources and time than the ordinary graphs and simple bar diagrams. Sometimes multi-coloured pictorial devices may need the services of a well-qualified cartographer or an artist. Besides, the services of a good printing press may be needed if such charts are to be included in published reports.

Type of Audience

Finally, a major consideration before the statistician should be the type of audience before whom the presentation is to be made. Obviously, for the general public, more refined or elaborate devices would be most unsuitable. In case of such an audience, simple time-series graphs or simple bar diagrams would be more suitable. In contrast, where the audience is professionally qualified or otherwise quite competent, the statistician should prefer a more elaborate device.

We now turn to specific devices that are used in the presentation of data.

GRAPHIC DEVICES

There are two major categories of graphs – the natural scale graph and the ratio scale graph; the former is more frequently used. Within the natural scale graph, again there are two types:(a) time series graph;(b) frequency graph.

Time series graph, as the name implies shows the data against time which could be any measure such as hours days, weeks, months and years. Thus a graph showing a number of industrial workers employed in a company for each of the years 1991-2000 is time series. Some other variables such as income of employees and the number of employees earning that income if plotted on a graph, will be known as a frequency graph. Here, we give some idea of a number of charts that are frequently used in business reports.

The line chart is probably the most commonly used chart. Figure 20.1 is a line chart which displays manpower employed by BPOs in the travel sector. The line chart is drawn on graph paper with the *x*-axis representing time and the *y*-axis representing values of the variable or variables. While using the line chart, one has to be careful in selecting a suitables scale depending on the range of data to be plotted against time. On a multiple line chart showing two or more series, it is advisable to use different colour or form for each line to provide clarity.

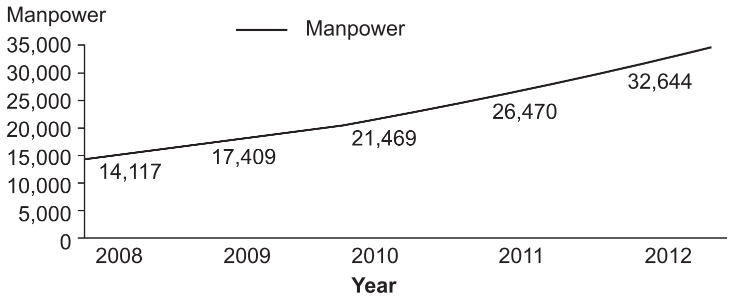

Fig. 20.1 Manpower Employed by BPOs in the Travel Sector

(Source: 2009 E&Y Report on Destination India — An Insight into the Domestic BPO Market)

Bar Charts

A bar chart displays the magnitude of the data by its length or width. A bar chart is very simple to understand provided it has been carefully designed. Bar charts are best at illustrating multiple comparisons and complex relationships. They are suitable when different but related types of data are displayed.

In such cases, bar charts comprise a group of bars placed adjacent to each other. Such charts are known as cluster bar charts. Such charts should be limited to four groups and four types of data within each group so that they can be understood well.

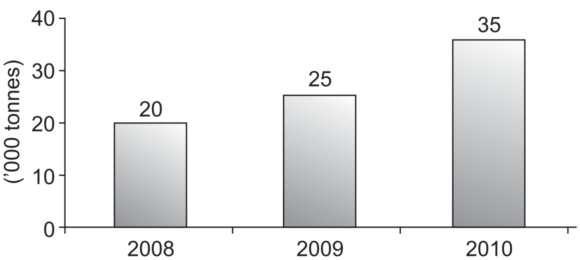

Fig. 20.2 Production of item x ('000 tonnes)

It will be seen that each bar has an equal width but unequal length. The length indicates the magnitude of production. From such a diagram, it becomes obvious that there is an increase in trend in the production of X commodity. In view of its simplicity and ease of drawing it, a bar diagram is very popular in practice. However, such a diagram can display only one classification or one category of data.

Figures 20.2, 20.3 and 20.4 are the three variations of the bar chart. The first one is a simple bar chart, the second one is a multiple-bar chart and the third one displays subdivided bars.

Multiple Bars

When two or more interrelated series of data are depicted by a bar diagram, then such a chart is known as a multiple-bar chart. Suppose we have export and import figures for a few years. We can display be two bars close to each other one representing exports while the other representing imports. Fig. 20.3 shows such a diagdram based on hypothetical data.

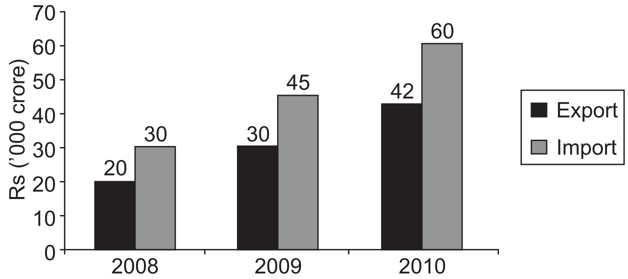

Fig. 20.3 Multiple Bars

It should be noted that multiple bar diagrams are particularly suitable where some comparison is involved. *For example,* the number of skilled, semi-skilled and unskilled workers in a factory for a couple of years can be represented well by means of a multiple-bar chart.

Subdivided Bars

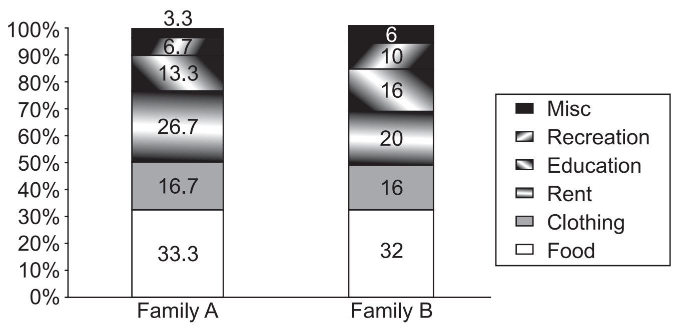

Fig. 20.4 Percentage Subdivided Bars

We may now show the percentage expenditure of the two families by percentage bars. It may be noted that we have calculated cumulative percentages, which have been plotted.

Stratum Chart

A stratum chart displays a set of line charts on which the data are successively aggregated over the series. It is also known as component-parts line chart as the component of each item is stacked up on top of one another. It is a very appropriate chart when over time changes in components are to be displayed. Figure 20.5 illustrates the stratum chart.

Tax Revenue of Central and State Governments and Union Territories

						(Rs '000 crore)
Years	**Income & Corporate Tax**	**Customs**	**Union Excise Duties**	**Sales Tax**	**Other**	**Total**
1995-96	32	36	40	36	31	175
1996-97	37	43	45	42	33	200
1997-98	37	40	48	46	42	213
1998-99	47	48	56	56	48	255

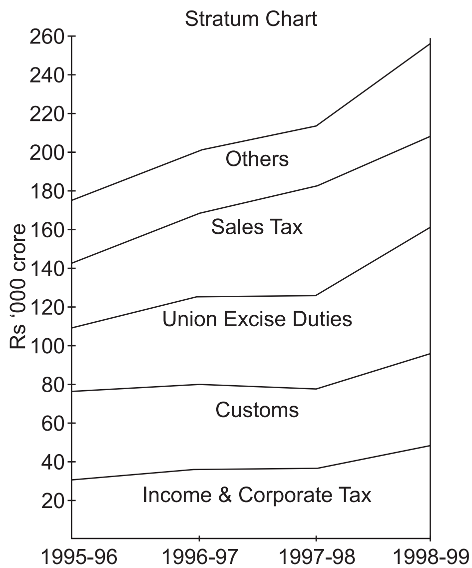

Fig. 20.5 Tax Revenue of Central and State Governments and Union Territories

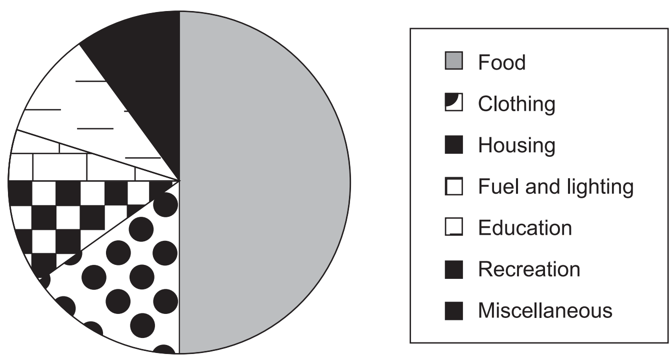

Fig. 20.6 An Example of Pie Chart

The pie chart is known as an angular sector chart though in common usage the term pie chart is used. It is advisable to adopt some logical arrangement, pattern or sequence while laying out the sectors of a pie chart. Usually the largest sector is given at the top and others in a clock wise sequence. The pie chart should also provide identification for each sector with some kind of explanatory or descriptive label. If the space within the chart is sufficient the labels can be placed inside the sectors, otherwise these should be shown outside the circle, using an arrow pointing out to the concerned sector.

There are certain *limitations* of pie charts. They are not as effective as bar charts for accurate reading and interpretation. This limitation becomes all the more obvious when a series is divided into a large number of components or the differences among the components are too small. When a series comprises more than five or six categories pie chart would not be a proper choice since it would be confusing to differentiate the relative values of several small sectors having more or less the same size. Although pie chart is frequently used it turns out to be inferior to a bar chart whether it is simple bar or a divided bar or a multiple bar.

Pictograms

Pictograms are the pictures that are frequently used in presenting data. As they are attractive and easy to understand, they are an appropriate mode for presentation of data. In pictograms, a pictorial symbol is used to clearly indicate the item that is being displayed. For example, if we are dealing with the production of cars, then we may use the symbol of car. It may be noted that pictograms are not abstract presentations such as bar charts.

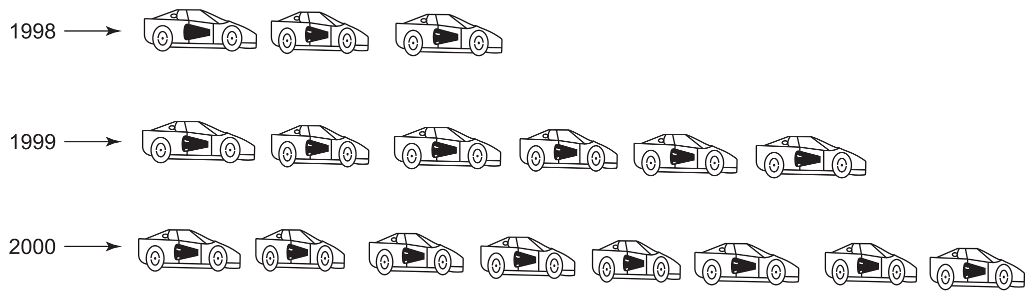

Fig. 20.7 An Example of Pictogram

Figure 20.7 shows some hypothetical data pertaining to cars sold by a manufacturer. A symbol of one car represents 1000 cars sold by the manufacturer. From the figure it becomes obvious that in 1998 only 3000 cars were sold, which rose to 6000 cars in the following year and finally to 8000 cars in 2000 . There are two major *advantages* of pictograms. *First* they are far more attractive as compared to other charts. As such they generate interest in the audience. *Second*, it has been observed that the facts presented by pictograms are remembered for a longer time than tables, bars and other charts.

There are some *limitations* of pictograms. *First* they are difficult to draw. *Second* sometimes we cannot show the actual data properly. For example if we have to show the number of enrolment of students, in view of limited space we may say that the picture of one student shows that 100 students have been enrolled. Now if the actual enrolment is say 279, then how to represent it as we cannot divide or split the symbol of one student. In case we round up this figure to 300 then it is clear that a higher figure is being shown resulting in an inaccuracy.

Cartograms

Cartograms are the maps that are used to present statistical data on a geographical basis. Suppose we have to show the rate of literacy on different parts of India. What we can do is to group different literacy rates into three or four categories. Then we display these rates on India's map using different-coloured lines to identify different literacy rates. Similarly we can show the number of registered factories in different States of India for a particular year. The actual number can be put with in the geographical boundaries of the States. Alternatively, we can show the States into three distinct categories — highly industrialized, moderately industrialized and poorly industrialized and use different colours for these categories to bring them into sharp focus.

Cartograms too are very attractive but they should be used especially where geographic comparisons are to be made and where approximate measures can serve the purpose. This is understandable as maps are unable to provide 100 percent accuracy.

USE OF VISUAL AIDS IN THE REPORT

We have earlier discussed the use of tables in presenting data and provided guidelines for their proper use. This was followed by graphic devices where some popular devices were illustrated. Now, we turn to the use of visual aids in research reports. There are four main reasons for use of visual aids.

People are Visually Minded

Right from our childhood we find there are visual influences in our every day life. We find books, road signs, advertisements, movies, and television. All these are visual stimulations that have some impression on our mind.

Retention is Increased

As compared to oral presentation of research report, visual aids, when used, will help the audience to retain in memory what has been shown. When the report is based only on verbalisation, it has been estimated that 90 percent of the message is either forgotten or misunderstood. In other words, retention is mearly 10 percent. As against this, if appropriate visual aids are used at right places in the report, retention increases to 50 percent.

Visualisation Encourages Organisation

Visual aids are quite helpful to the researcher while making the presentation. They will enable him to organise his thoughts in an orderly manner. Sometimes while presenting the report, the researcher may find difficulty in making his point clear. On such occasions if a proper visual aid is readily available, it helps the researcher in explaining the point in the right perspective.

Misunderstandings are Less Likely to Occur

As the research is presented orally, the use of visual aids at right places would avoid any misunderstanding to the audience which otherwise might have been caused.

Having realised that the use of visual aids would be proper while presenting the report, the researcher has to decide which visual aid/s should be used. There are a number of visual aids available from which he has to decide which one would be proper. Starting from traditional device of chalkboards and whiteboards to hand out materials, flip charts, overhead transparencies, slides, videotape equipment (VCR) and projectors can be thought of for use in presentation.

The researcher must take into account the nature and volume of data and the background of the audience. Even when there is no oral presentation, it is advisable to make use of audiovisual devices at suitable places in the report so that the report is not only well understood by the audience but it also makes a favorable impact on them.

EVALUATION OF THE RESEARCH REPORT

After the report has been submitted by the researcher, he should try to get the feedback on the same. In a number of cases, this will be available to him without his asking while in others he may have to ask for it specifically. Feedback will enable him to know the deficiencies of his report, both in regard to the subject-matter and the write-up. He should receive the feedback with an open mind, especially, if he attempts a revision of the study later, or to avoid any shortcomings and pitfalls especially in regard to the presentation of the subject-matter, in subsequent studies.

Apart from this feedback, a detailed evaluation of the research project should be undertaken. This evaluation should be done in as objective a manner as possible. Obviously, those involved in the preparation of the report or any of the research activity undertaken in connection with that research project should not be associated in its evaluation. Their association may bring in the subjective element in the evaluation, which may defeat the very purpose of this exercise.

To begin with, one has to ask a very important question—Does the report fulfil the objectives set out for research? Sometimes, it has been noticed that while taking up a research project some high-sounding objectives are included in it, but by the time the research is completed, one or more such objectives are either overlooked or diluted to a large extent.

The subsequent questions to be asked should be in conformity with the research process. There will be several questions—at least one in respect to each stage of the research process. *For example*, questions could be on the following lines:

1. Were the data sought in conformity with the actual requirements of the study?
2. Was the selection of the instrument used for the collection of data appropriate?
3. Was the data collection instrument properly designed?
4. Was the sample design used in the survey appropriate? Was the sample size adequate? How was the sample actually chosen?
5. Was there sufficient control in the survey when data collection was in progress?
6. Were the techniques used in the analysis of data appropriate?
7. Was the interpretation of data objectively done?
8. How was the written report? Did it faithfully report the findings of the study?

Answers to these and such related questions should be sought. It may be recalled that in *Chapter 4* on the research process, a number of errors that are likely to arise in research have been explained. One should examine how far the research report has been free from each of these errors. Likewise, if the study is exclusively based on experimentation, one should ascertain whether it is free from different types of experimental errors.

Despite the utmost care on the part of the research team, it is extremely difficult, if not impossible, to find a perfect research report. The point to emphasise is that errors or shortcomings should be noted down. These shortcomings should not occur in any subsequent research project. It is in this manner that an evaluation exercise can lead to an improvement in the quality of research. A sincere researcher will find considerable improvement in the quality of research undertaken by him over time.

Summary

This chapter has first dealt with 'interpretation', pointing out some of the major flaws that might occur in the interpretation of data. This is followed by a discussion on oral reports and the considerations relevant in oral reporting. The subsequent part of the chapter has focused on written reports.

First, different bases of classifying reports have been explained. This is followed by a brief account of various formats of reports. The need for a proper outline has been emphasised. There should be some flexibility in the outline so that, if necessary, it can be changed subsequently. A typical report outline based on a logical format along with a brief explanation of its contents has been given.

The subsequent discussion is centred on report writing. It has been mentioned that although report writing needs some skill which can be developed with practice, the broad principles of writing a report should be followed. Some of these principles are: objectivity, use of concrete style, coherence, impersonal reporting and clarity in the presentation of ideas. This is followed by a discussion on the use of tables, graphs and charts. First, guidelines in the use of tables have been given. As regards graphic devices, some specific principles have been explained. The discussion then focused on some charts, viz, line chart, stratum chart, bar chart, pie chart and pictogram, along with illustrations.

Finally, the need for obtaining a feedback on the report has been brought out. This will be extremely helpful in revising the report or in preparing another one.

Key Terms and Concepts

Questions

1. What are the major differences between oral and written reports?
2. What considerations are relevant in oral presentation?
3. What are the different bases of classifying reports? Are these mutually exclusive?
4. What are the advantages and disadvantages of using a chronological structure for report writing?

5. What are the advantages and disadvantages of using problem-analysis-solution structure for report writing?
6. How is an outline useful in the preparation of a research report?
7. Give a typical report outline.
8. What would you cover in the introduction of a research report?
9. What would you cover in the methodology section?
10. What are some of the important principles of writing a report?
11. Would you include the following in a research repot? Why or why not?
    (i) Limitations of the report
    (ii) Charts and diagrams
    (iii) Summary
    (iv) Issues for further investigation.
12. Why should objectives of the study be kept in mind when writing a research report?
13. What is the advantage of having a feedback on the report?
14. "Skills required for writing a good report are quite different from those required for conducting a good research." Comment.
15. "A research report containing excessive information is not a good report." Comment.
16. Two persons working on the same research project may prepare extremely different reports. How would you account for wide differences in their reports?
17. Select a marketing research study available to you. Examine it critically in the light of what you have just learnt. Identify its strengths and weaknesses and give your opinion on the quality of the report as a whole.
18. How would you evaluate a research report?
19. On the one hand, it is argued that the research report must be complete and, on the other, that it must be concise. Are these two objectives incompatible? If so, how do you reconcile them?
20. What are the key considerations in preparing an oral report?
21. Should the research report contain charts? Why or why not?
22. Given below are a few types of charts:
    Bar, Pie, Stratum and Line.
    Indicate, for what kinds of information they are appropriate.

CASE STUDY 1

QUANTUM RESEARCH*

A national chain specializing in men's wear is interested to set up an additional store in a metropolitan city. This city has a large population of about 35 lakh and the management thinks that three shopping centres would be suitable for the new location.

The management of the national chain is interested to know what type of people exhibit a particular pattern of buying behaviour. In particular, the management wants to know as to how buying behaviour is influenced by (1) the combined effect of income levels and personality characteristics, and (2) the association between income levels and shopping centre preference.

The management of the national chain hired the services of Quantum Research, a marketing research agency, to obtain the required information. As regards the association between income-level and shopping-centre preference, the marketing research agency developed the following table based on the data collected by it:

Table

Income level	**Preference for**		
(Rs.)	**Centre *A***	**Centre *B***	**Centre *C***
Low: Below Rs. 5000	80	42	15
Lower middle: Rs. 5000–10000	92	87	46
Upper middle: Rs. 10000–20000	54	130	78
High: More than Rs. 20000	24	65	132

Questions

Assuming yourself as a research executive in Quantum Research, answer the following:

1. What analytical technique(s) would you use in analysing the above data?
2. State the null hypothesis that you would like to test.
3. Run an analysis of the data using 0.05 level of significance.
4. What are your conclusions?

* On the lines of a case "Data Facts Research" in *Marketing Research* (7th edition) by David J. Luck and Ronald S. Rubin, Prentice-Hall of India, New Delhi, 1989, p. 471.

CASE STUDY 2

ANALYSIS OF DATA

A company is considering the introduction of a new scheme of health insurance for the benefit of its employees. However, before taking any final decision, it would like to know the reaction of its employees towards this scheme.

Since it has a large number of employees, the company has decided to collect some information from a sample of its employees. Information collected from 50 employees is shown in Exhibit 1. In the table:

1. Respondents are numbered 1 to 50.
2. Col. 2 indicates the new scheme. Respondents were asked to show their preference or dislike on a five-point scale. The values denote the preferences as follows:

Extremely interested	5
Interested	4
Indifferent	3
Not interested	2
Not at all interested	1

3. Sex—M: Male; F: Female
4. Marital Status—M: Married; S: Single
5. Age in years
6. Education: Four categories:

Below higher secondary	1
Higher secondary	2
Graduation	3
Post-graduation	4

7. Present arrangement. Four categories

Private doctor–own expenses	1
Government/Corporation Hospitals	2
Partial reimbursement from an outside agency	3
Full reimbursement from an outside agency	4

8. Monthly Income: Four categories

Less than Rs. 5000	1
Rs. 5000–12000	2
Rs. 12000–25000	3
Rs. 25000 +	4

You are now required to analyse the data.

Questions

1. Divide the sample into two groups: (a) those showing interest in the new scheme and (b) those who are either indifferent or not interested in the new scheme. Cross-tabulate these two groups along with education.

(i) higher education—graduation and above and
(ii) lower education—below graduation.

What is your finding? Is the association statistically significant at the 0.05 level?

2. Perform similar exercise to ascertain association between preference for new scheme and income level of respondents, taking the first income level in the poor class; second and third levels in the middle class; and the fourth one in the upper class.
3. If a third category with two groups—older respondents (40 years and above) and younger respondents (below 40 years) is added to the cross-tabulation arrived at in Q. 1 above, does the association undergo any change?
4. Suppose we give numerical values to sex and marital status as follows:

(i) Male 1
Female 2
(ii) Single 1
Married 2

Having done this, we consider concept rating

(i) as a criterion variable and all other variables as predictor variables. Now, perform an exercise on multiple regression and interpret the regression equation.
(ii) What is the value of R^2?
(iii) Ascertain whether each predictor variable is statistically significant at the 0.05 level?

Exhibit 1

Respondent	Concept rating	Sex	Marital status	Age (years)	Education	Present arrangement	Monthly income
1	3	M	M	25	1	2	1
2	2	M	M	27	3	2	2
3	2	F	S	28	3	3	3
4	5	M	S	24	4	1	4
5	3	M	M	30	2	2	2
6	1	M	S	35	2	3	3
7	2	F	M	39	2	3	2
8	4	F	S	37	4	1	3
9	4	M	M	36	3	1	3
10	2	F	M	29	3	2	2
11	3	M	S	41	1	2	1
12	1	M	S	43	1	1	2
13	2	M	M	40	2	1	1
14	5	F	M	31	3	3	4
15	4	M	S	35	3	1	3
16	3	F	S	45	2	2	3
17	2	F	M	46	1	1	1
18	4	M	S	38	3	1	2

Contd.

Respondent	Concept rating	Sex	Marital status	Age (years)	Education	Present arrangement	Monthly income
19	5	F	M	40	4	1	3
20	4	M	S	39	4	3	4
21	2	M	S	27	3	2	2
22	3	M	M	27	3	1	3
23	4	F	S	31	3	1	3
24	5	M	M	24	4	2	4
25	2	F	S	32	3	3	3
26	4	M	M	38	4	1	3
27	2	F	M	25	3	3	2
28	3	F	M	29	2	2	2
29	4	M	S	40	3	1	2
30	3	F	S	45	4	2	4
31	4	F	M	35	3	1	3
32	5	F	S	32	4	1	3
33	1	M	S	29	2	3	3
34	2	M	M	42	2	2	1
35	1	F	M	27	1	2	2
36	3	M	M	29	1	3	1
37	4	M	S	28	2	1	3
38	3	M	M	41	2	2	1
39	4	M	S	43	3	1	2
40	3	F	S	50	2	3	1
41	5	M	M	52	3	1	3
42	3	F	M	47	4	2	3
43	4	F	S	30	3	1	2
44	2	M	M	53	1	2	1
45	1	M	S	39	2	3	2
46	4	F	M	55	3	2	2
47	3	M	S	49	1	3	2
48	4	F	M	38	2	1	3
49	3	M	S	27	3	3	2
50	4	F	S	46	3	1	3

CASE STUDY 3

ENERGISING HERBAL TEA

A prominent Ayurvedic company, which is known for its medicines all over the country, has recently developed a herbal tea. It feels that normal tea is injurious to health, especially when taken in excessive quantity. Further, it is habit forming and gradually one gets addicted to it. It claims that its herbal tea is completely free from caffeine and its ingredients are genuine and their combined effect is very soothing to the nerves. A person, after taking a cup of herbal tea, feels relaxed.

Although the company has just developed this herbal tea, it has not introduced it in the market on a large scale. It is keen to place advertisements on television and newspapers but has delayed that. The company management wants to have solid evidence of the merits of its tea. It thinks an experiment is called for.

Question

Prepare an experimental design to ascertain the superiority of herbal tea over normal tea. Your experiment should identify clearly test units, dependent and independent variables, probable sources of extraneous variation on the dependent variable and methods of control of extraneous variables. Present your experimental design in symbols.

CASE STUDY 4

EVALUATING EXPERIMENTAL DESIGNS

Below are given two experimental designs. These designs relate to two different industries:

1. A textile manufacturing company has posted discount coupons along with its annual reports and financial accounts to all its shareholders. Each coupon indicates a 10 per cent rebate on the price of cloth which the shareholder purchases. The coupons have been mailed to shareholders on the basis of their shareholdings in the company at a certain specified proportion. Each coupon entitles its holder to purchase cloth worth Rs. 1000 from an authorised dealer. The company has sent the list of its authorised dealers along with the coupons. The validity of the coupons is six months, i.e., from 1st July to 31st December.

   The company has undertaken a survey of 5000 persons—2500 were its own shareholders and another 2500 were persons not holding any shares of the company. All these persons, who represented more or less the entire country, were asked to indicate how much amount they spent on cloth, separately, during two half-yearly periods: January to June, and July to December. As a result of this survey, the company is now in possession of data pertaining to amounts spent on cloth by the two groups of respondents for two time-periods.
2. A tea manufacturing company (call it ABC) has recently launched a vigorous advertising campaign to increase awareness and preference for its branded tea. The campaign is in the form of large advertisements given in the monthly magazine '*Readers Digest*' in six successive issues of the magazine.

   In order to evaluate the campaign, the company carried out a survey of 3000 readers of *Readers Digest*. It got the names and addresses of all subscribers from the Subscription Manager of *Readers Digest*. A random sample of 3000 readers was drawn from this list. A questionnaire was sent to these readers both before and after the campaign. They were asked to answer some questions.

Two of these questions were:

(i) Name (in order of importance) leading tea manufacturing companies in the country.

(ii) Which company would you consider first while purchasing packaged tea?

The following table shows data received on the basis of responses to these two questions:

	Before	**After**
Percentage aware of ABC Company	20	45
Percentage prefer ABC Company's packaged tea	15	20

It may be added that the ABC Company received responses from 800 readers before the advertising campaign and 710 readers after the advertising campaign. Thus, in the above table 'before' figures relate to 800 respondents while 'after' figures relate to 710 respondents.

Questions

Indicate in each case:

(a) What type of experiment is being envisaged?
(b) Identify factors affecting validity seriously.
(c) How would you overcome the problems identified by you and improve the experimental design?

CASE STUDY 5

A NEW BREAKFAST CEREAL*

A new breakfast food was developed by ABC company, which has been engaged in bringing out new items for breakfast. This breakfast food was a ready-to-eat cereal and was a different type of cereal flake. The company introduced it in the market as a substitute of cornflakes, which is a popular breakfast item.

The ABC company was expecting to have an extremely favourable response from the consumers. But the sale of this new breakfast cereal was much less than what the company expected at the time of launching it. This unfavourable, as also unexpected development, led the company to sponsor a research project. Accordingly, a research project was designed, the purpose of which was to measure the effect of more television advertising. As the company was already using normal advertising to promote the new product, it was obvious that the company would spend more than what it spent on normal advertising. It was decided to spend 10 per cent and 20 per cent more than the expenditure incurred on normal advertising. The company was to determine two things: (1) whether additional advertising is really effective in increasing the sale of the new product, and if so, (2) which level of television advertising would be most beneficial.

The company planned a test market exercise. The test was run in two cities which were similar to each other. In one city, 10 per cent more and in the second city 20 per cent more advertising expenditure was incurred. Two panels of consumer households, which were matched with demographic characteristics, were used. The size of each panel was 400. The test continued for a period of three months in city-1 and for six months in city-2. It may be noted that the same television commercial was used for the two cities. Incidentally, side by side the company was running its normal advertising which was for a period of six months.

The results obtained, both from normal advertising and the test market advertising, are given in the following table.

Table Number of Households that Purchased New Breakfast Cereal

Size of household	Normal advertising		10% more than normal advertising		20% more than normal advertising	
	Purchased	Did not	Purchase	Did not	Purchase	Did not
1–3	80	360	41	124	48	102
4–5	52	263	32	105	36	98
More than 5	18	227	7	91	26	90
Total	**150**	**850**	**80**	**320**	**110**	**290**

* On the lines of a case "Superior Food Products" in *Marketing Research* by Boyd, Westfall and Stasch, Richard D. Irwin, Line. Illinois, 1996, pp. 547–549.

Questions

1. Analyse the results of the experiment as given in the above table.
2. Which test of significance have you used and why?
3. What are your conclusions?

CASE STUDY 6

PROMOTION OF TOURISM

According to the World Trade Organisation (WTO), about 763 million tourists travelled internationally in 2004. The total amount spent by tourists all over the world was as high as US$ 622 billion in 2004. It is interesting to note that tourism accounts for a little over 12 per cent of total world exports and a little over 8 per cent of global employment.

Exhibit 1 gives information on foreign tourists and on foreign exchange earnings for the years 1997–98 to 2004–05. The performance of the tourism industry in India has improved. The number of foreign tourists who arrived in India rose from 23.71 lakh in 1997–98 to 36.38 lakh in 2004–05, registering a growth of 153 per cent. This increase is, no doubt, impressive, all the same there seems to be considerable scope for further improvement.

India Tourism Development Corporation (ITDC) is an official body set up to promote tourism in India. There is a general feeling that India is not one of the world's top holiday destinations and has a lot of catching up to do. It has also to remove a number of barriers, which force prospective foreign tourists to avoid India and visit other countries.

The ITDC is seriously considering a detailed study on promotion of tourism in India. The objectives of the proposed study would be:

(a) To prepare the profile of foreign tourists on the basis of some characteristics.
(b) To ascertain what are the expectations of foreign tourists and what is actually offered to them.
(c) To ascertain the major difficulties faced by foreign tourists in India.
(d) To invite their suggestions to overcome existing shortcomings so that the tourism industry may get a boost.

The ITDC has decided to sponsor this study with a leading marketing research agency, which has developed expertise in this area. You, being a researcher working with this marketing research agency, have been asked to take an overall responsibility of this study.

Exhibit 1 Foreign Tourist Arrivals

Year	Foreign tourists	Growth rate
	Number in million	
2003	2.7	14%
2004	3.4	25%
2005	3.9	15%
2006	4.4	13%
2007	5.0	12%
2008	5.1	6%

(*Source*: Ministry of Tourism, Government of India, Insdustry Report)

Questions

1. Design a suitable questionnaire for the field survey.
2. Describe the sample design, sample size and the break-up of sample size by locations to be covered.
3. Assuming that the information sought has been collected through a field survey, give a format which you would adopt in writing the report. You should provide a brief explanation for each chapter/section to be included in the report, indicating its relevance in the report.

CASE STUDY 7

ASSOCIATIVE RELATIONSHIPS

A company has been selling several electronic products for the last five years. It covers eight sales territories and employs a number of selling agents. In addition, it spends on advertising in all the territories. The table given below provides relevant data pertaining to its trade.

Sales territory	Sales (Lakh Rs.)	Advertising ('000 Rs.)	Number of selling agents
1	100	40	10
2	80	30	10
3	60	20	7
4	120	50	15
5	150	60	20
6	90	40	12
7	70	20	8
8	130	60	14

Questions

As the company is interested to know how its sales are affected by advertising and selling agents, you are asked to answer the following questions.

I
1. Compute the regression equation taking sales and number of selling agents as variables.
2. Compute the coefficient of determination and the correlation coefficient and explain their meaning.
3. Test whether or not correlation is significant using 0.05 level of significance.
4. Compare the standard error of estimate and the confidence limits for the regression line.
5. Interpret the various measures that have been computed and indicate what value, if any, they might have in predicting sales.

II
1. Now involving another variable (advertising), compute the multiple regression equation. Explain how it can be used to predict sales.
2. Compute the coefficient of multiple determination and explain its meaning.
3. Test whether or not the coefficient of multiple determination is significant. Use 0.5 level of significance.
4. Do you think that multicollinearity is present in this problem? Explain.

CASE STUDY 8

BOOMING MEDICAL TOURISM IN INDIA

According to RINCOS's 2009 report, the Indian medical tourism is emerging as one of the most attractive medical tourism destinations in the world. This is evident from the fact that around 570,000 patients came to the country in 2008 and brought US$ 880 million. Most of the tourists coming to India are from the developed countries such as the US and UK.

The biggest factor driving patients to seek healthcare in India is the fact that the country provides first world treatments at third world cost. Many private hospitals such as Apollo and Wockhardt have infrastructure and expertise at par with those available in the West, but cost 60%–95% lower than these in the West.

A leading hospital in Delhi has been having a good inflow of foreign patients for the past couple of years. It also expects that the number of such patients would further grow in the coming years. At the same time, it wants to know the feedback of patients as to what they think about the quality of treatment and other related services. The hospital is also interested to know how far the patients feel satisfied.

Questions

1. How would you organise a survey of foreign patients on various items that concern them?
2. Prepare a comprehensive itemwise scale for this purpose.

CASE STUDY 9

DESCENT PAINT COMPANY*

The Descent Paint Company is one of the prominent paint companies in the country. It manufactures a general line of exterior and interior paints that are sold to three categories of buyers: Contractors, industrial users and retail building supply dealers. As the company's sales have been declining in recent years, the management is concerned with further erosion. In order to arrest this decline in sales, management has decided to utilise a "pull" advertising strategy to build up consumer demand. As a result of increased consumer demand, the retailers would maintain sufficient stock of paints.

Having decided to use this advertising strategy, management contacted a T.V. channel to run a commercial over a period of two weeks. It was suggested to management that a control test of the awareness of the company's products be made before the commercial is to be aired. This will enable management to make a comparison after promotional effort.

The results of the promotional compaign are presented in the following table:

Awareness of Descent Paint Company		
Percentages Before and After the T.V. Campaign		
	Before T.V Campaign	**After T.V. Campaign**
Previous purchasers	60	88
Non-purchasers	28	46

Question

1. Using the absolute difference in percentages method, which customer group showed the larger increase in awareness?
2. Using the relative difference in percentages method, which customer group showed the larger increase in awareness?
3. Using the percentage of possible change in percentages method, which customer group showed the larger increase in awareness?
4. Having used the three different ways of using percentage changes, which method would you recommend? Why?
5. What are some of the problems involved in the other two methods you did not recommend?

* On the lines of case No. 15-4 in *Marketing Research* by David J. Luck and Ronald S. Rubin, Prentice Hall of India, New Delhi, September 1989, pp. 412-413.

CASE STUDY 10

CADBURY PERK'S BRAND

Cadbury Perks, when it began its journey in 1996 ,displayed deliverance of brand promise. It created a new demand in the market for wafer-choolates in India tipped against Nestle's Kitkat. However, with the entry of Nestle's Munch, it had to face competitive challenges.

As the target group for the chocolate segment comprises the youth aged 14–18 years old, Cadbury is thinking how to reach this target group. It has also to ascertain the best positioning of its product in the market.

Questions.

1. What is the role of marketing research in determining the best positioning strategy for Cadbury?
2. What kind of data would be helpful in determining a positioning strategy?
3. Do you think that in this case a survey needs to be undertaken? If yes, which survey method would you recommend and why?
4. Design a questionnaire for the survey.
5. What sample would you take?
6. How the survey will be carried out to show position of Cadbury vis-à-vis Nestle in the chocolate market?

4

Selected Applications and Ethical Issues

21 Sales Analysis and Forecasting

Learning Objectives

After reading this chapter, you should be able to understand:

- Sales Analysis
- The Concept of Market Potential
- Methods of Estimating Current Demand
- Forecasting
- Methods of Forecasting
- The Choice of Forecasting Model

SALES ANALYSIS

The term 'sales analysis' refers to the analysis of actual sales results. This is different from 'sales forecasting' as it is concerned with the actual performance of sales and not with what they are likely to be at a future date.

Since sales analysis enables a company to identify the areas where its sales performance has been good or mediocre, customers who have bought in bulk, products with high and low sales volume, etc., it is in the interest of the company to analyse its sales periodically. A systematic, comprehensive and periodical sales analysis will be helpful to a company to reinforce its sales effort where it is most needed. In this way, it can achieve the best possible results.

Our discussion of sales analysis is on the basis of four major types, viz., by territory, by product, by customer, and by size of order.

Sales Analysis by Territory

In order to undertake sales analysis by territory one must decide on (i) the territorial unit to be taken for such an analysis, and (ii) what specific information should be collected for this purpose. As regards the territory, the district level is the appropriate choice. Later on, by pooling district data, one may undertake a state or region-wise analysis, depending on one's need. As regards the data, information on the product sold, such as quantity, price per unit, and total value should be available. This information along with the name and address of the customer is available in the invoice. Thus it provides the essential data on sales and it is not necessary to collect any data separately. However, if additional information is needed, it can be collected through the invoice by incorporating additional items in it.

Once the territory-wise sales data are available, it is possible to compare these with the previously set sales targets. By such a comparison, territories where actual sales have fallen below the sales targets, can be identified. One may probe further into the possible reasons for this poor performance. Is it because these territories face severe competition? Or because sufficient sales effort has not been made in these territories? Answers to these questions will enable the company to boost its sales in weak territories.

Sales Analysis by Product

Sales analysis by product will enable a company to identify its strong or weak products. It is advisable to undertake an analysis on the basis of a detailed break-up of products such as product variation by size, colour, etc. This is because if an analysis is based on a broad breakup, it may not reveal important variations.

When a company finds that a particular product is doing poorly, two options are open to it. One is, it may concentrate on that product to ensure improved sales. Or alternatively, it may gradually withdraw the product and eventually drop it altogether. However, it is advisable to decide on the latter course on the basis of additional information such as trends in the market share, contribution margin, effect of sales volume on product profitability, etc. In case the product in question has complementarity with other items sold by the company, the decision to abandon the product must be made with care and caution.

Combining sales analysis by product with that by territory will further help in providing information on which products are doing better in which areas.

Sales Analysis by Customers

Another way to analyse sales data is by customers. Such an analysis would normally indicate that a relatively small number of customers accounts for a large proportion of sales. To put it differently: a large percentage of customers accounts for a relatively small percentage of aggregate sales. One may compare the data with the proportion of time spent on the customers, i.e., the number of sales calls. An analysis of this type will enable the company to devote relatively more time to those customers who collectively account for proportionately larger sales.

Sales analysis by customer can also be combined with analysis both by area and product. Such an analysis will prove to be more revealing. For example, it may indicate that in some areas sales are not increasing with a particular type of customer though they have grown fast in other areas. Information of this type will be extremely useful to the company as it identifies the weak spots where greater effort is called for.

Sales Analysis by Size of Order

Sales analysis by size of order may show that a large volume of sales is accompanied by low profit and vice versa. In case cost accounting data are available by size of order, this would help in identifying sales where the costs are relatively high and the company is incurring a loss. Sales analysis by size of order can also be combined with that by products, areas and types of customers. Such a perceptive analysis would reveal useful information to the company and enable it to make a more rational and effective effort in maximizing its return from sales.

THE CONCEPT OF MARKET POTENTIAL

Market potential has been defined as "the maximum demand response possible for a given group of customers within a well-defined geographic area for a given product or service over a specified period of time under well-defined competitive and environmental conditions."[1]

We will elaborate this comprehensive definition. First, market potential is the maximum demand response under certain assumptions. It denotes a meaningful boundary condition on ultimate demand.

Another condition on which the concept of market potential depends is a set of relevant consumers of the product or service. It is not merely the present consumer who is to be included but also the potential consumer as maximum possible demand is to be achieved. Market potential will vary depending on which particular group of consumers is of interest.

Further, the geographic area for which market potential is to be determined should be well-defined. It should be divided into mutually exclusive subsets of consumers so that the management can assign a sales force and supervise and control the activities in different territories without much difficulty.

Another relevant aspect in understanding the concept of market potential is to clearly know the product or service for which market potential is to be estimated. Especially in those cases where the product in question can be substituted by another, it is desirable to have market potential for the product class rather than that particular product. For example, tea is subjected to a high degree of cross-elasticity of demand with coffee.

It is necessary to specify the time period for which market potential is to be estimated. The time period should be so chosen that it coincides with planning periods in a firm. Both short and long-time periods can be used depending on the requirements of the firm.

Finally, a clear understanding of environmental and competitive conditions relevant in case of a particular product or service is necessary if market potential is to be useful. What is likely to be the external environment? What is likely to be the nature and extent of competition? These are relevant questions in the context of any estimate of market potential since these are the factors over which the firm has no control.

It may be emphasised that market potential is not the same thing as sales potential and sales forecast. It is only when "a market is saturated can the industry sales forecast be considered equivalent to market potential."[2] Such a condition is possible in case of well established and mature products. Generally, the industry sales forecast will be less than the market potential. Likewise, a company's sales forecast will be less than its sales potential. The former is a point estimate of the future sales, while the latter represents a boundary condition which the sales might reach in an ideal situation. "In the latter sense, sales potential is to a firm what market potential is to an industry or product class: both represent maximum demand response and are boundary conditions."[3]

[1] *Handbook of Marketing Reasearch*, Robert Ferber (Ed.), McGraw-Hill Book Company, New York, 1974.

[2] *Ibid*., pp. 4–87.

[3] Ibid., pp. 4–84.

METHODS OF ESTIMATING CURRENT DEMAND

There are two types of estimates of current demand which may be helpful to a company. These are: total market potential and territory potential. "Total market potential is the maximum amount of sales that might be available to all the firms in an industry during a given period under a given level of industry marketing effort and given environmental conditions."[4]

Symbolically, total market potential is:

$$Q = n \times q \times p$$

where Q = total market potential
n = number of buyers in the specific product/market under the given assumptions
q = quantity purchased by an average buyer
p = price of an average unit

Of the three components n, q and p in the above formula, the most difficult component to estimate is q. One can start with a broad concept of q, gradually reducing it. For example, if we are thinking of readymade shirts for home consumption, we may first take the total male population eliminating that in rural areas. From the total male urban population, we may eliminate the age groups which are not likely to buy readymade shirts. Thus, the number of boys below 20 may be eliminated. Further eliminations on account of low income may be made. In this way we can arrive at the 'prospect pool' of those who are likely to buy shirts.

The concept of market potential is helpful to the firm as it provides a benchmark against which actual performance can be measured. In addition, it can be used as a basis for allocation decisions regarding marketing effort.

The estimate of total market potential is helpful to the company when it is in a dilemma whether to introduce a new product or drop an existing one. Such an estimate will indicate whether the prospective market is large enough to justify the company's entering it.

Since it is impossible for a company to have the global market exclusively to itself, it has to select those territories where it can sell its products well. This means that companies should know the territorial potentials so that they can select markets most suited to them, channelise their marketing effort optimally among these markets and also evaluate their sale performance in such markets.

There are two methods for estimating territorial potentials: (i) market-buildup method, and (ii) index-of-buying-power method. In the first method, several steps are involved. First, identify all the potential buyers for the product in each market. Second, estimate potential purchases by each potential buyer. Third, sum up the individual figures in step (ii) above. However, in reality the estimation is not that simple as it is difficult to identify all potential buyers. When the product in question is an industrial product, directories of manufacturers of a particular product or group of products are used. Alternatively, the Standard Industrial Classification of Manufacturers of a particular product or group of products is used.

The second method involves the use of a straight forward index. Suppose a textile manufacturing company is interested in knowing the territorial potential for its cloth in a certain territory. Symbolically,

$$B_i = 0.5Y_i + 0.2r_i + 0.3p_i$$

[4] Kotler, Philip: *Marketing Management: Analysis, Planning*, *Implementation and Control*, New Delhi, Prentice-Hall of India Pvt. Ltd., June 1991 (Indian reprint), p. 246.

where B_i = percentage of total national buying power in territory i
Y_i = percentage of national disposable personal income originating in territory i
r_i = percentage of national retail sales in territory i
p_i = percentage of national population living in territory i

It may be noted that such estimates indicate potential for the industry as a whole rather than for an individual company. In order to arrive at a company potential, the concerned company has to make certain adjustments in the above estimate on the basis of one or more other factors that have not been covered in the estimation of territorial potential. These factors could be the company's brand share, number of salespersons, number and type of competitors, etc.

MARKET POTENTIAL

It may be noted that though market potential and sales forecast are sometimes used interchange-ability, they are not the same thing. Market potential refers to total sales possibilities. As such, there may be different potentials depending on what conditions are assumed.

Market potential is very helpful to a company in augmenting its sales function. There are three major uses of potentials that are explained below.

1 Allocation of Marketing Resources: Market potential can be used in the allocation of marketing resources in particular, allocation of salesmen. For example, a company's product is being sold in a number of markets. After ascertaining one or two markets where potential is very high, the company must focus on those markets and make an optimum allocation of its sales resources. However, a careful study of the potential should have been done before allocation of resources.

2. Defining sales Territories: A sales manager tries to develop sales territories based on sales potential so that salesmen have an equal opportunity to make sales. Initially, sales territories may not be well-defined. After some time the company, on the basis of experience gained, may develop workload measures in accordance with sales potential. This can serve as the basis for designing sales territories.

3. Setting Sales Quotas: Having designed sales territories on the basis of potential for each territory, the company can now set sales quota for each territory. This will enable the company to use an improved measure of the performance of salesmen instead of using the old rule, i.e. last year's sales plus a specified percentage say 5 percent.

While sales potential is the most important factor in setting sales quotes, other factors that are relevant should not be ignored. When the manager sets sales quotas for salesmen under his charge, a complex interpersonal relationship between him and the salesmen is formed. He should exercise sufficient care in setting such quotas that would stimulate salesmen to put up their best effort to attain their respective sales targets. Salesmen must be convinced that the manager has set sales quotas very objectively and no one has been given an undue advantage.

Figure 21.1 illustrates the relationship between market potential, market forecast, and market demand function. Market demand is shown to be a function of the level of industry marketing effort plus a given environment. A market forecast is shown to be the level of market demand given on expected level of industry marketing effort and an *assumed* environment. Market potential then becomes the *limit* approached by market demand within an assumed environment as industry marketing effort approaches infinity. Market potential therefore establishes an upper limit to market demand, while a market forecast specifies the expected level of market demand for a particular time period.

Market demand concepts and terminology: Market demand as a function of industry marketing effort

(a) assumes a particular environment
(b) two different environments assumed.

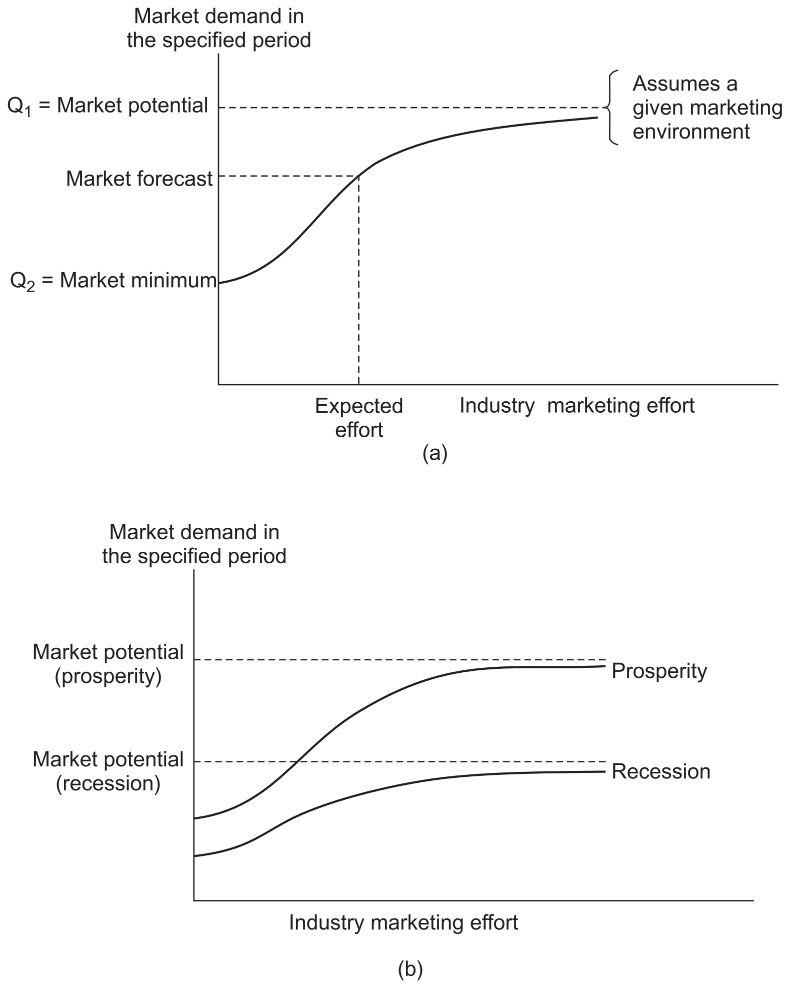

Fig. 21.1

(Source: Philip Kotler, *Marketing Management*, 4th edition, Prentice-Hall, 1980, p. 216)

FORECASTING

The discussion so far related to various aspects of time series analysis. We now look into another related aspect, *viz*., forecasting. Let us start with the question: Why is forecasting necessary?

The Importance of Forecasting

As we all know that economic and business conditions do not remain the same over time. In view of changes in economic and business conditions, it becomes necessary for management to keep itself abreast of the effects that such changes are likely to have on their organisations. In the absence of realistic forecasts, management may find itself placed in an adverse situation resulting into losses. In fact, the need for forecasting is felt in other spheres as well. For example, take the case of the government. It has to make forecasts in respect of population growth, employment, revenues, etc., so that it can formulate appropriate policies for good governance. In the field of education too, forecasting is important. In the absence of forecasting, educationists are unable to plan for the future. This will have an adverse impact on the quality of education as they would be ill-equipped to provide adequate number of teaching and administrative staff as well as physical facilities. In short, we find that forecasting is quite necessary for planning for the uncertain future in different areas of the economy.

It is worthwhile at this stage to know the actual process of forecasting.

Forecasting Process

There are five steps involved in the forecasting process.

First, one has to decide the objective of the forecast. The statistician should know as to what will be the use of the forecast he is going to make.

Second, the time period for which the forecast is to be made should be selected. Is the forecast short-term, medium-term or long-term? Why should a particular period of forecast be selected?

Third, the method or technique of forecasting should be selected. One should be clear as to why a particular technique from amongst several techniques should be used.

Fourth, the necessary data should be collected. The need for specific data will depend on the forecasting technique to be used.

Finally, the forecast is to be made. This will involve the use of computational procedures.

In order to ensure that the forecast is really useful to the company, there should be good understanding between management and the analyst who is to make the forecast. The management should clearly spell out the purpose of the forecast and how it is going to help the company. It should also ensure that the analyst has a proper understanding of the operations of the company, its environment, past performance in terms of key indicators and their relevance to the future trend. If the analyst is well-informed with respect to these aspects, then he is likely to make more realistic and more useful forecast for the management.

METHODS OF FORECASTING

Figure 21.2 shows different methods of forecasting.

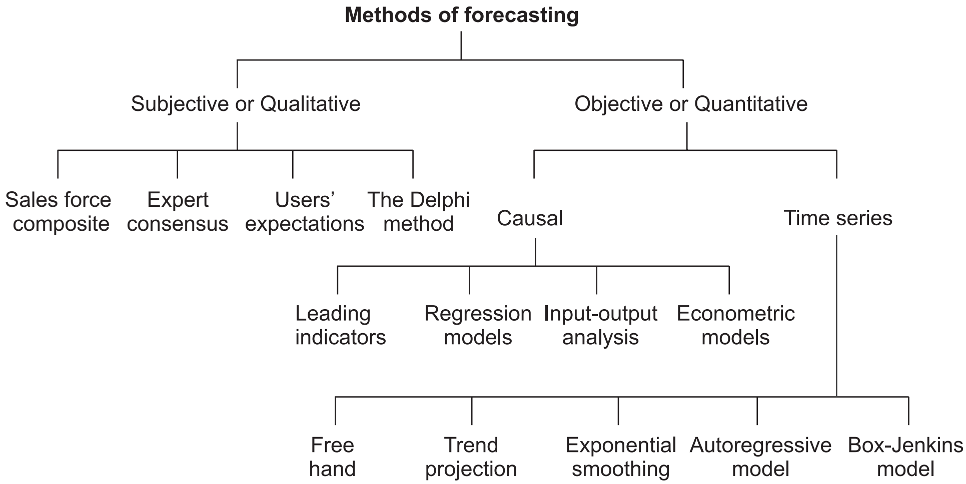

Fig. 21.2 Methods of Forecasting

The methods of forecasting can be divided into two broad categories viz., subjective or qualitative methods and objective or quantitative methods. These can be further divided into several methods. Each of these methods is discussed below.

Subjective Methods

In the subjective methods, judgement is an important ingredient. Before attempting a forecast, the basic assumptions regarding environmental conditions as also competitive behaviour must be provided to people involved in forecasting. An important advantage of subjective methods is that they are easily understood. Another advantage is that the cost involved in forecasting is quite low.

As against these advantages, subjective methods have certain limitations also. One major limitation is the varying perceptions of people involved in forecasting. As a result, wide variance is found in forecasts. Subjective methods are suitable when forecasts are to be made for highly technical products which have a limited number of customers. Generally, such methods are used for industrial products. Also, when cost of forecasting is to be kept minimum, subjective methods may be more suitable.

There are four subjective methods—field sales force, jury of executives, users' expectations and the Delphi method. These are discussed here briefly, the focus being on company sales forecasts.

Field Sales Force Some companies ask their salesmen to indicate the most likely sales for a specified period in the future. Usually the salesman is asked to indicate anticipated sales for each account in his territory. These forecasts are checked by district managers who forward them to the company's head office. Different territory forecasts are then combined into a composite forecast at the head office. This method is more suitable when a short-term forecast is to be made as there would be no major changes in this short period affecting the forecast. Another advantage of this method is that it involves the entire sales force which realizes its responsibility to achieve the target it has set for itself. A major limitation of this method is that sales force would not take an overall or broad perspective and hence may overlook some vital factors influencing the sales. Another limitation is that salesmen may give somewhat low figures in their forecasts thinking that it may be easier for them to achieve those targets. However, this can be offset to a certain extent by district managers who are supposed to check the forecasts.

Jury of Executives Some companies prefer to assign the task of sales forecasting to executives instead of a sales force. Given this task each executive makes his forecast for the next period. Since each has his own assessment of the environment and other relevant factors, one forecast is likely to be different from the other. In view of this, it becomes necessary to have an average of these varying forecasts. Alternatively, steps should be taken to narrow down the differences in the forecasts. Sometimes this is done by organising a discussion between the executives so that they can arrive at a common forecast. In case this is not possible, the chief executive may have to decide which of these forecasts is acceptable as a representative one.

This method is simple. At the same time, it is based on a number of different viewpoints as opinions of different executives are sought. One major limitation of this method is that the executives' opinions are likely to be influenced in one direction on the basis of general business conditions.

Users' Expectations Forecasts can be based on users' expectations or intentions to purchase goods and services. It is difficult to use this method when the number of users is large. Another limitation of this method is that though it indicates users' 'intentions' to buy, the actual purchases may be far less at a subsequent period. It is most suitable when the number of buyers is small such as in case of industrial products.

The Delphi Method This method too is based on the experts' opinions. Here, each expert has access to the same information that is available. A feedback system generally keeps them informed of each others' forecasts but no majority opinion is disclosed to them. However, the experts are not brought together. This is to ensure that one or more vocal experts do not dominate other experts.

The experts are given an opportunity to compare their own previous forecasts with those of the others and revise them. After three or four rounds, the group of experts arrives at a final forecast.

The method may involve a large number of experts and this may delay the forecast considerably. Generally it involves a small number of participants.

It will be seen that both the jury of executive opinion and the Delphi method are based on a group of experts. They differ in that in the former, the group of experts meet, discuss the forecasts, and try to arrive at a commonly agreed forecast while in the latter the group of experts never meet. As mentioned earlier, this is to ensure that no one person dominates the discussion thus influencing the forecast. In other words, the Delphi method retains the wisdom of a group and at the same time reduces the effect of group pressure. An approach of this type is more appropriate when long-term forecasts are involved.

Table 21.1 Selected Subjective Methods of Forecasting

	Sales Force Composite	**Expert Consensus**	**Delphi Method**
Description	Sales representatives make estimates of sales by product to each customer and potential customer. These are aggregated to obtain an overall forecast by product.	Experts makes individual forecasts from which a consensus is reached through discussion.	Forecasts made by experts are provided to all forecasters without disclosing their identity. This process is repeated until consensus is reached.

Contd.

Accuracy short and Medium Term (Up to one year)	Good	Poor to good	Fair to very good
Long term (More than one year)	Poor	Poor to fair	Fair to very good
Data required	Data on past sales for the appropriate period for each customer of the sales representative.	Only those data requested by individual forecasters and data requested during the meeting held to reach the consensus.	Individual responses are consolidated and provided to a group of experts
Typical applications	Next-quarter and annual sales forecast by product.	Next-quarter, annual and long-range sales forecasts.	Annual and long range forecasts of existing and new products.

(Adapted from Table 21-1 in Tull Donald S. and Del I.Hawkins: *Marketing Research- Measurement Method*, Prentice-Hall of India, New Delhi, 1998, p.706.)

Quantitative or Objective Methods

These methods can be divided into two broad categories namely:

1. Causal or Explanatory Methods
2. Time Series forecasting

We first discuss causal or explanatory methods.

Causal or Explanatory Methods

Causal or explanatory methods are regarded as the most sophisticated methods of forecasting. These methods yield realistic forecasts provided relevant data are available on the major variables influencing changes in sales. There are three distinct advantages of causal methods. First, turning points in sales can be predicted more accurately by these methods than by time-series methods. Second, the use of these methods reduces the magnitude of the random component far more than it may be possible with the time-series methods. Third, the use of such methods provides greater insight into causal relationships. This facilitates the management in decision making.

Causal methods are briefly discussed here.

Leading Indicators Sometimes one finds that changes in sales of a particular product or service are preceded by changes in one or more leading indicators. In such cases, it is necessary to identify leading indicators and to closely observe changes in them. One example of a leading indicator is the demand for various household appliances which follows the construction of new houses. Likewise, the demand for many durables is preceded by an increase in disposable income. Yet another example is of number of births. The demand for baby food and other goods for infants can be ascertained by the number of births in a territory. It may be possible to include leading indicators in regression models.

Regression Models Linear regression analysis is perhaps the most frequently used and the most powerful method among causal methods. As we have discussed regression analysis in detail in Chapters 16 and 18, here we shall only dwell on a few relevant points.

1. Regression models indicate linear relationships within the range of observations and at the times when they were made. For example, if a regression analysis of sales is attempted on the basis of independent variables of population sizes of 15 million to 30 million and per capita income of Rs. 1000 to Rs. 2500, the regression model shows the relationships that existed between these extremes in the two independent variables. If the sales forecast is to be made on the basis of values of independent variables falling outside the above ranges, then the relationships expressed by the regression model may not hold good.
2. Sometimes there may be a lagged relationship between the dependent and independent variables. In such cases, the value of dependent variables are to be related to those of independent variables for the preceding month or year as the case may be. The search for factors with a lead-lag relationship to the sales of a particular product is rather difficult. One should try out several indicators before selecting the one which is most satisfactory.
3. It may happen that the data required to establish the ideal relationship, do not exist or are inaccessible or, if available, are not useful. Therefore, the analyst has to be careful in using the data. He should be quite familiar with the varied sources and types of data that can be used in forecasting. He should also know about their strengths and limitations.
4. Finally, regression model reflects the association among variables. The causal interpretation is done by the analyst on the basis of his understanding of such an association. As such, he should be extremely careful in choosing the variables so that a real causative relationship can be established among the variables chosen.

Input-output Analysis Another method that is used for forecasting is the input-output analysis. Here, the analyst takes into consideration a large number of factors, which affect the outputs he is trying to forecast. For this purpose, input-output table is prepared where the inputs are shown horizontally as the column headings and the outputs vertically as the stubs. It may be mentioned that by themselves input-output flows are of little direct use to the analyst. It is the application of an assumption as to how the output of an industry is related to its use of various inputs that makes an input-output analysis a good method of forecasting. The assumption states that as the level of an industry's output changes, the use of inputs will change proportionately, implying that there is no substitution in production among the various inputs. This may or may not hold good.

The use of input-output analysis in sales forecasting is appropriate for products sold to governmental, institutional and industrial markets as they have distinct patterns of usage. It is seldom used for consumer products and services. It would be most appropriate when the levels and kinds of inputs required to achieve certain levels of outputs need to be known.

A major constraint in the use of this method is that it needs extensive data for a large number of items which may not be easily available. Large business organisations may be in a position to collect such data on a continuing basis so that they can use input-output analysis for forecasting. However, this is not possible in case of small industrial organisations on account of excessive costs involved in the collection of comprehensive data.

Econometric Models Econometric is concerned with the use of statistical and mathematical techniques to verify hypotheses emerging in economic theory. An econometric model incorporates functional relationships estimated by these techniques into an internally consistent and logically self-contained framework. The use of econometric models is generally found at the macro level such as forecasting national income and its components. Such models show how the economy or any of its specific segment operates. As compared to an ordinary regression equation, they bring out the causalities involved more distinctly. This merit of econometric models enables them to predict turning points more accurately. However, their use at the micro-level for forecasting has so far been extremely limited.

Table 21.2 Selected Causal Methods of Forecasting

	Regression Model	Econometric Model	Leading Indicators
Description	An equation relating sales to predictor variables is derived using multiple regression analysis	A system of interrelated regression equation used to forecast sales or profits	Analysis of several factors: Overall economic environment, advertising expenditure, market potential and offtake of durable goods
Accuracy Short and Medium term (Upto one year)	Fair to very good	Fair to very good	Fair to good
Long term (More than one year)	Poor to fair	Poor to good	Poor to fair
Data required	Sales and values of predictor variables by region over time	Similar to data required for regression model	Most recent data on several items as listed above
Typical applications	Forecasts of brand and product line sales	Forecasts of industry sales and economic changes	Forecasts of brand and product line sales.

(Adapted from Table 21-7 in Tull, Donald S. and Del I. Hawkins, *Marketing Research – Measurements & Methods*, Prentice-Hall of India, New Delhi, p. 723)

Time Series Forecasting

Having briefly looked into causal or explanatory methods of forecasting, we now turn to the time series forecasting.

Freehand Method One of the methods of getting a secular trend is the freehand method. It may be mentioned that it is the simplest method of finding the trend line, which is simply extended for forecast. It is highly subjective method as the trend line fitted to the same set of data will vary from one person to another as such it is the most inappropriate method to be used for forecasting.

Trend Projection Another method is the method of least squares in fitting the trend. Earlier in Chapter 16, while dealing with regression analysis the least squares method was discussed. The trend is forecast simply by substituting the appropriate value of t (i.e., the year for which the forecast is desired) in the least squares line. In case the data are monthly or quarterly, this value is to be multiplied by the seasonal index. Finally, we measure the cyclical component and try to ascertain what it is likely to be at the point for which the forecast is being made. We multiply this component to obtain TSC. Since the irregular movements cannot be forecast as they are random fluctuations, we forecast the three "regular" components T, S and C.

This method of least squares is far superior though we must remember that all forecasts into the future are based on the assumption that the characteristics displayed by the existing data will continue to influence future values. If this assumption does not hold, even with statistics proving a good fit to known data, forecasts could be most inaccurate.

We now discuss the other three-time series methods of forecasting which are being increasingly used in recent times. These are Exponential Smoothing, Autoregressive method and Box-Jenkins model. This discussion will be followed by the discussion on Measuring the Forecasting Error. Finally, the chapter will end with a discussion on the choice of a Forecasting Model, which undoubtedly is very important for obtaining realistic forecasts.

Exponential Smoothing A method which is often useful in forecasting time series is exponential smoothing. When a large number of forecasts are to be made for a number of items, exponential smoothing is particularly suitable as it combines the advantages of simplicity of computation and flexibility. It may be used for short-term forecasts (one period into the future) particularly when there is no long-term trend in a time series data or when the trend is not clear.

This method uses differential weights to time-series data. The heaviest weight is assigned to the most recent data and the least weight to the most remote data in the time series. It is a type of moving average that 'smooths' the time-series of its sharp variations.

The formula used for exponential smoothing is based on three terms:

(i) The present observed value of the time series Y.

(ii) The previous computed exponentially smoothed value E_{i-1}

(iii) A subjectively assigned weighting factor or smoothing coefficient W.

Thus, the formula is

$$E_i = WY_i + (1 - W)\, E_{i-1}$$

where E_i = value of the exponentially smoothed series being computed in time period i

E_{i-1} = value of the exponentially smoothed series computed in the preceding time period i–1

Y_i = observed value of the time series in period i

W = subjectively assigned weight whose value is between 0 and 1.

It should be evident from the above formula that the weighing factor or smoothing coefficient affects the results substantially. As such we have to select it very carefully. In case our purpose is served just by eliminating unwanted cyclical and irregular fluctuations, a small value of smoothing coefficient should be preferred. On this basis the more recent values will have low weightage and exponentially smoothed value will have higher weightage. In case our purpose is forecasting, a higher value of smoothing coefficient should be preferred as it will give a higher weightage to the more recent values and a lower weightage to the exponentially smoothed value.

In order to explain the actual process used in exponential smoothing, let us take an example.

Example Sales data of a firm for the years 1995 to 2000 are given below:

Years	Sales (million Rs)
1995	15
1996	24
1997	15
1998	20
1999	22
2000	28

Let us select $W = 0.5$ and another $W = 0.3$. We will use these weights so that we will get two series of exponentially smoothed values.

The exponentially-smoothed value for 1995, i.e., first year E_1 is simply the observed value for that year, being 15. In other words, E_1 is 15. Now, for subsequent years calculations are given below:

1996 $\quad E_2 = WY_2 + (1 - W)\, E_1$
$= (0.5)\,(24) + (1 - 0.5)\, 15$
$= 12 + 7.5$
$=$ Rs. 19.5 million

1997 $\quad E_3 = WY_3 + (1 - W)\, E_2$
$= (0.5)\,(15) + (1 - 0.5)\,(19.5)$
$= 7.5 + 9.75$
$=$ Rs. 17.25 million

This process will continue until we calculate the exponentially smoothed values for the latest year. In the same manner calculations have been done with smoothing coefficient $W = 0.3$. The following table shows the exponentially smoothed values along with the original time series.

Table Exponentially Smoothed Values of Sales of a Business Firm

Year	Sales (million Rs)	W = 0.5	W = 0.3
1995	15	15.00	15.00
1996	24	19.50	17.70
1997	15	17.25	16.89
1998	20	18.63	17.82
1999	22	20.32	19.07
2000	28	24.16	21.75

In order to forecast sales for the year 2001, we will take the smoothed value for the latest year in the time series (2000) as its estimate. Symbolically, $\hat{Y}_i + 1 = E_i$. For a smoothing coefficient of 0.5 that projection is 24.16 million rupees and for a smoothing component of 0.3 it is 21.75 million rupees.

Autoregressive Model Another approach to forecasting with annual time series data involves the fitting of an autoregressive model. Sometimes, the values of a time series data are highly correlated with the values that preced and succeed them. In such cases an autoregression model is used for forecasting.

A first-order autocorrelation refers to the magnitude of the association between consecutive values while a second-order autocorrelation refers to the magnitude of the relationship between values wich are two periods apart.

The first-order autoregressive model may be expressed as:

$$\hat{Y}_i = b_0 + b_1\, Y_{i-1}$$

The second-order autoregressive model may be expressed as:

$$\hat{Y}_i = b_0 + b_1\, Y_{i-1} + b_2\, Y_{i-2}$$

It will be seen from the above two models that the first-order autoregressive model is similar to the simple linear regression, while the second-order autoregressive model is similar to the multiple regression having two explanatory variables.

Similarly, we can have the pth-order autoregressive model which may be expressed as:

$$\hat{Y}_i = b_0 + b_1 Y_{i-1} + b_2 Y_{i-2} + \cdots + b_p Y_{i-p}$$

The p^{th}-order autoregressive model deals with relationships between values up to p periods apart.

A question that is very relevant here is: How can we decide as to which model will be the most appropriate? It is rather difficult to know this. We must weigh the advantage of simplicity against the possibility of overlooking an important autocorrelation behaviour that may exist in the data. On the other hand, we must be equally concerned with choosing a high-order model estimation of several parameters, which may be unnecessary particularly when the total number of observations in the time series is not large. This is understandable because when we choose, for example, a second-order model, then there is a loss of first two observations. Each higher-order will involve a loss of one additional observation. In view of this, one should be careful in deciding which order of model should be used. It may be noted that a statistical software package is invariably used to calculate the values of parameters in autoregressive models.

Box-Jenkins Method We may now briefly describe the Box-Jenkins method of forecasting, which uses a very different approach than what we have discussed so far. First of all, the analyst identifies a tentative model considering the nature of the past data. This tentative model and the data are entered in the computer. The Box-Jenkins programme then gives the values of the parameters included in the model. A diagnostic check is then conducted to find out whether the model gives an adequate description of the data. If the model satisfies the analyst in this respect, then it is used to make the forecast. In case the model is not satisfactory, then the computer points out diagnostic information, which is then used by the analyst in revising the model. This process is continued until the analyst obtains an appropriate model, which is used for making forecasts.

It may be pointed out that some studies used the Box-Jenkins model as well as some other methods and found that the Box-Jenkins model gave more accurate forecasts as compared to other methods. There is, however, limitation of this method that it requires at least 45 observations in the time series.

Table 21.3 Selected Forecasting Methods using Time Series

	Trend Projection	**Exponential Smoothing**	**Box–Jenkins Model**
Description	Uses regression analysis to determine the underlying pattern of growth stability, or decline in the data.	The forecast is the average sales for the last x periods. The more recent period sales have a greater weight.	A technique for selecting the optimal model in terms of "fit" to the time series.
Accuracy Short and Medium term (Up to one year)	Fair to very good	Fair to very good	Fair to very good

Contd.

Long term (More than one year)	Poor to fair	Very good	Poor to good
Data required	A minimum of 25 months if seasonals are present	A minimum of 25 months if seasonals are present	A minimum of 45 observations
Typical applications	Inventory control for standard items, short-term sales forecast	Inventory control for standard items, short-term sales forecast	Inventory control, forecasts of fund flows, short-term sales forecasts

(Adapted from Table 21-5 in Tull, Donald S. and Del I. Hawkins, *Marketing Research–Measurements & Methods*, Prentice-Hall of India, New Delhi, pp. 714–715)

Measuring the Forecast Error

It should always be remembered that all forecasts are based on the assumption that the characteristics displayed by the existing data will continue to influence future values. In case this assumption does not hold, even a very good forecasting technique may provide a most inaccurate forecast. The management must aim at maximum accuracy of the forecast, and in the majority of forecasting situations accuracy is indeed regarded the most important criterion for selecting a forecasting technique.

While there are several measures that have been suggested to measure the forecast error, a measure that is most commonly used is called the Mean Absolute Deviation (MAD). This is based on the size of the absolute value of the residuals.

Symbolically, $MAD = \dfrac{\sum_{i-1}^{n} | Y_i - \hat{Y}_i |}{n}$

where | | represents the absolute value.

MAD is thus an average of the absolute deviations between the actual (Y_i) and (*) values in a particular time series. In case a forecast model fits the past time series perfectly, then the MAD is zero. When the forecasting model fits the past time series poorly, then the MAD is large. The concept of MAD is very useful when there are two or more models. Obviously in such cases the model which gives the lowest value will be the most appropriate and, as such, it should be chosen.

When two models give the same value of MAD, then the choice should go in favour of the simpler model.

THE CHOICE OF FORECASTING MODEL

As there is a wide variety of forecasting methods, one is not sure as to which method should be adopted. The question of choosing the right method in a given situation assumes considerable importance. This should be clear by a couple of examples.

Suppose that a very optimistic forecast for sales has been made by a manufacturing company for its product. On this basis, it has expanded its manufacturing operations and produced a larger quantity of output than in the earlier years. However, as the time goes by, it realises that sales have been more or less at the previous level, resulting in a heavy loss on account of large stock of unsold product with the company. Apart from this, loss has resulted on account of higher inventory the company has maintained in order to produce a larger quantity of output.

We can take another example in contrast to the earlier one. A sale forecast for a particular product has been made. But it turns out that the forecast is not realistic—it is on a much lower side than the demand for that product. In view of a low forecast, the company has missed a very good opportunity of augmenting its sales and profits.

One can visualise several situations in business where either high or low forecasts would go against the interest of the company. This closely establishes a major point that efforts must be made to make the forecasts as realistic as possible.

In order to select a specific method of forecasting, it is necessary first to compare the requirements of the forecast with the capabilities of the proposed method. Generally, there are three requirements of any forecast. These are: (i) extent of accuracy desired, (ii) data required, and (iii) extent of time available. If accuracy, say, within ± 5 per cent is required, then methods that are judged to yield less than ± 5 per cent accuracy in forecast need not be considered. However, if no other method is expected to give better accuracy than that, then one has to use any of these methods. If the *data* needed to use the proposed method are not available (as, for example, time series data in forecasting sales of new products), then obviously one has to consider some other method. In the same manner, if *time available* is too short, an elaborate method requiring considerable time to complete the forecast cannot be used. In such a situation, one has to compromise and use a less sophisticated and a less rigorous method.

When we apply these three screening criteria before selecting a particular method, we may find that a sizeable number of potential forecasting methods get eliminated. The management has to choose from amongst the remaining methods. The choice will normally depend on cost-benefit analysis where greater accuracy is weighed against added costs.

A point worth emphasizing is that whatever forecasting model is selected, it should be closely monitored. When a new data value (Y_i) becomes available, it must be compaed with the forecasted value ($\hat{Y}_i$). In case the difference between Y_i and $\hat{Y}_i$ is considerable, one must re-evaluate the forecasting model. This re-evaluation may indicate that the forecasting model is not appropriate and as such it should be revised.

Selecting Time Series Forecasting Models

While using a time series for forecasting sales, the researcher should bear in mind that there is an implicit assumption that patterns observed in the past will be valid in the future as well. Frequently, one finds that this assumption does not remain valid both for forecasting industry sales and individual firm sales. Management should pass on the latest information on the possible changes in future events to the researchers so that they can come out with more accurate forecasts. For example, a firm is experiencing severe competition in the market for its product. It may be seriously thinking to reduce its price. Now this information is very relevant to the researcher. This is because the sales forecast at the old price level will be quite different from the one based on reduced price level.

Further, one finds changes in the time series patterns over time. In order to have some idea of the changing pattern in time series, the researcher should first examine a plot of the data before using the same for forecasting.

It has been observed that instead of forecasting based on a single time series model, a forecast based on two or more time series models usually gives better result.

Finally, the task of forecasting should not be exclusively entrusted to a single person. While it should be coordinated by one person, preferably the marketing research manager, such key people as sales managers and production managers must be actively involved in it. It is important to ensure that there is a consensus for a particular forecast. In the absence of it, the forecast is not likely to be taken seriously and, as a result, its utility will be much less.[5]

Summary

The chapter first discusses sales analysis by territory, product, customer and size of order. This is followed by a discussion on market potential, pointing out how this concept can be helpful to the business firm in augmenting sales. It then discusses different methods used for estimating current demand.

The focus then shifts to forecasting, starting with the forecasting process. The various methods of forecasting, grouped into two broad categories – (i) subjective or qualitative methods and (ii) objective or quantitative methods have also been discussed. While explaining different methods of forecasting, the chapter provides three tables showing accuracy in forecast, data requirement and typical applications in case of each forecasting method. The chapter then emphasises the need for balancing the advantages and limitations of forecasting methods in relation to limitations and requirements of a forecasting situation. Finally, broad guidelines for managers, specifying several important factors which must be considered by them before they finally decide on using a particular forecasting method, have been discussed.

Key Terms and Concepts

Sales Analysis 473
Market Potential 475
Forecasting 479
Field Sales Force 480
Jury of Executives 481
Users' Expectations 481
The Delphi Method 481
Causal Method 482
Leading Indicators 482
Regression Models 482
Input–Output Analysis 483
Econometric Models 483
Time Series Forecasting 484
Trend Projection 484
Exponential Smoothing 485
Autoregressive Model 486
Box–Jenkins Method 487

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[5] See *Handbook of Marketing Research*, R. Ferber (Ed.), New York, McGraw-Hill Book Company, 1974, pp. 4–55 and 4–56.

Questions

1. Distinguish between sales analysis and sales forecasting.
2. You have been called upon to analyse the sales data of a firm. What type/s of sales analysis would you undertake?
3. Distinguish between market potential and market demand. Why is this difference important?
4. Distinguish between the breakdown and buildup methods of estimating current demand.
5. What is an index of buying power method in relation to estimating territorial potential?
6. Why is sales forecasting necessary for a business firm?
7. What are the steps involved in a forecasting process? Is there any way to ascertain the accuracy of a proposed forecast?
8. What do you understand by subjective and objective methods of sales forecasting? Name the methods under each of these two broad categories.
9. What method or methods would you use if the sales forecast for a product is to be made for
   (i) short term (less than one year)
   (ii) medium term (1 to 3 years)
   (iii) long term (more than 3 years)?
10. Explain in detail any two methods of forecasting, indicating their strengths and limitations.
11. What is exponential smoothing? Explain it with an example.
12. Explain the following methods of forecasting:
    (a) Autoregressive Model
    (b) Box-Jenkins Method.
13. What factors should be kept in mind while choosing a forecasting model?

22 New Product Development and Test Marketing

Learning Objectives

After reading this chapter, you should be able to understand:

- New Product Development
- New Product Development Process
- Test Marketing
- Uses of Test Marketing
- Types of Test Markets
- Guidelines for Designing Market Tests

NEW PRODUCT DEVELOPMENT

A company may find itself in a situation where it may be advisable to develop a new product. When sales of its current range of products have been declining over the past few years or when it receives complaints about its products from customers, distributors, retailers, it may have to find the possible reasons for the same. This may lead to the improvement of the existing product or the development of an altogether new product. As we know, the concept of product life cycle suggests that a product passes through different stages. When a company finds that some of its products have entered the declining stage, it may have to take concrete measures to replace them. This can be achieved in two ways: acquisition and innovation. We are concerned here with the latter which can be broadly of two types: internal innovation and contract innovation.

New product development can be carried out in one of the following ways[1]:

1. New product features can be developed by adapting, modifying, magnifying, minimising, substituting, rearranging or combining the existing features of a product.
2. Different quality versions of the existing product can be developed so that the needs of different markets can be met.
3. Additional models and sizes of the existing product can be brought out.

[1] Birn, Robin, *The Effective Use of Marketing Research*, London, Kogan Page Ltd., 1988, p. 50.

If the company pursues the policy of internal innovation, it implies that it has its own research and development department which is engaged in the development of new products including modifications and improvements in the existing ones. If, on the other hand, the company pursues contract innovation, it implies that it has engaged the services of outside researchers or new-product-development agencies for introducing new products for the company. Sometimes the company may prefer acquisition while at other times it may follow the strategy of innovation.

There is a dilemma faced by the management with respect to new product development. On the one hand, the company finds that it is necessary to develop new products, on the other, the stake involved in the new product development is very high on account of research and development activity being highly capital intensive. If the new product fails in the market, the company has to sustain a heavy loss. It is, therefore, necessary that new product development be carried out with extreme caution.

New product development is an extremely difficult and time-consuming process. The role of marketing research in new product development is not as straightforward as it might appear. Unforeseen situations may arise which may force the company to abandon its projects mid-way. Such situations arise not infrequently. One has to be fully informed about the market and product opportunities before venturing into a new product development project. It is desirable to proceed step-by-step in this process.

NEW PRODUCT DEVELOPMENT PROCESS

The development of new products involves the following stages: (i) idea generation, (ii) concept development and testing, (iii) product evaluation and development, (iv) business analysis, and (v) commercialisation. In all these stages, marketing research techniques can be applied though they would vary in each stage. In the section that follows, these stages and the major marketing research techniques used therein are discussed.

Idea Generation

The objective of this stage is to obtain (a) new ideas for products, (b) new attributes for the existing products, and (c) new uses of the existing products. There are several sources of new-product ideas such as customers, company salesmen, dealers, scientists, competitors, top management, industrial consultants, advertising agencies, marketing research firms, industrial publications, universities and commercial laboratories.

Several methods can be used to generate new ideas. These are briefly discussed below.

Attribute Listing

Major attributes of an existing product, are listed. Then, one is asked to imagine how each of these attributes can be modified so that the product will improve. In this connection, Osborn suggested that new ideas can be generated with reference to a particular product: can it be put to other uses? can we adapt? modify? magnify? minify? substitute? rearrange? reverse? combine?[2]

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[2] Osborn, Alex F., *Applied Imagination*, New York, Charles Scribner's Sons. 1963 (Third edition), pp. 286–287.

Forced Relationships

This technique involves listing of several objects and then trying to find how each object can be combined with the other objects. For example, a bed and a sofa set, two separate products, were combined into one—bed-cum-sofa set—fulfilling a 'felt need' of using furniture in a limited space.

Morphological Analysis[3]

This term refers to a variety of techniques which are similar to forced relationships and attribute listing. Although there are several variations, a simple method of morphological analysis consists of the following stages: First, the parameters of the situation are listed. Second, each parameter is sub-divided into its smallest parts. Third, these parts are represented in a matrix. Finally, all possible combinations of parameters and their sub-parts are examined. In this way, morphological analysis will enable identification of the components of current successful products and find new combinations of attractive features. Such an analysis has been extremely successful in the development of new technologies. No doubt, morphological analysis is time consuming. But the time spent is justified. A thorough search of all the possible combinations would not be possible without morphological analysis.

Problem Analysis

Here, the consumers are approached to find out it they have experienced any problem while using a particular product or product category. One can then select one or two major problems from such a list on the basis of their importance, the frequency of their occurrence, and the cost of effecting improvement in the product.

Brainstorming

This technique involves the use of a small number (usually between six and ten) of consumers who are asked to participate in a 'brainstorming' session. The purpose of such a session is to generate a number of new product ideas. In order to ensure that a brainstorming session is most effective, it is necessary to comply with certain rules suggested by Osborn. These are: (a) No criticism of any new idea should be made. (b) Freewheeling is welcomed, indicating that the wilder the idea, the better it is. (c) A good number of ideas must be generated. (Quantity is important at this stage.) (d) Participants should suggest how two or more ideas can be combined into still another idea.[4]

Synectics

Some authors feel that a major limitation of brainstorming session is that it produces solutions too quickly before developing some perspectives. Instead of defining the problem specifically as in brainstorming sessions, the Synectics approach suggested by Gordon, defines the problem so broadly that the participants in the group have no idea of the specific problem. In such exercise,

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[3] Based on Stevens, Michael, *Practical Problem Solving for Managers*, New Delhi, Universal Book Stall, 1989 (First Indian Reprint), pp. 141–142.

[4] Osborn, Alex F., *op.cit*., p. 156.

the participants give their viewpoints and as more and more facts are gradually interjected, their discussion tends to move towards specificity.[5]

Concept Development and Testing

It should be obvious that all the new product ideas generated, cannot be pursued. This may be on account of several reasons. The company may find that a particular new product idea is incompatible with its major objectives. Further, it may not have the requisite production or marketing skills. Another possible reason for not pursuing a new product idea is that it may not be technologically feasible. Thus, a preliminary screening will eliminate a number of new product ideas. Those which survive this screening are then pursued further through concept testing.

The major objectives of concept testing are:

1. To get the reaction of consumers' views of the new product idea.
2. To give direction regarding the development of the project.
3. To choose the most promising concepts for development.
4. To ascertain whether the product in question has adequate potential for its commercialisation.

The concept test can take three different forms. First, it can be entirely *verbal*—a statement about what it does. Second, it can be *visual*—in form of a photograph or drawing. Third, a *mockup* of the product may be used. This is merely a dummy product to get across the idea.

Focus-group Interviews

The focus-group technique, as discussed earlier, is used for concept testing as well. Focus-group interviews are conducted with 8 to 12 participants where the moderator gives the group discussion a more specific direction than is the case in an idea generating session. The main objective is to have a deeper insight so that the concepts can be further refined.

Monadic Tests

In monadic testing, a respondent evaluates a single item in isolation from the other alternatives. The respondents are divided into groups, the number of groups depends on the number of new product concepts. Thus, there are as many groups as there are new product concepts to be tested. Each respondent evaluates only one concept on uniform dimensions as are used with respect to other concepts. Although the scale for recording the evaluations could be any of the attitude rating scales discussed in Chapter 10, the numeric rating scale is generally used.

When each respondent has given his rating on the specified dimensions, an average score for each product is calculated. The new product concept that obtains the highest score is chosen for further evaluation. If the groups are not comparable with respect to age, education, etc., then their ratings to product concepts might be biased. The bias would be more when characteristics such as age and education have a bearing on the product concepts to be tested. In such a case, monadic tests will not be reliable.

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[5] Lincoln, John W., "Defining a Creativeness in People" in *Source Book for Creative Thinking*, (Eds: S.J. Parnes and H.F. Harding), New York, 1962, pp. 274–275.

Paired Comparison Tests

The method has been questioned on its ability to be a true preference testing. This is because it provides a measure of the respondent's attitude toward an item rather than a comparison with all the other items.[6] Paired comparison tests are an improvement over monadic tests. Instead of examining only one product concept as in the preceding method, the respondent examines two product concepts at a time indicating which of the two is preferable.

While using paired comparison tests, one should also be aware of their shortcomings. A major drawback is that it becomes difficult to maintain continued cooperation of members of a consumer-use panel. To overcome this, panelists may be paid so that they would realize their responsibility in respect of the tests. Another drawback is that a paired comparison test is unable to simulate the same conditions as are found in the marketplace under which buying decisions are made.

There is yet another drawback in finding as to how valid the findings of the test are in comparison to actual buyer behaviour. Normally, a consumer of a product does not compare the merits of one product with those of others on the basis of each characteristic of the products. This apart, the reliability of a test is impaired when consumers are subjected to a number of trial uses. In such cases, consumers are not consistent in their preferences.

There is yet another problem that relates to order bias in paired comparison tests. Usually one finds that preferences are related to the order in which the two products are tested.

An alternative to a paired comparison test is a sequential monadic or non-direct comparison test. Here, each respondent is exposed to each product concept, separately. After he has been exposed to all the product concepts, he is asked to give his ratings. The one which secures the highest score is obviously selected for further evaluation.

A major advantage of this method is that it is more in conformity with the actual marketplace. Respondents evaluate products after they have been exposed to them at different time periods in the market. Moreover respondents are not 'forced' to select a product concept over another one just because they have been asked to do. This method may lead to a bias on account of the use of a particular order of presentation of the product concepts. This problem can be overcome by the process of randomisation in sequencing the product concepts across respondents.

Conjoint Analysis

Another technique known as conjoint analysis can be used in testing new product concepts. This method attempts to ascertain the joint effects of two or more nominal independent variables on the ordering of a dependent variable. Here, respondents give their ratings on two or more attributes at a time. The use of conjoint analysis will not only indicate the relative importance of product attributes but also the manner in which they are related to each other. This will enable the researcher to identify the best combination of product attributes.

There are instances where the concept testing has proved to be extremely helpful in successful marketing a new product. Paramount Products[7] launched a new nail polish under their umbrella name 'Shingar', but the launch was unsuccessful on account of confusion of images—Indian name versus 'foreign' product concept. However, as a result of concept testing, a new positioning based on consumer beliefs and expectations was arrived at. The product was given a new name 'Tips

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[6] Day, Ralph L.: "Measuring Preferences" in *Handbook of Marketing Research*, pp. 3–117.

[7] Cited by Manendra Mohan in his book, *Advertising Management*, New Delhi, Tata McGraw-Hill Publishing Co. Ltd., 1989, p. 39.

and Toes' and advertising was geared to exploit this new name. Tips and Toes was then accepted by retailers and consumers.

Product Evaluation and Development

Product testing involves almost the same process used in concept development and testing. The objective of product testing is to ascertain the market response to the proposed product so that the management can decide whether or not the product should be carried forward. It may be emphasised that product testing, being a subsequent step to concept development and testing, is expected to yield more reliable results. This would involve a more realistic plan for the product exposure.

Another major difference between the product testing stage and the concept development and testing stage is that the former involves the trial use of the product by a group of respondents while the latter attempts to measure only the initial interest in the proposed product. Here, some kind of usage test is undertaken to find out whether the respondents would be interested in it and whether they would subsequently buy it if it were available in the market.

Usage Tests

The new product can be tested in different types of usage situations. There are two types of usage tests: laboratory usage tests and consumer usage tests.

In the former test, R and D people may test a new product with respect to one or more attributes. For example, a car manufacturing unit will have its R and D department whose task is to effect improvements in the car, say, economy in fuel consumption. R and D personnel may evaluate the proposed vehicle by undertaking test drives under varying conditions. Generally, laboratory testing is found to be more rigorous for ensuring that performance norms come up to a certain level.

A point worth noting is that a consumer usage test and the laboratory test may give different evaluations of the same product. This is because consumers' perception may be different and accordingly they may attach importance to those attributes which were not considered by the R and D department. In a consumer usage test, a small number of consumers are given a sample of the new product. They are asked to use it in a normal fashion and later indicate their reaction to it as also the defects that they have noticed.

A variant of the consumer usage test is the blind usage test. In such a test, the consumer is given the product in question without disclosing its brand name or advertisement. This method is particularly useful when a new formulation of an established brand is to be tested.

In usage tests, the researcher should ensure that respondents have actually used the new product and that their responses are free from bias. This is important as many a time respondents indicate their willingness to buy the new product without eventually doing so. This would give a highly favourable picture of the product (which ultimately does not turn out to be so).

Business Analysis and Commercialisation

New product ideas that survive the product evaluation and development stage are then taken up for an in-depth analysis to ascertain their business attractiveness. For this purpose, it is necessary to project the future sales, costs and profit, and if such estimates are reasonably good, the product in question is commercialised. However, as new information becomes available, the estimates of sales, costs and profit may have to be revised.

In order to carry out business analysis and commercialisation of the new product, two important techniques—test marketing and simulated test marketing—are used. Both these techniques are based on the application of experimental and quasi-experimental designs. The increasing use of these designs shows that they are dependable and yield reasonably good results.

When a new product concept has scored high in a business analysis, it is passed on to the R and D department which develops one or more physical versions of the accepted product concept. It develops a prototype that satisfies the predetermined criteria.

The Adoption Process for New Products*

The theory of the diffusion of innovation addresses how a new idea of a product or a service is assimilated into a social system over time. This topic has been studied in depth by a number of experts from different disciplines, including economists, sociologists and marketers. The diffusion process indicates how an idea, say, of a new product moves on from its source of creation to its ultimate users or adopters. The adoption process, different from diffusion process, indicates the steps that an individual goes through from the time he comes to know about an innovation until final adoption.

It may be noted that response to an innovation product or service – will vary from person to person. There will be some people who are early adopters while many others take their time to decide whether to adopt a new product or not. In case they adopt, obviously they are late adopters. There is another basis of classifying individuals. Some individuals are considered as opinion leaders as many individuals seek their opinion or alternatively just follow them. Opinion leaders play a major role in expediting the adoption process.

Figure 22.1 relates to a study by Rogers. It provides the classification of individuals on the basis of time of adoption of innovation. As can be seen from the figure, innovators and early adopters constituted 16 percent of the respondents as against 16 percent laggards, who were extremely slow in adopting a new product or service. In between, we find 68 percent of the respondents, half of whom were in early majority and the other half as late majority.

Rogers has attempted to synthesise over 3000 studies of the diffusion process and suggests that consumers go through a sequence of five stages when accepting and adopting a new product. The stages are:

1. **Knowledge:** When an individual is exposed to innovation's existence.
2. **Persuasion:** When an individual forms a favourable or unfavourable attitude toward the innovation.
3. **Decision:** When an individual is seriously thinking to adopt or reject the innovation.
4. **Implementation:** When an individual has put an innovation into use.
5. **Confirmation:** When an individual reinforces an innovation decision already made.

Apart from these sequences of five stages that an individual passes through until its final use, a major consideration on the acceptability or rejection of an innovation defends on its attributes. For example, when an innovation is not complex and when its benefits are easily visible to others, such an innovation will be favoured by early adoption. Again, when communication channels are quick and have a wide coverage, the individuals would learn about that innovation early resulting in an early adoption on a large scale.

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* Based on Lilien, Gary L., Philip Kotler and K. Sridhar Moorthy: *Marketing Models*, Prentice-Hall of India Private Limited, New Delhi, 2003, pp. 461–462.

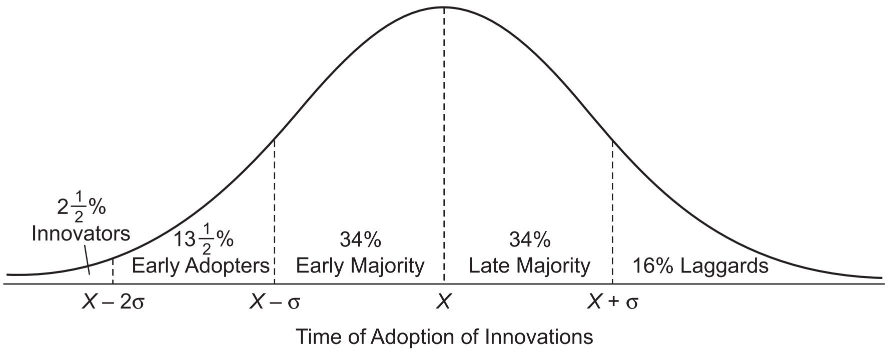

Figure 22.1 Adoption categorisation on the basis of relative time of adoption of innovations. (*Source*: Rogers, E.M.: *Diffusion of Innovations*, 1998, p. 24)

TEST MARKETING

After the concept testing and development of a new product, it is necessary to find out whether it is going to be accepted or not in the market. This is achieved through test marketing. The main objective of test marketing a new product is to reduce the commercial risk when it is brought in the market.

> "Test marketing is a controlled experiment, done in a limited but carefully selected part of the marketplace, whose aim is to predict the sales or profit consequences, either in absolute or in relative terms, of one or more proposed marketing actions. It is essentially the use of the marketplace as a laboratory and of a direct sales measurement which differentiates this test from other types of market research."[8]

From the above definition it is clear that test marketing is essentially an exercise in experimentation, where the marketplace is a laboratory. It also brings out that the predictability of sales or profit is the objective of test marketing.

USES OF TEST MARKETING

There are two uses of test marketing. First, it may be used as a tool for managerial control. Second, it may also be used as a predictive research tool. These two uses are discussed in some detail here.

Test Marketing as a Managerial Control Tool

Test marketing frequently serves as a pilot operation for large-scale marketing activity. When a company intends to expand its business operations, some element of risk is involved. This is particularly true in respect of new products or brands where the management may be understandably apprehensive. There are, for example, many physical problems such as handling of the product, breakage, storage, stocking and transportation which if not handled properly, may prove to be costly mistakes. In such cases, test marketing is used to improve the mechanics of the marketing

[8] *Handbook of Marketing Research*, Robert Ferber (Ed.), New York, McGraw-Hill Book Company, 1974, pp. 4–32.

operation so that the management may know in advance the problems that are likely to arise and hence improve its marketing operations.

Here, the role of test marketing is limited. It is not advisable to undertake an elaborate and time-consuming test marketing as this may be unnecessary. It is used as a device to gain experience, to identify the problems likely to arise in marketing operations, and to develop a sound marketing programme eventually. It is not used for purposes of prediction of sales or profit.

Test Marketing as a Predictive Research Tool

Test marketing is often used as a predictive research tool in two different situations. These are: (i) the introduction of a new product or brand, and (ii) the evaluation of alternative marketing variables.

Test Marketing for New Products or Brands

When a new product or brand is to be introduced in the marketplace, the management is apprehensive about its performance. This will be true particularly where the new product does not have any direct substitutes. In such a case the management neither has any information of its own nor any experience of the others. In such a situation, test marketing can be used to predict the likely performance of the new product.

More often, one finds that test marketing is used for a new brand of an existing product category. However, a new brand may be substantially different from the others in the product category or it may be just another brand and may not be very different from the others. In the former case, some form of blind product testing is desirable to find out whether the new brand is more acceptable to the consumers. In the latter case where new brand is just another addition to the product category, test marketing may not be desirable. When heavy investment is required for the new brand, it may be advisable to run a test market to ensure its market acceptability first.

Test marketing is also used while recycling an existing brand. When a company is seriously considering a new packaging for its product, its repositioning, or some improvement in an existing brand, it may use test marketing before introducing such a change. In case of an existing brand, test marketing should be used only when the change is substantial otherwise it will be only a wasteful expenditure.

When a test market is conducted for a new product or new brand, the management would like to know how this new product or new brand will do in terms of sales and profits at the national level. In this regard three approaches as suggested by Gold,[9] can be used.

1. *Buying Income Method:* Here the test area sales of the new product/brand are expanded by the ratio of national income to the test area's income. Thus,

$$\text{Estimate of national sales} = \frac{\text{Total income of the cournty}}{\text{Test area income}} \times \text{Test area sales}$$

2. *Sales Ratio Method:* Here the test area sales of the new product/brand are expanded by the ratio of national sales of other product to test area sales of this other product. Thus,

$$\text{Estimate of national sales} = \frac{\text{National sales of other product}}{\text{Test area sales of this other product}} \times \begin{matrix}\text{Test area sales}\\ \text{of test product}\end{matrix}$$

[9] Gold, Jack A.: "Testing Test Market Predictions" in *Journal of Marketing Research*, Vol. 1, August 1964, p.10.

This 'other' product or brand should be related to the test product in some way. Management should have sufficient evidence to think that the relationship in regard to the 'other' product would hold good with respect to the test product.

3. *The Share-of-the-Market Method*: Here the ratio of test area sales of new product to test area sales of the whole product category is to be multiplied by the national sales of this whole product category. Thus,

$$\text{Estimate of national sales} = \frac{\text{Test area sales of new brand}}{\text{Test area sales of this whole product categoty}} \times \begin{array}{c}\text{National sales of this} \\ \text{whole product category}\end{array}$$

Of these three methods, Gold found that the share-of-the-market method yielded most accurate results. At the same time, since it needs information of all the competing brands, it is very costly.

Subsequently, other methods in the form of mathematical models have been suggested for projecting test market results and are generally based on consumers' panel data. It is reported that the use of panel data in such models has given very accurate projections of sales of new brands at the national level. The discussion of these models is beyond the scope of this book.

Test Marketing for Evaluating Alternative Marketing Variables

Another predictive use of test marketing is to evaluate alternative individual marketing variables. For example, test marketing may be used to find whether a new media pattern is better than the existing one and, if so, to what extent. Similarly, one may use test marketing to ascertain whether a higher advertising budget is more profitable than a lower one. One can think of several situations where test marketing can be applied to measure the effect of a variable.

However, one has to be extremely careful in designing a test so that it gives dependable projections. A little later we shall discuss design methodology for a test market. A more important topic is discussed here: should test marketing be conducted or not?

The Decision to Undertake Test Marketing

The management is often faced with the dilemma of going in for test marketing or not. This decision has to be based on a cost-benefit analysis. Against the expected benefits, the management has to examine various costs involved in a test market. As the likely benefits of test marketing have been discussed, here the discussion is confined to the other aspect, namely, costs.

Both direct and indirect costs are involved in test marketing.[10] The direct costs include (i) cost of setting up a pilot plant, (ii) commercials, (iii) advertising, (iv) expenses incurred on the production of point-of-sale material, (v) couponing, (vi) sampling and (vii) trade allowances offered to obtain distribution. An indirect cost, for example, would be the cost of disclosing a new product idea to a competitor. Other indirect costs are: (i) deployment of sales force from the existing and established products to test marketing, (ii) opportunity cost of sales lost in case of a successful introduction, (iii) possible negative impact on other products, etc. The fact that test marketing would mean high direct and indirect costs, necessitates that there should be a very careful analysis of benefits and costs before using this device.

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[10] Based on Klompmaker, Jay E., *et al*., "Test Marketing in New Product Development," in *Harvard Business Review*, May–June 1976, p. 129.

It is advisable to spend adequately on a test market so that one is able to get decisive results rather than to save on its designing and implementation, reducing its scope and thereby obtaining inconclusive results. In the latter case the entire expenditure on a test market will be in vain.

In deciding whether or not to undertake a test market, major problems associated with test marketing must also be considered. An overwhelmingly important problem is the lack of projectivity of the test market results. This is due to a number of reasons. One possible reason could be that a company's competitors might have learned about its test marketing and engage themselves in monitoring its results. They may then come out with a similar product leading to stiff competition.

When to Test Market[11]

Having looked into both the costs and benefits and the problems likely to arise in test marketing, the company may like to decide the timing of a test market. A few considerations become relevant in deciding as to when test marketing should be undertaken.

First, the cost and risk of failure should be considered against the profit and probability of success. A product with low costs and low risk of failure may not need testing.

Second, the investment needed in plant both for test marketing and national introduction should be considered. In case the difference in investment is not much, one should prefer introducing the product of the national level. In contrast, if the difference is considerable, test marketing should be undertaken first.

Third, the possibility and speed with which the competitors are likely to initiate and/or preempt the proposed product should be considered. The faster the competitive firm's response (and the more likely it is to do so), the stronger the need to avoid test marketing.

Fourth, the effects of a national failure on the trade and consumers should be considered. One should ascertain whether the company's reputation and its other products are likely to suffer in the event of a failure in test marketing.

In the light of these factors, a company may decide in favour of or against launching a test market. If in a given situation only one factor is relevant, then the company may decide on the basis of only that factor and this process will be much simpler than in other situations where two or more factors, mentioned above, are involved.

TYPES OF TEST MARKETS[12]

There are four basic types of market tests:

Standard, controlled, electronic and simulated. These are discussed below.

Standard Test Market

A standard test market (STM) is one in which a small sample of market areas is selected. Through regular distribution channels, the new product is sold, using one or more of its combinations, price and promotional levels in the selected areas. STMs are also used for price, package and advertising testing.

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[11] Based on Kinnear, Thomas C. and James R. Taylor, *Marketing Research–An Applied Approach*, New York, McGraw-Hill Book Company, 1987, p. 631.

[12] Based on Tull, Donald S. and Del I. Hawkins: *Marketing Research: Measurement & Method*, New Delhi, Prentice Hall of India Private Limited, 1993 (Sixth edition), pp. 256–270.

Selection of Site

As the selection of a wrong site is sure to distort test market results, it is necessary to be careful in selecting the proper site. Instead of random sample, purposive selection is made on the basis of such criteria as demographic characteristics, size of the area and its representativeness, climate etc. The purpose of all this is to ensure that the site selected is representative of the larger geographical area where the new product will be marketed. During the period when the new product is being marketed, its sales are monitored through store audits.

Limitations of STMs There are certain limitations of STMs. The limitations of "after-only" designs are mentioned in Chapter 6, are applicable to most of the STMs. Further, STMs require much longer time, say around 12–18 months, which delays the launching of the new product. Another limitation from which STMs suffer is on account of jamming. At times, a competitive firm may distort the STM of its rival. For this, the competitive firm may resort to one of the following methods:

(i) It may reduce the price of its product.
(ii) It may spend more on advertising.
(iii) It may even start purchasing the new product of the rival firm.

There is one more option available to the competitive firm. Since STMs are conducted for a long time, the competitive firm may analyse the new product and eventually develop its own product. This last option will completely distort the test market results.

Advantages of STMs Despite the limitations mentioned above, STMs are more frequently used as compared to other types of market tests. This is because of the high cost of new-product failure. One reason for their frequent use is that simultaneously it is possible to test the support of retail and wholesale traders. This can be done by finding out as to how much shelf space is provided by traders to the new product. If the shelf space available to the new product is inadequate, its sales too will not be much even though the demand for it from the prospective consumers is high.

Controlled-Store and Minimarket Tests

In controlled-store and minimarket tests, the marketing research firm handles all the warehousing, distribution, pricing, shelving and stocking, which is not the case in STMs. Here, the M.R. firm approaches an outlet to provide some space against payment so that the new product can be placed in that store. Thus, a few outlets in different areas can be utilized. In such a test, media advertising typically cannot be used because of the limited distribution of the product. In contrast, a minimarket test involves a good number of outlets. As such, the visibility of the test as well as the costs are higher as compared to controlled-store tests.

As the M.R. firm itself distributes the new product, it maintains the sales data. It can use panels in order to know trial and repeat purchase rates, household penetration, demographic characteristics of the users, etc. It can even conduct a survey to supplement panel data.

These two methods have some advantages over STMs. First, the competitive firm is unable to get the test results as the M.R. agency/firm is the only source of sales data. Second, these tests are relatively less visible to competitive firms, though most controlled stores and minimarkets are actively observed. Third, these tests are much faster as there is no need to put the new product through a distribution channel. Finally, the costs of running these tests are much less than those in STMs.

There are some limitations of these tests. First, as the number of stores is very limited and/or due to the small size of the new product involved, some difficulty is faced in making projections on the basis of the test market results. Second, these tests are unable to give information as to how much support the trade will give to the new product. In case the wholesaler does not push the new product or the retailer does not provide adequate shelf-space, the new product is unlikely to succeed. Third, it is sometimes difficult to duplicate planned national advertising programmes. Finally, the M.R. agency ensures near-optimal positioning in each store, no stockouts, adequate shelf-space etc. Now, such a favourable situation is very different from the one encountered during the national introduction. However, taking all factors into consideration one finds that these tests are relatively fast, cheap and realistic as compared to STMs.

Electronic Test Markets (ETMs)

Electronic Test Markets (ETMs) have now become an important part of test marketing. ETMs operate like minimarket tests with the difference that here the M.R. firm is able to collect ongoing scanner-based sales data from the major outlets in the area.

Apart from being used in testing new products, ETMs are even more commonly used in deciding advertising levels and themes. These tests are able to provide precise measurement of individual household's purchasing and TV viewing behaviour. Their limitations are the same as those found in minimarket tests. There are two additional concerns: (i) the representativeness of the electronic diary panel on account of the high refusal rate of those approached to join such panels; and (ii) the small size of the towns involved in the test.

Simulated Test Markets

Simulated test markets are also known as laboratory tests. In order to run these tests, the following procedure is followed.

1. Generally, potential respondents are contacted in mall intercept interviews and are listed as "qualified", which implies that the respondents satisfy the demographics and/or usage characteristics of the desired target market.
2. The respondents thus qualified are shown a description of the product concept, a finished or rough package, a finished or rough commercial, or a product prototype or finished product, depending on the purpose of operating simulated test markets.
3. Respondents then express their attitude toward the product or their intentions to buy it. Those with positive attitudes or purchase intentions are given the product to try it out.
4. Respondents use the product in their homes in a normal manner as they use any other product.
5. After the expiry of reasonable time, the respondents are again contacted and asked to evaluate the product's performance. Normally, evaluation includes attitude measures and statements of repurchase intentions and likely usage rates.
6. The final step involves the calculations of percentage of respondents who decide to try the new product. This is used to estimate the percentage of the target market population provided that (i) the people are aware of the existence of the new product and (ii) the new product is easily available in those stores where the respondents shop.

The foregoing discussion clearly indicates that a good deal of reliance is being placed on the behaviour of respondents in an artificial situation, which may be far from reality. It seems intuitive that such behaviour would be very different from actual behaviour of the people in the market-place. Those operating STMs do realize this and they use test markets to understand relationship between product's performance in the laboratory and its subsequent performance in actual market introduction.

These tests are not only fast and economical but are also confidential, easily controlled and capable of covering a wide geographical area. They do not measure trade response, reactions of competitors or difficulties in implementation. Further, they are dependent upon the mathematical model used in conducting them.

Problems of Test Marketing

A number of problems arise with test marketing. All of them, however, give rise to one overriding negative result.. This means that the test market is unable to provide projectivity to the national roll-out of the product. A number of reasons can be advanced for this poor projectivity of test marketing.

1. As competitors come to know about test market, at an extreme level, they can attempt to destroy the company's ability to make judgment from a test. This is on account of increasing efforts made in test cities resulting in distortion of test results.
2. Normally, only a small sample of stores is used in the test market with a resultant sampling error. Further, sales data from sample stores may be inaccurate because of poor store records or insufficient knowledge of the store's billing and handling systems.
3. When the market test is going on, competitors would spare no effort to learn of the company's activities and even monitor results. They may even overtake the company by introducing this type of product in the market.
4. During the test market operations, special introductory offers and promotions are often made to the trade and consumers so as to measure repurchase activity. However, such offers remain confined to a limited area. These offers are not available at the scale of the test for a national roll-out.
5. The company conducting a test market ensures that trade is aware of the test and gives artificially high distribution and retailer support.
6. The salespersons being aware that a test is being conducted in their market, get excited beyond normal levels of their activity.

TTK Prestige successfully utilised a home shopping channel to test response for a new product, but customer feedback to a new product introduced in South prompted the company to change the product completely.

"The role of test market becomes very important if one is getting into unchartered territories where risk of failure is high, investments are high, back-end need to be set up and time is really of essence." When Ford launched its Ford Fiesta sedan in April 2011, it conducted a consumer immersion programme before the launch to understand its TG in the Delhi market. The programme involving the senior Ford management, agency partners saw teams meeting families across Delhi to understand their lifestyles, family structure, buying behaviour etc. All this information was then relayed back into customising the marketing and communication strategy for the new car.

Test marketing involves lots of manhours, years of research and yet it could come to a naught.

The scope of test marketing differs depending on the familiarity consumers have with the brand. While it may be relatively easy for companies like Merico or retailer like Big Bazaar, for a newbee like Vini Group. concept testing involves a mix of metros (12–13 cities) involving 30 customers per city for a slew of products like 18+, Viton and Jinjola.

Test marketing within the FMCG space also depends on the nature of the market. For example, if a market is media dark, then test marketing acquires the form of activations. If it is a product related to health, roping in expert opinion like doctors in the pilot phase becomes essential.

GUIDELINES FOR DESIGNING MARKET TESTS[13]

In general, the following guidelines will be helpful in designing a good market test:

1. The market test must be representative of the whole. This is an extremely important aspect otherwise the projectivity of the test will be faulty. In order to achieve this, the sample markets should be randomly dispersed. It may be desirable to stratify the universe by regions or states first and then choose individual markets within the regions or states. The sample markets should be normal and should not be dominated by one industry.
2. It is desirable to run the test for at least a year. This is to ensure that a seasonal pattern, if existing, does not distort the results. This is particularly necessary in case of those products that are likely to have a seasonal pattern. Further, the test market should also reflect a repeat-purchase situation. This is possible only when the duration of the test market is sufficiently long.
3. The test market must be carefully controlled. As far as possible, extraneous variables must not be allowed to unduly influence the test. This is particularly relevant in testing alternative variables when a control group is necessary. When a control group has to be set up for comparison with the test area, one should ensure that both should be selected in an identical manner. Similarly, the control group should be as randomly dispersed as the test area in addition to being as large as the test area.
4. It is necessary to ensure that the test market gives accurate results. Without a relevant and accurate measurement of the test market, the projective results will be misleading. In this connection, three things should be looked into: (i) the measurement criterion such as sales, market share or profit; (ii) the selection of the base period against which comparisons are to be made; (iii) the method of projecting the results of the test market.
5. It is advisable to test only one variable at a time since a large area is needed to test even one variable. Moreover, the introduction of another variable in the same test market may lead to unnecessary complications.
6. In order to ensure that projections made on the basis of a market test are realistic, it is advisable to use at least one year's back data as the base. This will enable us to choose the most appropriate method for forecasting. Sometimes it may be desirable to use more than one method for forecasting and to average the projections obtained from these methods.
7. The basic principles in market tests should never be sacrificed for the sake of expediency.

[13] Based on *Handbook of Marketing Research*, R. Ferber (Ed.), New York, McGraw-Hill Book Company, 1974, pp. 4–38 to 4–45.

A market test where several important principles are compromised will lead to confusing and misleading results.

8 It is desirable to undertake basic marketing research prior to the test marketing. Adequate research done before running a test market will give more reliable results. At the same time, it may indicate that test marketing is not needed in certain cases. Greater attention should, therefore, be given to pre-market test research to derive the maximum advantage from the test marketing.

Summary

This chapter first describes the concept of a new product. This is followed by a detailed discussion on the new product development process, involving (a) idea generation, (b) concept development and testing, (c) product evaluation and development, (d) business analysis, and (e) commercialisation.

The discussion then focuses on the adoption of an innovation—a product or a service. In this context, it describes how an individual goes through a sequence of five stages, beginning from knowledge stage and concluding with confirmation stage.

The focus then shifts to test marketing. First, the two major uses of test marketing viz. test marketing as a (i) managerial control tool, and (ii) predictive research tool are explained. Other aspects— the decision to undertake test marketing and when to test market have also been briefly discussed. The chapter then explains four types of test markets namely, standard test market, controlled-store and minimarket test, electronics test market, and simulated test market. At the end, the chapter provides guidelines for designing market tests.

Key Terms and Concepts

Idea Generation 493
Attribute Listing 493
Morphological Analysis 494
Brain Storming 494
Synectics 494
Monadic Tests 495
Usage Tests 497
Adoption process 498
Diffusion process 498
Test Marketing 499
Standard Test Market 502
Controlled Store Test 503
Minimarket Test 503
Electronic Test Markets 504
Simulated Test Markets 504

Questions

1. What is meant by ‘new product development’?
2. What is the process of new product development?
3. What are the different methods of idea generation?
4. Highlight the major differences between (i) concept development and testing, and (ii) product testing.

5. Distinguish between monadic and paired comparison tests as applied to new product development.
6. What is test marketing?
7. What are the two major uses of test marketing?
8. Under what circumstances would it be advisable for a company to undertake test marketing?
9. What factors would you bear in mind while designing a test market?
10. How would you project the results of test marketing to the national level?
11. What is a controlled test market?
12. What is a simulated test market? What procedure would you follow to conduct such a market test?
13. What do you understand by (a) diffusion process and (b) adoption process?
14. What are the strengths and weaknesses of electronic test markets?
15. What problems are likely to arise while conducting a test market?

23 Advertising Research

Learning Objectives

After reading this chapter, you should be able to understand:

- Importance of Advertising
- Need for Advertising Research
- Setting of Advertising objectives
- Copy Testing and Media Research
- Setting the Advertising budget
- Paradoxes in the Evaluation of Advertising Research

IMPORTANCE OF ADVERTISING

A study[1] done by the Centre for Media Studies emphasises the phenomenal growth in advertising that has taken place in India in recent years. It observes: "By any count 1986–88 years will go down as a turning point in the Indian advertising industry." A number of factors have contributed to this growth. First, advertising expenditure has crossed the Rs. 1000 crore mark. Second, advertising through TV has become a force to reckon with. Third, consolidation and realignment of advertising agencies has taken place. Fourth, newspapers and magazines have to woo advertisers and advertising agencies. Fifth, advertising expenditure is no longer questioned following the new buoyancy in the market.

Another study[2] shows that five consumer megatrends have swept across the urban landscape in India. These are: the new individualism, the growing multi-culture orientation, the search for status, a harder look at brand values, and the new aspirations among the consumers. These megatrends have emerged as a result of four forces of change in the Indian society. These forces are: more

[1] Centre for Media Studies, *The Indian Advertising Scene—1988: Some Perspectives*, Monograph Series, New Delhi, February 1989.

[2] Khan, Sattar, A Study of Creative Strategies Employed in Advertising Consumer Products in English Language Press Media in India, Bombay, University of Bombay, *Unpublished Ph D Thesis,* June 1989.

purchasing power with consumers, availability of a wide variety of products and brands, availability of greater information about products and brands, and changes in the socio-economic environment in the country. In view of these developments, advertising has assumed more importance in recent years. This rising trend will continue on account of a number of factors such as increase in urbanisation, expansion of education, increase in per capita income, etc.

This would mean that companies will give far more attention to their advertising efforts, use more sophisticated and improved advertising techniques and be more concerned about knowing the impact of their advertising efforts.

NEED FOR ADVERTISING RESEARCH

The role of research in advertising can be seen in various stages of advertising planning. First, what should be the objectives of advertising? Unless the objectives are clear, advertising cannot be useful. Research would enable the company to be clear in its objectives of advertising. Second, advertising research should be used for developing a strategy for marketing the product in question. Further, the selection of the target audience can be facilitated by advertising research. In this connection, mere demographic classification will not be adequate. It may be equally necessary to pay attention to product usage behaviour. Another aspect where research can be useful is the selection of message that an advertisement should carry and through what media it should be conveyed. This is a major area of advertising research. Finally, research has to concern itself with the evaluation of advertising in order to find out whether the expenditure on advertising has been justified or not. If not, the reasons should be ascertained so that an improvement in advertising can be made in the future. In short, research can be instrumental in increasing the efficiency of advertising as a result of which the pay-off from advertising expenditure will increase.

SETTING OF ADVERTISING OBJECTIVES

The first step in developing an advertising programme is to set the advertising objectives. The business firm must be clear as to what should be the objectives of the proposed advertising programme. Advertising objectives can be classified into three categories:

Informative advertising, Persuasive advertising and Reminder advertising.

As regards information advertising, it is most appropriate when the firm has just entered the market and is expected to introduce its product for information of public. Such an advertising primarily aims at building primary demand for its product. The persuasive advertising, on the other hand, is used to build selective demand for a particular brand that has already been in the market for some time. This type of advertising is normally used when the firm finds itself facing sevage competition in the market. Coming to reminder advertising, the firm would normally use it in the mature stage of the product life cycle. The consumer is reminded that the product is very much in the market. Closely related to reminder advertising is reinforcement advertising the purpose of which is to assure current purchasers that they have made the right choice by buying the company's product.

It may be noted that the choice of advertising objective should not be arbitrary. Much before releasing an advertisement, the company must fully understand the advertising process as well as the current marketing situation. In the absence of proper planning, many advertising programmes fail to bring the desired results and thus escalating cost of business operations.

After having decided the objectives, the next stage is to decide what the message should be . The company has to take decisions on a number of related issues apart from the message itself. These may be: what headlines to be used: what pictures or symbols? What situations? All these can be put under copy testing.

In addition to deciding what message is to be contained in the advertisement, the company has also to choose appropriate media vehicles? Should it use newspapers, radio magazines, television, billboards? It may have to decide whether a combination of one or more media vehicles should be followed and, if so, in what manner.

There is yet another problem on which the company has to take a decision. This relates to setting advertising budget.

All these three issues that are so important for the success of an advertising programme are discussed below.

COPY TESTING

Another important area in advertising research is copy testing. The word 'copy' is used to denote an entire advertisement, including the message, pictures, colours etc., regardless of the medium in which the advertisement has appeared. As Shirley Young says:

> "Copy testing is troublesome for almost everybody. Most advertisers and agencies have a checkered history of its use and often differ on both what and how to measure. This continued dissatisfaction, with copy testing has led to a never ending search for the next new technique to embrace."[3]

Methods of copy testing can be divided into two categories, viz., 'before' tests and 'after' tests. The former category includes all those tests that are used in ascertaining the suitability or otherwise of an advertisement before it is finally released. Their purpose is to effect improvements in the copy or advertisement. The latter category includes tests to measure the effectiveness of an advertisement after it has been formally released. Despite this distinction, at times the difference between the two types of method gets blurred. This is because some 'before' methods require that an advertisement should be run in one or two media.

'Before' Methods

A number of pre-test methods are used for copy testing. In this section, we will discuss the following methods: (i) consumer jury, (ii) rating scales, (iii) portfolio tests, (iv) psychological tests, (v) inquiry tests, (vi) laboratory testing, (vii) simulated sales tests, and (viii) Day-after recall tests.

Consumer jury: In this method, a sizeable number of consumers from the target audience are shown a set of rough and unfinished advertisements. With respect to these advertisements, they are asked such questions as: Which copy would you prefer to read? Which one would induce you to buy the product? Which headline is the most interesting? Paired comparisons or ranking may be used by respondents. The assumption in this method is that at least one of the advertisements shown will be liked by them.

[3] Young, Shirley: "Copy Testing without Magic Numbers" in *Journal of Advertising Research*, Vol. 12, No. 1, February 1972, pp. 3–12.

Rating Scales: This method involves the use of certain standards against which a copy is tested. The copy is rated on the basis of scale values. As a result, a numerical score is obtained. It may be added that weights may be assigned to different factors or items on the basis of which a copy is to be tested, depending on their relative importance or relevance. This method is generally used by professional advertising agencies which are able to 'rate' advertisements without any difficulty.

This method has one major advantage as it provides a list of factors against which a copy is to be tested. However, there are certain limitations. First, the problem is how weights are to be assigned to different items. Second, different respondents will rate the items differently. It is difficult to say who is right in his rating. Third, an overall high score of a copy does not necessarily mean a superior copy. This is because that copy might have scored high ratings with respect to several items and low ratings with respect to only a few items. It is these few items which may be extremely relevant in judging the copy.

Portfolio tests: According to this method, a number of alternative copies that are to be tested are placed in a portfolio. At times, the copies are placed in dummy copies of magazines or newspapers. Respondents are given the portfolio and asked to go through it. After they have done so they are asked to recall the copies from memory. Such a recall may be either unaided or aided. The interviewer may facilitate recall by asking about specific advertisements. The interviewer may further ask the respondent to recall the advertisement as much as possible. The extent of recall will indicate the strength of the copy.

Psychological tests: This method uses a number of psychological techniques to find out the reactions of respondents to a given advertisement. Techniques such as word association, sentence completion, depth interviewing and story telling are used by trained psychologists to find out what respondents see in a given advertisement and the influence it has on them. As it is extremely difficult to interpret the information obtained on the basis of psychological tests, only trained persons should be appointed to carry out this task. In view of this, only a small sample can be used for such tests.

Laboratory testing: This method uses mechanical devices to measure the respondent's psychological responses to a given advertisement. The commonly used tests are the galvanic skin response and the eye movement. As regards the former, a device is used to measure changes in the amount of perspiration in the hands. This may be taken as a measure of emotional change as a response to an advertisement. However, the test is unable to indicate whether such an emotional change is favourable or unfavourable to an advertisement. In the latter test an eye camera registers the continuous movement of the eye as it reads an advertisement. However, the results obtained from an eye camera are difficult to interpret. For example, if the eye was fixed on a certain point could it be interpreted that the respondent was interested in the advertisement or that he was confused?

Inquiry tests: Some advertisements may invite several inquiries from the readers about a given product or service. However, it is questionable whether a large number of inquiries can be regarded as a good yardstick for a successful advertisement.

Inquiry tests can take several forms. One way could be to place the same offer in different copies in different issues of the same magazine/newspaper. These offers are keyed to a specific advertising copy. If the number of inquiries linked with a particular copy outnumer the other, it may be concluded that this copy appeals more to readers. Another variant could be to give the same offer in different advertising copies that appear in different newspapers or magazines. This assumes that there are only negligible differences among different media. However, this may not be the case. Sometimes, the same offer is made through two pieces of copy. One piece of copy is carried in half the copies of the newspaper or magazine and the second piece of copy is carried in the remaining half. Inquiries received are then linked to the two pieces of copy.

Inquiry tests can be developed in the form of controlled experiments to ascertain the impact of an advertisement copy. However, one has to exercise great care in isolating the effect of other factors from that of advertising.

Simulated sales tests: These tests expose prospective consumers to different pieces of copy through point-of-purchase displays or direct mail. Thus, one may select two groups of similar stores where two alternative pieces of copy are displayed at the entrance or at some other place in the store. Sales of the product in question are measured both before and after the display of copy in the two groups of store. The copy in those stores which have registered a higher increase in the sale of the product over time is regarded as a better copy. Likewise, comparisons can be made between two pieces of copy using direct mail.

While these tests are both more economical and simpler than actual sales tests, one major limitation is that there is no certainty that the advertisement when actually given will have the same result as at the time of the test.

Day-after recall tests: These tests are generally undertaken for television commercials. The test involves an on-air exposure of a commercial in a couple of cities. This is followed by a telephonic enquiry of the respondents to find out if they can recall the message. The aggregate recall score that is arrived at is compared with a standard score based on similar studies. If the score given by the commercial is higher than the standard score, it is inferred that the advertisement is useful and should be telecast on a larger television network.

The main advantage of this test is that it is performed in a natural setting. Moreover, a proper sample design can be used in this method. In contrast, the major limitation is that it turns out to be a test of the respondent's ability to remember. This does not necessarily establish that the respondent will behave in a different way as a result of watching the commercial on television. How far can the recall be related to a change in the respondents' attitude and behaviour? This is a pertinent question which is difficult to answer in the context of day-after recall tests.

'After' Tests

There are three methods that are frequently used to test an advertisement after its formal release. These are recognition test, recall test and sales test. They are described below.

Recognition tests: These tests are carried out with respect to a printed advertisement and commonly referred to as a readership study. Here, the respondents are asked if they have read a particular issue of a magazine. They are further asked as to what they saw and read. Generally, the respondent is shown a particular page of the magazine and then the following measures of recognition are taken:

1. Noted—the percentage of readers who have seen the advertisement earlier.
2. Seen-Associated—the percentage of readers who read a part of the advertisement which indicates the brand or advertiser.
3. Read Most—the percentage of readers who read a major part of the advertisement.

Scores are assigned to these three measures and overall scores are determined for all the advertisements contained in a particular issue of the magazine. These scores are then related to the expenditure incurred on the advertisements. In this way, cost ratios can be determined.

The recognition method has certain limitations. Some respondents may confuse specific advertisements with similar or identical advertisements seen elsewhere. Respondents may forget having seen an advertisement earlier or falsely claim that they have seen it.

Recall tests: In this method respondents are asked to recall specifics of the advertisement. In the foreign countries, there are some advertising agencies that offer a post-testing readership service. To begin with, copies of test magazines are sent to a sample of respondents who are asked to read them in a normal manner. Telephone interviews are held on the following day. Respondents are read out a list of advertisements and asked to identify those they remember and the extent to which they are able to recall. Thus, scores are assigned to the ability of the respondent to remember the name of the product, the underlying message contained in the advertisement and their favourable attitude regarding the advertisement.

Recall tests, no doubt, go beyond recognition tests but it is difficult to say the recall scores indicate the desired consumer behaviour. Recall scores may be high and yet there may not be any perceptible change in the consumer behaviour with respect to the product in question.

Sales tests: This method measures the effect of an advertisement on the sale of the product. The assumption is that changes in sales are as a result of the advertisement. However, as there are several factors influencing sales, one has to be extremely careful in establishing a relationship between advertising and sales. It is desirable to isolate the influence of other factors while determining the impact of an advertisement on the sale of the product. Experimental studies can be designed to study the impact of an advertisement on sale. An experimental study of this type is explained in Example 2 in the chapter on Experimental Designs.

Need for More Systematic Copy Testing Research

Despite the improvement that has taken place in copy testing, there is a strong case for undertaking it in a far more systematic manner. Ostlund, Clancy and Sapra[4] reached some interesting conclusions in this regard. One of the conclusions was that although advertisers and agencies were spending a great deal of their money on copy testing services, there was hardly any assurance of the validity of this method. According to them the inaction concerning the assessment and improvement of copy-testing method performance is probably due to the lack of minimum standards for reliability, sensitivity and validity for either TV copy-testing methods or print methods.

Almost the same observations are echoed by William Rubens. He says:

> "Billions of dollars are spent each year on television advertising, and to make sure that those dollars are spent wisely, millions of dollars are spent each year on the measurement of the television audience. But relatively little is spent to make sure that audience measurement is being done correctly."

In the survey conducted amongst advertisers and advertising agencies, Ostlund, Clancy and Sapra avoided the use of the words reliability and validity. They asked the respondents to indicate the extent to which they were accustomed to testing a commercial, i.e., two or more times by the same method or two or more times by different testing methods. It may be mentioned that the reliability of the copy testing method can be ascertained by testing the same commercial twice by using the

[4] Ostlund, Lyman E., Kevin J. Clancy, and Rakesh Sapra, "Inertia in Copy Research" in *Journal of Advertising Research*, Vol. 20, No. 1, February 1980, pp. 17–23.

same method. Likewise construct validity of the copy testing method can be assessed by testing a commercial two or more times by using different methods. This construct validity may be regarded as a step prior to the more demanding and complicated requirements of empirical validation through field methods such as experimental designs. The authors observed that for advertisers, testing the same commercial twice by the same method or by a different method was very uncommon. About 40 per cent of the advertiser respondents indicated that such repeat testing occurred less than 5 per cent of the time. About 20 per cent claimed to test a commercial twice by the same method or twice by a different method about 5 per cent to 25 per cent of the time. As regards the advertising agencies, about 90 per cent stated that they conducted the testing of a commercial twice by the same method in less than 5 per cent of the cases. Only 7 per cent of agency respondents claimed to test twice by the same method, 5 per cent to 25 per cent of the time. Another 37 per cent of agency respondents claimed to test twice by different methods in 5 per cent to 25 per cent of the cases.

On the basis of these results, the authors conclude that both advertisers and advertising agencies are indifferent in providing an assessment of the reliability and validity of the test methods that are used on a variety of products and copy executions. This clearly underlines the need for undertaking reliability and validity tests to improve advertising methods. Although such tests cannot be used continuously on account of the expenditure involved, some effort is called for in this direction.

MEDIA RESEARCH

The main issues in media research are: (a) How to choose amongst media types—television, radio and newspapers? (b) How to decide on a specific insert within a particular type of media, say, television? In order to decide on these two issues, it is necessary to have some data. The Advertising Research Foundation (ARF) suggested the following types of data for this purpose:

1. *Media vehicle distribution*: The circulation number for a magazine or newspaper or the number of television or radio sets available to carry the advertising.
2. *Media vehicle audience*: The number of people exposed to the media vehicle. This would be larger than the number in (1) above as more than one person reads the same newspaper/magazine or watches on the same television set.
3. *Advertising exposure*: The number of people exposed to a specific advertisement in the media vehicle. This number would be less than the number in (2) above as all those who are exposed to a newspaper/magazine may not notice a particular advertisement.
4. *Advertising perception*: The number of people who perceived the advertisement in question. This number would be less than that in (3) above. The people may perceive an advertisement because of several factors such as its large size, use of attractive colours or its positioning in the media vehicle or on account of the product involved.
5. *Advertising communication*: The number of people who comprehend specific things about the advertising. This number would obviously be less than the number of people who perceived.
6. *Sales response*: The number of people who buy the product in question as a result of advertising. This number would be far less than that in (5) above.

It may be noted that of these six categories, there is an interaction of media and message in the last four categories. This makes it difficult to obtain the numbers for media alone in respect of these categories. Accordingly, media vehicle data are generally obtained for the first two categories, viz., media vehicle distribution and media vehicle audience.

Media Audiences

Media research comprises, *inter alia*, the measurement of the size and break-up of individual vehicle audiences. We will discuss this under two heads—print media and radio and television.

Print Media

Prior to the reports of the Audit Bureau of Circulation (ABC), the measures regarding the individual vehicle audiences were those which the media themselves claimed. Such measures were rather inflated as any individual media vehicle would suggest that its circulation is far and wide. Since the ABC's reports are now available, these inflated measures have ceased. The ABC compiles its report which gives the size of circulation of a newspaper/magazine on the basis of certified audits.

This information while being useful, is not sufficient. It is difficult to estimate precisely the size of audience for a particular publication. The data collected by merely asking respondents as to whether they have looked at a particular copy would be unreliable. This is because some respondents may regard reading a particular magazine as a status symbol and hence they may report exaggerated readership. Likewise, reading of some magazines may be regarded as below one's status and hence their readership may be reported to be much less than in reality.

Another important aspect in determining the audience size for print media is the extent of duplication between magazines. This is because readership of three or more magazines among respondents is quite common. But the data on readership seldom give the extent of duplication. The problem is how to get the size of 'unduplicated' audience. A detailed study to determine the duplication among a large number of magazines would obviously be very expensive, not to mention the time it would involve.

Radio and Television

There are four methods to measure the size of the audience for any radio and television programme. These methods are discussed briefly below.

• *Coincidental method*: First of all, a sample of households having a telephone is selected. This is followed by an inquiry on telephone as to whether a particular programme on radio is being listened or being watched on television. Other information such as the name of the sponsor and the product being advertised is also collected.

The main advantages of this method are that it is quick and economical. It has some limitations though. First, the method has to be confined to only those households which own telephones. In a country like India, a large number of households do not have telephones and hence they have to be excluded. Second, since the enquiry has to be conducted while a particular programme is in progress only a limited number of households can be contacted in this short duration. Finally, it is extremely difficult to undertake an enquiry with respect to late night programmes.

• *Roster recall*: As the name implies, a roster or list of programmes is used to facilitate respondents to recall what programmes were listened to or watched. Respondents are contacted personally by interviewers.

This method has some major limitations. First, the responses are dependent upon memory. Second, depending on the status or popularity or otherwise of a particular programme, respondents may give their replies regardless of whether they have listened to a programme (or seen it). Third, the method is unable to provide information on a continuing basis. Finally, it is not possible to estimate duplication in the audience as respondents are approached for programmes within a short time period. It is possible to estimate the number of persons who watch both programmes, falling within the same time span on which respondents are being contacted.

• *Diary method*: As the name implies, the method uses a diary for estimating the number of persons listening to or watching different programmes. A diary, especially designed for this purpose, is issued to respondents who have agreed to furnish the desired information. Each respondent records his radio listening or television viewing, along the personal data such as age and sex in this diary. If respondents accurately record their radio listening or television viewing, this method would give accurate and complete information, eliminating the errors that may arise due to memory lapse and interviewer bias. Further, it is cheaper than other methods involving personal interviewing and recall.

However, in practice, one may find that respondents are not so careful in listing the programmes listened to or viewed by them. Besides, there is a lack of continuity in the flow of information as the diary method is unable to provide the estimate of an audience, say, minute-by-minute. Apart from this, some respondents in the panel may stop giving the information sought or move to another address. In such a case, how far the panel will remain representative of the population is a moot question.

• *The audimeter*: An audimeter is an electronic machine attached to a television set. As soon as the television set is turned on, the machine records it on the tape. In advanced countries, this method is frequently used. The audimeter ensures a continuous flow of information which is not possible in any of the earlier methods. This is its main advantage. Another advantage of this method is that there is complete objectivity in the information thus collected. Moreover it is possible to have a cumulative estimate of the audience since the audimeter sample will be almost same from month to month. The method suffers from some limitations as well. First, turning a set on does not necessarily mean that the programme in question is being watched. Second, the method cannot indicate as to who is watching a programme.

Setting the Advertising Budget

Whenever any company has decided to use advertising as an aid to carry out its business operations, it must decide how much to spend on advertising. There are a number of methods that can be used in setting the advertising budget. Of these, four methods are more commonly used. These are: affordable method, percentage-of-sales method, competitive parity method, and objective-and-task method. These are briefly discussed here.

1. Affordable Method As the name implies, many companies set the advertising budget on the basis of what they can afford. This, of course, is a very simple method, no extra effort is required for deciding the advertising budget. This method suffers from a major weakness as it leads to a fluctuating advertising budget. In view of this, the company may find it difficult to plan long-range market development.

2. Percentage-of-sales Method In accordance with this method, many companies set their advertising budgets at a specified percentage of sales (either current or anticipated) or of the sales price. This method has certain advantages. First, advertising budget is likely to vary with what the company can afford. Second, it enables management to think in terms of the relationship between advertising cost, selling price and profit per unit. Third, as several companies in the same business follow this method, it encourages competitive stability.

Despite the aforesaid advantages, this method has certain drawbacks. It uses circular reasoning in viewing sales as the cause of advertising rather than as the result. Further, it fails to provide any logical basis for the choice of a specified percentage. This may be based on the practice followed in the past, or what the competitors are doing. Yet another limitation is that it does not encourage advertising appropriations on a product-by-product and territory-by-territory basis. This is because here all allocations are made at the same percentage of sales.

3. Competitive-Parity Method Some companies follow this method which implies that they set their advertising budgets specifically to match competitors' outlays. This enables them to maintain competitive parity. Two arguments are advanced in favour of this method. First is that competitors' expenditures represent the collective wisdom of the industry. Second is that maintaining a competitive party helps to prevent advertising wars. But as no conclusive evidence is available, both these advantages do not seem to be valid. Further, on the same lack of evidence, it cannot be said that this method helps industry in stabilising advertising expenditures.

4. Objective-and-Task Method This method enables the company to decide on three things, namely, (1) what are the objectives of advertising? (2) In order to meet those objectives, what tasks are to be performed? (3) Estimating the cost of each task listed in (2) above .The total of these costs is the proposed advertising budget.

It will be seen that this method has strong appeal. On account of this advantage, this method is quite popular among advertisers. However, there is one limitation as the method fails to indicate how the objectives themselves should be chosen and whether they are worth the cost in attaining them.

EXAMPLES OF ADVERTISING RESEARCH STUDIES IN INDIA

An advertising research study dealing with Santoor, a brand of toilet soap was done by Ravi Menon and Ashutosh Sinha.[5] Simulated Test Marketing (STM) methods were used to choose between two alternative advertising themes for the relaunch of Santoor. Although the study relates to simulated test marketing which formed the subject of the preceding chapter, it is discussed here as it also pertains to advertising research.

Santoor was launched in 1986. In early 1989, a relaunch of the brand was being contemplated. At this time its distribution was not yet fully national. The few states where Santoor had been quite successful contributed to a large part of the brand's sales volume.

A number of changes were now contemplated: a new perfume and a new pack design, while distribution was to be extended to smaller towns and to all the states in the country. Finally, a change in the advertising was also planned: the brand was to be positioned 'for the modern woman.'

The advertising agency, Ulka, came up with two alternative appeals for advertising:

'Romance': to have soft fragrant skin that makes one attractive to men.

'Young Skin': to have youthful skin.

Three alternative advertisements were developed for the 'young skin' concept, while one was developed for 'romance'.

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[5] Menon, Ravi and Ashutosh Sinha, How We Chose an Ad Campaign for Santoor, Bombay, Indian Market Research Bureau, *Unpublished paper*.

In the first phase of the study, qualitative research using focus group discussions was conducted in Bombay, by Probe Qualitative Research (PQR). Of the three alternative advertisements for 'young skin', one ad (i.e., 'Bookshop') was found most appealing. The lone ad for the 'romance' concept was also shortlisted through qualitative research.

The two ads (one for each concept) thus shortlisted are described below:

Aamir Khan (Romance): The ad features a dreaming Aamir Khan (a film star).

Bookshop (young skin): The mother of a young girl is mistaken for a college student at a bookshop.

The question to be probed was: Will Aamir Khan actually succeed in generating a higher increment of trial?

An adapted form of an STM model was employed to answer this. The study was conducted in Bombay (where the focus was on the potential new triers for the brand) and Cochin (where the main interest was the existing user base: Kerala being a strong market for Santoor). Two panels of respondents were recruited. The Aamir Khan ad was shown to one panel, while the other panel was exposed to the Bookshop ad.

The exercise was carried out over the following five stages:

Stage I: Women who met the target group definition were recruited. The recruitment interview also assessed the brands of soap ever tried and those currently used. Preferences between brands were also measured using a Constant Sum Preference scale.

Stage II: Respondents were brought to a central location. They were shown advertising for Santoor as well as other ads in a clutter of commercials, after a short television programme.

Stage III: A coupon worth Rs. 12 was handed over as a 'gift'. The ladies were then led to a stall that stocked Santoor as well as several other brands. They were free to buy whatever they wished, or not buy anything at all, in which case they could collect cash in exchange.

Stage IV: An optional in the STM procedure. In order to obtain a detailed assessment of the advertising itself, the test advertisement was screened once again, followed by a short interview. At the end of this, the brand (Santoor) was given as a gift to those who had not purchased it at the simulated shop.

Stage V: After a lapse of a week, the respondents were once again interviewed at their homes for their evaluation of the product. Their preference between brands was measured once again, this time including Santoor in every instance.

The total sample size was over 500.

It may be noted that the STM system is based on the assertion that if we know something about a person's attitudes, we can make a statement about his or her likely behaviour. So if a person's preference between brands is known, then we can say something about his *relative chance of buying* these brands.

The study concludes that as the trial part of the model works well, this is a good method for advertisement testing. The trial at the simulated shop offers an absolute standard which is lacking in any kind of 'intention to buy' scale.

Another study[6] done by Sankara Pillai examines the impact of clutter on advertising viewership and recall. One of the major problems with regard to television media planning in India is the dichotomous choice between two types of vehicles. On the one hand, there is the option of buying an extremely high viewership programme that has a string of 30–40 ads, and on the other the choice is that of a moderate viewership programme with only moderate clutter level.

[6] Pillai, Sankara: *Impact of Clutter on Advertising Viewership and Recall: An Indian Experiment*, Bombay IMRB, *Unpublished paper*.

The study by Sankara Pillai uses Near-Coincidental Interviews and a series of controlled Forced Exposure Tests to provide measures of the effects of clutter on advertising. Before embarking on a study it was necessary to define how exactly clutter affects advertising. It was believed that there would be two influences at work. Firstly, the viewer may take advantage of the predictably long capsule to attend to other tasks. Thus, he may switch on the set later than the announced programme time or alternatively, even if the set is switched on, he may not be physically present in front of it. While the former situation implies a non-response to all or some of the ads, the latter situation would reduce the exposure from one of visual stimulus to that of an audio. There could also be intermediary situations in the quality of exposure, with the viewer being physically present in front of the set but doing something else, which results in varying degrees of attention being paid to the screen.

The second effect of clutter would be one of noticeability and registration of the advertising message. There is some evidence[7] to show that between 1965 and 1981, a period in which the number of ads aired increased greatly, the recall levels for the last ad seen on television declined from 18 per cent to 7 per cent. Krugman[8] hypothesis that this could be due to perceptual defence created by the viewer in the form of increased 'distraction opportunities'. Evidently, any study on the impact of clutter would also need to take into account the effect of clutter on noticeability and registration of the advertising message.

The study as designed by the IMRB, thus, had two separate components to measure each of these two effects. The method for measuring the first effect of clutter on set switching-on behaviour consisted of Near-Coincidental Interviews. Respondents pre-selected on demographic quotas were interviewed within 30 minutes after the conclusion of the programme. This was done to avoid interrupting the viewing which could lead to non-cooperation on the respondents part. The interview ascertained whether the programme was watched and if it was, whether the viewing commenced from the previous programme, the advertising capsule or after the commencement of the programme. If the viewing commenced during the capsule the exact time of starting the viewership was anchored by providing the respondent with the sequential list of advertisements telecast before the programme. The same technique was adopted to monitor the movement of the viewer out of the room, if at all, after commencement of viewing. For non-viewers of the capsule the opportunity-to-hear was also determined. Data were collected for 23 programmes in this manner with a sample size ranging between 200 and 400 for each programme. The study was carried out in nine places—four large metropolitan cities and five smaller towns. Of the 23 programmes, 11 belonged to the high clutter category while the remaining 12 were of the low clutter category.

For measuring the second effect, the impact of the clutter on noticeability and recall, a series of Forced Exposure Tests were carried out. Matched panels were exposed to a test ad (being aired for the first time) either in a low clutter capsule of 12 ads or in a high clutter capsule of 30 ads. All ads were in Hindi, of 20 seconds duration each, and represented major product categories advertised on TV. In either case, the ad capsule preceded 20 minutes of a popular programme. The position of the test ad was varied within the capsule to measure the effect of position. A total of 800 people formed the sample for this component of the study, with one half of the sample being exposed to the high clutter capsule and the other half being exposed to the low clutter capsule.

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[7] Lahman, C., "The Case of the 30-second Commercial" in *Journal of Advertising Research*, Vol. 23, No. 1, 1983, pp. 11–20.

[8] Krugman, H., "Point of View: Limits of Attention to Advertising" in *Journal of Advertising Research*, Vol. 28, No. 5, 1988, pp. 47–50.

The study clearly establishes that the impact of clutter is something that media planners can no longer ignore. This is especially true when planning TV media schedules for products targeted at certain segments, like the older age group, where the impact of clutter seems to be maximum.

Of the two effects of clutter on advertising, the impact of advertising noticeability and recall is much greater than that of the erosion of advertising viewership. Any study on the impact of clutter would, therefore, need to take into account both these aspects.

These examples of advertising research studies indicate that with the increasing importance of advertising in India, certain aspects of advertising are studied by professional marketing researchers. The studies also reflect the sophisticated methodology used in seeking out the right answers. It may be emphasised that these are only illustrative examples and in reality a wide variety of advertising problems are taken up for research from time to time. However, a good number of studies done by consulting firms are not made public because of the condition of confidentiality stipulated by the sponsoring organisations.

PARADOXES IN THE EVALUATION OF ADVERTISING RESEARCH

In the preceding pages, we have seen that a number of measures are used in measuring the effectiveness of an advertisement/advertising campaign. Both short-run and long-term measures are used for this purpose. In the former category are awareness, day-after recall, gross rating points per rupee, recognition, comprehension and persuasion scores. In the latter category are changes in customer attitudes and preferences, in brand loyalty, and in sales and market share performance. In this connection, it may be noted that there are certain paradoxes in the evaluation of advertising research. Zaltman and Moorman have brought out these paradoxes in an article.[9] These are briefly summarised below.

1. While many companies have conceded that short-run measures are not good indicators of the long-term impact of an advertising campaign, they seem to devote considerable attention to such measures.
2. Although advertising is considered as causative factor influencing market share and sales, it is strange to find that whenever market share and sales decline, the first casualty is the advertising budget.
3. A large number of client firms do not seem to have any specified objectives of advertising, yet advertising agencies seem to tolerate this. These agencies, on the contrary, should encourage their client firms to develop specific objectives or even to develop objectives for their own use.

Zaltman and Moorman make some important recommendations for the management and use of research. They especially emphasise the need for integrating advertising research into an overall programme of marketing research. Since advertising is only a sub-component of one element (promotion) of the marketing mix, any research that helps develop advertising programmes should also guide other marketing mix decisions. Further, they stress the need for focussing evaluative advertising research on the customer comprehension of an advertisement as was emphasised by Bijapurkar too. Developmental advertising research should concentrate on improving the commu-

[9] Zaltman, Gerald and Christine Moorman, "The Management and Use of Advertising Research" in *Journal of Advertising Research*, Dec. 1988/Jan. 1989, pp. 11–18.

nication for a given product concept and position. Since concept and positioning changes cannot be satisfactorily achieved merely by advertising, it is necessary to communicate this concept with other marketing mix activities

Summary

This chapter has first emphasised the importance of advertising and the need for advertising research. It then discusses the setting of advertising objectives pointing out that companies must be very clear as to what their expectations are from those objectives.

It then discusses the 'before' methods of copy testing. These are consumer jury, rating scales, portfolio tests, physiological tests, inquiry tests, laboratory testing, simulated sales tests and day-after recall tests. Likewise, 'after' Tests viz. recognition, recall and sales tests have been discussed.

This is followed by a detailed discussion of different methods used to measure the audience for any radio or television programme.

After having discussed methods of copy testing and media research, the chapter focuses on setting advertising budgets. Here it discusses four methods pointing out in each case their merits and limitations. Further, two examples of advertising research studies done in India have also been provided. The first relates to selecting an effective copy for advertising of Santoor toilet soap and the second examines the impact of clutter on advertising viewership and recall. Towards the end of the chapter, the need for more systematic copy testing research has been emphasised.

Finally, the chapter highlights the major paradoxes found in the evaluation of advertising research.

Key Terms and Concepts

Copy Testing 511
Consumer Jury 511
Rating Scales 512
Portfolio Tests 512
Laboratory Testing 512
Psychological Methods 512
Simulated Sales Tests 513
Media Research 515
Coincidental Method 516
Roster Recall 516
Diary Method 517
The Audimeter 517

Questions

1. Why is advertising research necessary?
2. Identify the major areas where advertising research can be helpful.
3. What are the two main issues involved in media research? Identify the type of data needed to conduct media research.

4. What are the 'before' methods of copy testing?
5. What are the 'after' methods of copy testing?
6. How would you measure the size of television audiences? Evaluate each of the methods that can be used.
7. Do you think that sales tests are a suitable method of measuring the advertising effectiveness? Why or why not?
8. Suppose that you are the manager of a large departmental store in a metropolitan city. You are interested in measuring the impact of the public address system on the sale of selected items such as soaps, soft drinks, etc. Describe how you would go about it.
9. Make out a case for undertaking copy testing research in a more systematic manner.
10. What are the major peoblems that a company has to face when setting measurable advertising objectives?
11. What are the different methods that can be used for setting advertising budget? Explain their relative merits and demerits.
12. What paradoxes are found in the evaluation of advertising research?

24 Market Segmentation and Brand Positioning

Learning Objectives

After reading this chapter, you should be able to understand:

- Market Segmentation
- Bases for Market Segmentation
- Requirements for Effective Market Segmentation
- Target Marketing
- Brand Positioning
- Components of Positioning
- Repositioning
- Integration of Market Segmentation and Brand Positioning

This chapter is devoted to two interrelated themes—market segmentation and brand positioning. Over the years, these have become important areas in marketing research. A proper understanding of these concepts and the procedures involved in identifying market segments and positioning of the product or brand in the target segment is of profound importance to marketing management. It enables the company to design most suitable strategies to improve its market share and earnings.

MARKET SEGMENTATION

Market segmentation is the process by which the total heterogeneous market for a product is divided into several sub-markets or segments. Each segment is homogeneous in all major aspects and is different from the other. In economic terminology it can be said that though there is only one demand schedule for the total market, if it is divided into different segments, each segment would have a separate demand schedule.

The need for market segmentation arises because a company with its limited resources cannot cater to the demand of the total market. In view of this, it has to identify the segments where its product would be most suitable and market that would be most profitable.

There are several benefits of market segmentation. It helps in designing products that match with the market demand. A company could determine the most effective promotional strategy and position its promotional efforts to synchronise with the period when the consumers' response is likely to be the maximum.

While the concept of market segmentation is simple, the problem arises when a company has to identify suitable market segments for its product or service. It has to identify segments in such a way that they are different from each other but have homogeneity within the segment. This is an extremely complex problem to be faced while segmenting the market.

BASES FOR MARKET SEGMENTATION

There are several ways by which a company can segment its market. The methods may vary from one product to another.

An important way of segmenting the entire Indian market is to divide it into (i) ultimate consumers and (ii) industrial users. The ultimate consumers buy and/or use products or services for their own use. In contrast, industrial users are industrial, business or institutional organisations which buy products and services in order to manufacture their own products. Since the two markets buy the products or services very differently, this division of the entire market into two, i.e., consumer market and industrial market, is extremely relevant and important from the viewpoint of marketing. In this chapter, the discussion is focused on consumer market segmentation. An illustrative list of bases for segmenting consumer markets is given in Table 24.1.

Table 24.1 Bases for Segmenting Consumer Markets

Demographic Bases	**Psychographic Bases**	**Behaviouristic Bases**	**Brand-related Attributes**
Region	Life style	User status	Brand perceptions
States	Personality	Usage rate	Brand preferences
Districts		Benefits sought	
City size		Readiness stage	
Density			
Climate			
Age			
Sex			
Family size			
Income			
Occupation			
Education			
Religion			
Social Status			

Demographic Segmentation

Market segmentation can be effected on the basis of demographic characteristics of the respondents. Demographic characteristics or bases are factors such as age, sex, race, nationality, religion, family size, urbanisation, income, occupation, etc. These measures are commonly used while segmenting the market.

Studies using demographic bases normally relate to large samples. They use structured and undisguised questionnaires for collecting primary data from the sample respondents. In addition to the demographic characteristics, the respondents are questioned on their purchasing power of a particular brand and their consumption rate of each brand.

It is said that in many cases, demographic segmentation is unable to discriminate perfectly between heavy and light users or between users and non-users. All the same, such a measure as rural-urban population or male-female respondents will show significant differences in usage rates of consumer goods. In view of this, demographic segmentation cannot be ignored. It is relatively easy to use demographic characteristics in a research study. In addition, it is easier to understand their impact on the level of consumption or usage. Such an understanding will, no doubt, be quite useful to advertising agencies to identify the media suited to get the desired results.

Psychographic Segmentation

Like demographic bases, the purpose of psychographic bases is the same, i.e., to identify various market segments. Psychographic bases are used to classify respondents with respect to their attitudes, beliefs, opinions and activities.

Several steps are involved in order to obtain psychographic data. First a number of statements are framed. Second, the statements are listed in random order in a questionnaire. Third, it is desirable to have several statements in a questionnaire for each activity, attitude, belief, etc., which is to be measured by the researcher. Finally, the respondents are asked to indicate to what extent they agree or disagree with each of the statements, say, on a ten-point scale. Respondents are asked to report their consumption of the given brand/product and of various advertising media. On the basis of these responses, the researcher has (i) to identify groups of respondents having different activities, interests, attitudes and opinions; and (ii) to ascertain how these groups differ with regard to their product, brand and media usage.

For example, let us consider a psychographic study[1] done by Pathfinders, a marketing research agency. Pathfinders conducted personal interviews of 10,303 working and non-working women, aged between 18 and 45 years, with family income of more than Rs. 350 per month, in 36 towns and cities across the country.

The study known as P : SNAP analysed the data collected from the interviews, conducted over a period of three-and-a-half months, and came up with eight identifiable types of Indian housewives:

1. *The gregarious hedonist:* Found predominantly in the east, she is most likely to speak Bengali and is intensely extrovert and liberal. She does not believe in sacrificing her life just to keep her family happy.
2. *The Contemporary housewife:* She is on the threshold of change. While she has not given up many traditional values, she aspires for modernity and is least likely to be living in north India. She feels the need to do something more meaningful besides housekeeping. She is fashion-conscious.
3. *The affluent sophisticate:* She lives mainly in the west zone. She is the highest user of all kinds of consumer products. She is comfortable talking to men outside her family circle, and would not mind if her children marry outside the community.

[1] Rahman, M., "Conforming to type", *India Today*, October 11th, 1987, pp. 124–125.

4. *The tight-fisted traditionalist:* Leading a sheltered life, she prefers to follow the film stars in her dress habits but is particular about prices. She restricts her circle of friends within her community. A majority live in north India.
5. *The troubled home-body:* Neither a leader nor an emulator, she is largely illiterate and is the least exposed to the media. Fashion takes a back seat and the future, according to her, is written in the stars.
6. *The anxious rebel:* Less likely to be found in the south, she would much rather be working than staying at home. She is anxious, thrifty but discerning in her shopping, though quite willing to try out new products.
7. *The archetypal provider:* Living overwhelmingly in the south, she is satisfied being a housewife. She sees TV much less than the average viewer, and is disinclined towards fashion. But she is ever willing to try out new food recipes, and loves to spend on her children and guests.
8. *The contented conservative:* She is extremely confident and probably the most efficient householder of all. She is a great optimist, is very conscious of the family's health and is, by and large, the advertising man's dream as she believes that ads are a great source of information.

The study observes that although the first three modern types represent more than 35 per cent of Indian housewives, life-style patterns outside the house remain largely traditional. As regards the housewives in different zones, it is the housewife in the east who emerges as the most modern and socially integrated. The housewife in the west is more confident of her ability to achieve something in life. The southern housewife emerges closest to the conception of conservative. The housewife in the north is introvert, the least hospitable and the most dominated by her husband. While the survey concludes that the Indian housewife sees herself basically as a traditional provider, all the same, a growing number of urban women are beginning to see themselves in a more modern context.

Limitations of Psychographic Segmentation

There are some limitations of psychographic segmentation. Some people hold the view that lifestyles of people are too heterogeneous to be classified into watertight groups. Even so, the general feeling among marketing people is that psychographic measures bring out some useful insights into market segmentation on the basis of such factors as attitudes, interests and activities of the respondents. Psychographic segmentation seems to be more useful as compared to the demographic segmentation. The former enables researchers to draw meaningful inferences in the sphere of advertising. *For example*, such studies may reveal how different segments respond to advertising messages. At the same time, a major limitation of such studies is that analysis of psychographic data is not only complex but also very subjective. A psychographic study generally involves the use of cluster analysis. There are different techniques of cluster analysis. The application of different techniques to the same set of psychographic data may bring out different market segments. Since the researcher himself has to choose a particular technique to be used, the analysis of psychographic data tends to be subjective. This is considered to be the major limitation of psychographic segmentation.

Behaviouristic Segmentation

Markets can also be segmented on the basis of the behaviour of respondents. One behaviouristic basis is to first identify heavy, moderate and non-users of a product and then to ascertain how demographic, psychographic and media usage characteristics vary among the three categories. This approach leads to the usage rate segmentation.

Usage Rate Segmentation

In order to use this method, it is necessary that data on the consumption of a particular product from a large number of consumers are available. Such data can be obtained through a consumer panel. If panel data are not available, then a field survey has to be undertaken to collect the requisite data. While collecting the data, a structured and non-disguised questionnaire is designed, provided demographic characteristics are to be used for segmentation. In the other case, a structured and disguised questionnaire is used. The measures of usage rate can be in the following forms:

(a) Users and non-users,
(b) Heavy users and light users, or
(c) Heavy users, light users and non-users.

The consumers' groups thus formed are then analysed either on demographic or psychographic measures.

It may be noted that in respect of several products/brands, a relatively small proportion of the total population accounts for a large proportion of total consumption. In view of this, the usage rate approach for market segmentation seems to be justified. This apart, the use of this approach is not only quite easy but also straightforward. These are the major advantages of this approach. As against these advantages, it has been criticized on the grounds that it fails to take into account the brand preferences of different consumers and is unable to provide any reason as to why a particular brand is chosen by a consumer and not the other brand/s. These shortcomings can be overcome if product or brand attributes approach is used instead.

Brand-related Attributes

In view of the limitations of the foregoing approach, there is now an increasing trend in favour of brand attributes approach. It is based on the consumers' perceptions of the characteristics of various brands. Here, it is believed that consumers always compare their perceptions of each brand's characteristics against an "ideal" brand. As these perceptions seem to form the basis for purchase decisions of the consumers, segmentation based on product or brand attributes has a distinct advantage.

Another way of predicting a consumer's purchase behaviour depends on two things, viz., his belief about the brand's attributes and the importance assigned to these attributes. Suppose a given brand has three attributes—attractive, smooth and durable. Further, suppose the relative importance of these three attributes is 4, 3 and 3; the total weight being 10. Now, a consumer assigns a score on scale of 10 to each of these attributes on the basis of his perception. These scores are: attractive 6; smooth 3; and durable 7. Then his total score for that brand will be $(6 \times 4) + (3 \times 3) + (7 \times 3) = 54 \div 10 = 5.4$. Similarly, scores for other competitive brands can be obtained. On the basis of the scores for each brand, it is possible to make a prediction of the consumer's preference ranking. Such an exercise will enable the researcher to know in depth (i) the product characteristics that different consumers want, and (ii) their perception with regard to these characteristics for each brand. If the researcher also knows the consumer's "ideal" with regard to these characteristics, then he can decide on the positioning of new products/brands. Decision on some related issues such as introduction of new products, repositioning old products and forecasting market-share trends can also be taken.

As regards statistical techniques for clustering of consumers into homogeneous groups, multiple discriminant analysis and cluster analysis are more frequently used. These techniques can also be used in studies on market segmentation based on product or brand attributes.

It may be pointed out that marketing management is favourably inclined to this approach. This is because of its relative advantage over other approaches. Its main strength is that it enables management to know how its brand is perceived by various segments in terms of the attributes which are important to them. On account of the availability of this information along with demographic, psychographic and media usage data pertaining to each segment, managers are in a position to choose target market segments. They can then design effective copy and media strategies for the preferred segments.

Despite this advantage, this approach is regarded as a very difficult exercise in marketing research on account of two reasons. First, it calls for a lot of competence and expertise for handling the large quantities of data involved. Second, the relationships brought out by the analysis tend to be merely descriptive and do not reveal any causes for the same. As a result, the conclusions drawn by marketing researchers tend to be based largely on their assumptions and inferences.

REQUIREMENTS FOR EFFECTIVE MARKET SEGMENTATION

Before we close this section, it may be worthwhile to know how market segmentation can be effective. There are three conditions which must be fulfilled if market segmentation is to be made effective.

1. The bases for segmenting, i.e., the characteristics on the basis of which customers are to be classified into different categories, must be measurable and the data accessible.
2. It is necessary that market segments are accessible. A company should cater to the chosen segment or segments on the basis of the existing channels of distribution, the advertising media and the sales force. This should be possible with minimum cost and waste.
3. Finally, the market should be segmented in such a manner that each segment is large enough for a company to have adequate sales and profits from the segment.

TARGET MARKETING

The foregoing discussion indicates how the marketing research can identify different segments of the market. Having thus identified market segments, a company may have to adopt target marketing. In this connection, there are three broad strategies available to a company from which it has to choose one.

The company may adopt the strategy of *undifferentiated marketing*, which implies that it may cater to the largest part of the market with one offer and marketing mix. Alternatively, it may go in for *concentrated marketing* which means it favours a narrow market segment and will develop the ideal offer and marketing mix for it. Yet another alternative before the company is *differentiated marketing* which means it has decided to cater to several market segments, developing an effective offer and marketing mix for each chosen segment. Excepting the undifferentiated marketing strategy, the company has to choose its target market segments.

How does one choose target markets? To begin with, the company has to analyse each segment as a distinct opportunity. Such an analysis will indicate the profit potential of each market segment. Once this information is available, the company has to consider several factors that are relevant in choosing the target market segment. These are: resources available with the company, product homogeneity, product stage in the life cycle, market homogeneity and competitive marketing strategies.[2] Once the target market segment has been identified, it will enable the company to concentrate all its promotional and media efforts for a given product or brand on the chosen market segment. It has to make itself fully aware of the target consumers' characteristics, needs and expectations. Since there may be some competitive brands in the same target market segment as the company has chosen, it has to decide how best it can 'position' its brand vis-à-vis other brands.

SEGMENTATION AND THE RESEARCH PROCESS

When a firm is considering seriously about market segmentation, it should be clear as to what difficulties are likely to arise and how the research process can overcome them.

1. **Sampling problem**: There is usually a sampling problem, which one quota sample or probability sample should be used? Often quota sample is used despite its limitations. The choice is mostly based on cost considerations ignoring the non response problem. It would be better if a small probability sample is used.
2. **Problem of Nonresponse:** Regardless of method used for data collection, in any survey there is the problem of nonresponse. Here too, the use of probability sample will enable the firm to have better control over callbacks. Thus the extent of nonresponse can be minimised.
3. **Which Method of Data Collection**? Before conducting a survey on market segmentation, the firm has to choose one of the methods for data collection. A variety of data collection methods are used but three of them are more frequently used. These are personal interviews, mail and telephone interviews. Each of these methods has advantages and limitations. The firm has to consider all aspects such as response, reliability and cost before making its final choice.
4. **Reliability of Data:** It has been observed that most of the segment studies have overlooked the question of reliability of data. This also applies to segment stability. The question: how stable will the segment be overtime? has received only scant attention, if at all. The firm has to find out which one is best in terms of balancing of reliability and costs.
5. **Method to classify Respondents:** The firm has to understand a variety of techniques in order to decide which are most appropriate to classify respondents into segments. This is very relevant as there are a number of techniques ranging from simple cross-tabulation to multidimensional scaling. In other words, on the basis of respondent profiles the firm has to decide how to discriminate among segments.

BRAND POSITIONING

Brand positioning is a relatively new concept in marketing. The concept owes its origin to the idea that each brand occupies a particular space in the consumer's mind, signifying his perception of the brand in question in relation to other brands. While product or brand positioning has been defined by various authors in different ways, the underlying meaning conveyed through these definitions

[2] Kotler, Philip, *Marketing Management*, New Delhi, Prentice-Hall of India Private Limited, 1981, Chapter 8, pp. 209–210.

seems to be the same. Instead of giving several definitions, we may give one here. According to Green and Tull,

> "Brand positioning and marketing segmentation appear to be the hallmarks of today's marketing research. Brand (or service) positioning deals with measuring the perceptions that buyers hold about alternative offerings."[3]

From this definition it is evident that the term 'position' reflects the essence of a brand as perceived by the target consumer in relation to other brands. In view of this, the management's ability to position its product or brand appropriately in the market can be a major source of company's profits. This seems to be an important reason for the emergence of product or brand positioning as a major area in marketing research.

COMPONENTS OF POSITIONING[4]

Positioning comprises four components. The first component is the product class or the structure of the market in which a company's brand will compete. The second component is consumer segmentation. One cannot think of positioning a brand without considering the segment in which it is to be offered. Positioning and segmentation are inseparable. The third component is the consumer's perception of the company's brand in relation to those of the competitors. Perceptual mapping is the device by which the company can know this. Finally, the fourth component of positioning is the benefit offered by the company's brand. A consumer can allot a position in his mind to a brand only when it is beneficial to him. The benefits may be expressed as attributes or dimensions in a chart where brands are 'fitted' to indicate the consumer's perceptions.

As perceptual maps are used to indicate brand positioning, blank spaces in such maps show that a company can position its brand in one or more of such spaces.

Techniques for Perceptual Mapping

There are a number of techniques for measuring product positioning. Some of these which are important are:

- Image profile analysis
- Factor analysis
- Cluster analysis
- Multi-dimensional scaling.

We will not go into the detailed mechanism of these techniques. All the same, we will briefly explain the techniques.

Image Profile Analysis

This technique is the oldest and most frequently used for measuring the consumer's perceptions of competitive brands or services. Normally, a 5 or 7 point numerical scale is used. A number of functional and psychological attributes are selected. The respondent is asked to show his perception

[3] Green, Paul E. and Donald S. Tull, *Research for Marketing Decisions*, New Delhi, Prentice-Hall of India Private Limited, 1986, p. 527.

[4] Based on Sengupta, Subroto, *Brand Positioning*, New Delhi, Tata McGraw-Hill Publishing Co. Ltd., 1990, Chapter 2.

of each brand in respect of each attribute on the 5 or 7 point scale. Figure 24.1 shows an illustrative image profile of four brands of detergnt powder.

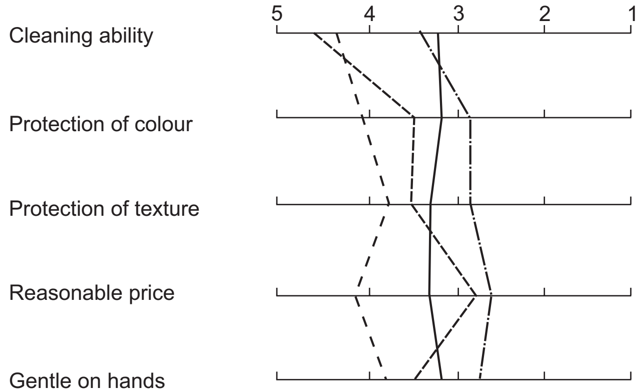

Fig. 24.1 Image Profile of Four Detergent Powders

It will be seen that the figure[5] provides some insight as to which brands are competing with each other and on what attribute(s). The technique has some limitations. First, if the number of brands is large, it may not be possible to plot all the brands in a single figure. Second, there is an implicit assumption in this technique that all attributes are equally important and independent of each other. This is usually not true. However, this limitation can be overcome by using the technique of factor analysis.

Factor Analysis

As regards factor analysis, it was mentioned in Chapter 19 that its main object is to reduce a large number of variables into a small number of factors or dimensions. In that Chapter three examples have been given to illustrate the use of factor analysis. This discussion also brings out some major limitations of the method.

Cluster Analysis

Cluster analysis is used to classify consumers or objects into a small number of mutually exclusive and exhaustive groups. With the help of cluster analysis, it is possible to separate brands into clusters or groups so that the brand within a cluster is similar to other brands belonging to the same cluster and is very different from brands included in other clusters. This method has been discussed in Chapter 19.

Multi-dimensional Scaling

Multi-dimensional scaling can be used to show how perceptual maps can be developed on the basis of responses from consumers. In this connection, two illustrations of perceptual maps were given. The first illustration[6] related to selected Business Schools based on hypothetical data. On the basis of two criteria, viz., how prestigious and quantitative an MBA course is, different Business

[5] Adapted from *Ibid.*, p. 243.

[6] *See,* p. 427.

Schools have been shown in the map. It will be seen that the MBA course of Business School 'C' is extremely different from that offered by Business School 'G'. Points which are close to each other indicate similarity of the MBA courses in the student's perception. The second illustration[7] related to four brands of washing soaps based on a survey data from Calcutta. This is a non-attribute based example where a paired comparison for four high-and-medium-priced detergents—Surf, Sunlight, Gnat and Key was undertaken. As mentioned there, Sunlight and Surf are closest and Surf and Key are farthest. In other words, the first two brands are most similar and the remaining two are most dissimilar. How the points in the figures for the four brands have been arrived at, has been explained at length in that chapter and so is not repeated here.

Subroto Sengupta has discussed at length product positioning in his book. While explaining different techniques of product positioning, he has shown how the concept of positioning can be used to improve the image of the concerned product or brand. He has given a number of examples covering a wide variety of products such as coffee, soft drinks, washing soaps, toilet soaps, shampoos and magazines. As Sengupta points out the perceptual maps of product class also indicate holes or vacant positions in the market. These open spaces can be helpful to the management in suggesting new product opportunities as also possibilities for repositioning of old products. While it is true that the management does get the clues on preferred attributes of the product in question, it is unable to know all the relevant features of the new product such as its form, package and price. This problem can be overcome through the application of the conjoint analysis. In addition, Sengupta has discussed some research studies in respect of advertising positioning.

Having discussed different components of positioning, which are in fact the techniques applied in positioning a product, we now give some idea about the success and failure of certain brands. The discussion is very brief and it is only illustrative. Table 24.2 shows five brands which were successful while three brands which failed on account of improper positioning. It will be seen from the table that in each case a number of reasons for success have been attributed. Likewise in respect of failed brands, except Crown Glory Soap, multiple reasons are given for their failure.

Table 24.2* Success and Failure of Selected Brands

Success Stories

Brands	**Reason for success**
Clinic Plus Shampoo	• Successful; positioning and distinct identity with the 'anti-dandruff/health' platform • Captured the South Indian market—a predominantly health market • Reached fast to product redefinitions like sachets • 'Clinic' and 'Plus' created positive associations with the doctor in rural areas
Ponds Talc	• Early advantage and is now a 'pillar brand'; the benchmark in the talc market with over 50% market share

[7] *See,* pp. 428–429.

* Original Source: Moorthy, YLR: Brand Management: The Indian Context, Vikas Publishing House, New Delhi, 2003. The above table is reproduced from an article "Managing a Brand" by Kanishk Gupta and Indira Bisht, published in PITCH, Vol. III, Issue 1, October 15, 2005.

Contd.

Brands	Reason for success
Lifebuoy Soap	• Good product • Cost cutting by bulk buying of packaging material • Value for money—low price, 150 gm soap • Long-lasting benefit appeals to target audience • Positioning—health and being a winner • Stayed contemporary without changing core values
Close-up Toothpaste	• Creatively positioned in the market on the 'social confidence' plank • Innovative product 'gel' • Advertising and promotional support
Colgate Toothpaste	• Positive in-use experience by consumers • Pioneer advantage and family habits • Consistently maintained positioning 'Suraksha Chakra' • Successful on ground activities and extensions for the rural market - Colgate Toothpowder

Flop Shows

Brands	Reason for failures
Crowning Glory Soap	• Improper targeting—a soap for hair and body targeted at an up market audience
Camay Soap	• Went for a low-price positioning in India whereas its international positioning is the reverse • Confused brand identity
Promise JFK (Just-For-Kids)	• Worldwide, kids' toothpaste market is miniscule (2% of the total market) • Tooti-frooti flavor made parents worry about children swallowing the toothpaste • Indian families do not buy more than one toothpaste especially for children

The information given here relates to the period 1993–99.

REPOSITIONING

As the term suggests, repositioning is changing the positioning of a brand. The need for repositioning arises when the existing positioning of a brand does not give the desired results. In his book "Brand Management – The Indian Context", YLR Moorthy has examined the repositioning of several brands. On the basis of careful examination, Moorthy has identified the following nine types of repositioning:

1. Increasing relevance to the consumer
2. Increasing occasions for use
3. Search for a viable position

4. Making the brand serious
5. Falling sales
6. Bringing in new customers
7. Making the brand contemporary
8. Differentiate from other brands
9. Changed market conditions.

Under each of these repositioning types, Moorthy gives some examples. It should be noted that the nine categories are not mutually exclusive. At times, one may find that a particular brand has been repositioned on account of multiple reasons. This suggests that it is not on account of declining sales alone that the change in positioning is required. A number of other reasons necessitate the corporations to reconsider where their products stand vis-à-vis other competitive products. If necessary, suitable steps should be taken so that their products stand out distinctly different from others.

By way of illustration, Table 24.3 shows repositioning of seven products. Alongwith repositioning, earlier positioning is also shown.

Table 24.3 Repositioning of Selected Products

Product	Earlier Positioning	Repositioning
Increasing Relevance to Consumer		
Lipton Yellow Level	Exotic and Foreign	Exotic and Indian
Kelvinator	The coolest one	The Refrigerator designed by a housewife
Increasing Occasions for Use		
Burnol	Curing Burns	3-in-1 (Burns, Cuts and Gashes)
Odomos	Indoor	Indoor + Outdoor
Titan	Watch with Elegance	Watch as a Gift
Search for a Viable Position		
Centaur	Hotel with Style (Sophisticated)	Hotel for Business Class (Functional)
Hero Puch	90 km/litre Fuel Efficiency	2-in-1 Bike Efficiency + Pick up

(*Source*: Moorthy, YLR : Brand Management : The Indian Context, New Delhi, Vikas Publishing House, 2003.)

An Illustration of Repositioning of Brand

We now give a detailed version of a study indicating how a brand which was putting up a poor performance in the market was repositioned. As a result, it improved its image and contributed to increased market share and profits.

A study done by the Indian Market Research Bureau (IMRB)[8] relates to repositioning of the Singer sewing machine. In the early eighties, Singer, which was renamed the Indian Sewing Machine

[8] Indian Market Research Bureau *Racing Ahead in Reverse Gear*, a paper presented at MRSI/ESOMAR Conference held in Bombay on 1st and 2nd March, 1993. The authors of the paper were Arun M. Joshi and Sandeep Saxena.

Company Limited, realised that the market for sewing machine had come to near stagnation. This was partly on account of a multitude of new household appliances.

On the basis of a focus-group study, the study team came to know the presence of two segments in the market. One segment described the sewing machine as "a must and a utility that gives convenience." The other segment was one where there was a growing perception that sewing is a drudgery. A quantitative study gave indications of the size of the two segments existing then:

Drudgery Segment	57 per cent
Utility Segment	43 per cent

It may be emphasised that over the years, Singer had come to be seen as a brand that embodied the values; trustworthy, dependable and durable. However, these core values were no longer motivating enough for the drudgery segment. The Sewing Machine Company Limited, therefore, needed to improve its image. It wanted to add new values in the form of "excitement" and "creativity" for its product. Accordingly, the company set up a plant to manufacture a sophisticated sewing machine, which was characterised by a large variety of decorative stitches, and advance technology. In early 1986, Fashionmaker entered the Singer showrooms.

The study team hypothesised that Fashionmaker would have made an impact (a) on the brand image of Singer, as well as (b) on the product category *per se*. As there was no suitable pre-launch study, the study team made use of data from a study that was done after the launch of Fashionmaker.

For this purpose, a quantitative study was done to collect data on attitude to sewing at home. This was through obtaining the level of agreement/disagreement on a Likert scale for each statement in a battery. In addition, data were obtained on brand image of Singer and Competition.[9] For this purpose, a semantic-differential scale was used to collect ratings of the two brands on a set of pre-chosen image attributes.

Data on attribute to sewing were gathered from a representative sample of housewives. As regards brand image data, interviews of sewing machine owners and potential buyers were conducted.

The study team chose to split the sample into two parts: (a) one part contained respondents who were not exposed to Fashionmaker in any way, and (b) another part contained the rest. It was ensured that the profiles of the two parts were fairly well matched on key demographic dimensions so that there might be comparability of data between pre-Fashionmaker situation and post-Fashionmaker situation.

The data on attitude to sewing were used to understand the segments in the market. Use was made of the technique of cluster analysis, and then, of discriminant analysis to enable the study team to describe the clusters.

The analysis showed a dramatic shift in the post-Fashionmaker situation. A new third segment emerged, together with a shrinking, "drudgery" segment. The new segment did not see sewing at home as a laborious task. It held the view that the machine was meant for much more than repairing and alterations—perhaps, for more frequent and creative use.

In order to know the changes that have taken place in brand image, the attributes of brand image were reduced to "factors", and then these were regressed against the "overall" attribute to arrive at the importance attached to the factors.

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[9] A strong regional player in the market.

As would have been expected, with the appearance of the new segment "versatility" in the market, the post-Fashionmaker situation saw emergence of two new dimensions—"exciting" and "creative" as being important.

Table 24.4 shows the relative importance of image dimension in the two situations.

Table 24.4 Relative Importance of Image Dimensions

Pre-Fashionmaker Situation		Post-Fashionmaker Situation	
Image Dimension	**Relative Importance (%)**	**Image Dimension**	**Relative Importance (%)**
Trustworthy, dependable and durable	53	Trustworthy, dependable and durable	41
Attractive looks	24	Exciting and trouble-free	18
Leader	23	Creative	16
		Leader	15
		Modern	10

Based on the results of the factor analysis of the image attributes, the study team determined the scores for the two brands—Singer and the Competition, on the key dimensions. It found that Singer had been able to gain an edge over the Competition through reorganising its set of values.

The study has thus shown how the emergence of new segments followed by suitable advertising has enabled the management to reposition Singer sewing machine.

In this connection, it will be interesting to know some observations made by Ranu Raj.[10] Writing on the importance of brand image, the author observes that, "new product development could also mean recycling existing brands... The real excitement comes from recreating the brand, from changing its image in consumers' minds and by adding drama to the product." The author further goes on to observe that Horlicks, the age-old brand of HMM, regained its dipping volumes by injecting a fresh lease of life into its fading product image. The brand was given a new formulation feeling by adding calcium into its existing ingredient mix, by changing its advertising, packaging and labelling. In short, adding value of the equity of the brand, and making it more contemporary and relevant to new, emerging needs of consumers.

The impact of brands over society has become substantial. Brands now belong to more than just their consumers or shareholders. Over the past three decades, brands are being pushed to earn the trust of society at large via environmental stewardship and social responsibility.

Many firms, despite their best efforts, are unable to create successful brands. They make some wrong decisions at varying stages in which a brand passes through until its final stage. David Aaker has suggested some steps that ensure eventual success of a brand. These are as follows.

1. A concept needs to be identified and there are a dozens of ways to accomplish that objective. Some are based on customer insights and others on advances in an offering or its delivery system.

[10] Raj, Ranu, The Importance of Brand Imagery, *Business World*, September 13–26, 1989, p. 13.

2. The concept needs to be evaluated and care taken that the firm does not inflate market response. At the same time, it should not be too pessimistic about its ability to bring the idea to market.
3. The firm needs to build barriers to competition through ongoing innovation. It may have to develop a strong brand either by preempting the best customers, or by other approaches.
4. The firm needs to manage the image and preference towards the new category or subcategory. This, no doubt, is a very different task than building a brand. In this context, David Aaker emphasises the concept brand relevance, which indicates that the firm must make the competitors irrelevant. This can be realised by developing offerings so innovative that they form new categories or subcategories. David Aaker holds that such an approach, with rare exceptions, is the only way to grow a business profitably.

INTEGRATION OF MARKET SEGMENTATION AND BRAND POSITIONING

At this stage, the need for combining market segmentation study and brand positioning study may be emphasised. As a consumer segment would respond to a brand that occupies the position preferred by it, so also a brand must be positioned to appeal to the target consumer segment. In other words, the two should be integrated. As David W. Cravens has rightly observed, "Target market and positioning strategies are like the two sides of a coin. They are inseparable and each depends upon the other."[11]

Green and Tull provide a good example of integrating target segment and positioning of brand (beer) in their book.[12] The authors conducted a study in a particular region of the United States, taking a sample of males addicted to beer. The data related to 12 different brands of beer. On the basis of this study, the authors showed how the questions of product positioning and market segmentation and propensities of consumer switching from one brand to another could be interrelated in a single study. It is, therefore, advisable to combine market segmentation and brand positioning in a more comprehensive single study. Such a study will be far more useful to the management in formulating suitable marketing strategy of the company than the two studies done at different times, as if they are completely unrelated.

Summary

The chapter first explains the concept of market segmentation. This is followed by a discussion of four types of segmentation, namely, demographic, psychographic, behaviouristic and usage rate segmentation. It then specifies the requirements for effective market segmentation. The focus then shifts to the problems encountered by a firm engaged in segmenting its market. In this context, what measures should be taken by the researcher have been mentioned.

Subsequently, the chapter focuses on brand positioning. It explains the concept and components of positioning. It then discusses four techniques used for brand positioning— (i) Image profile analysis (ii) Factor analysis (iii) Cluster anslysis, and (iv) multidimensional scaling. The subsequent discussion relates to repositioning of brands along with an illustration.

[11] Cravens, David, W. *Strategic Marketing*, Richard D. Irwin, 1982.

[12] Green, Paul E. and Donald S. Tull, *Research for Marketing Decisions*, New Delhi, Prentice-Hall of India Private Limited, 1986, pp. 545–551.

At the end, the chapter emphasises the need for integrating market segmentation and brand positioning. This, no doubt, is a more rational approach than the practice normally used overlooking matching brand with market segmentation.

Key Terms and Concepts.

Questions

1. What are the requirements for effective segmentation?
2. Distinguish between the consumer characteristics approach and the product approach to market segmentation.
3. What do you understand by demographic and psychographic measures of market segmentation?
4. What are the merits and limitations of the psychographic approach to market segmentation?
5. Distinguish between market segmentation based on (i) usage rate, and (ii) product or brand attributes.
6. What, in your opinion, would be the most suitable way to develop market segments for (a) wrist watches; (b) detergents; (c) coffee?
7. Explain the concept of positioning.
8. What are the different components of positioning?
9. What are the different techniques of brand positioning? Explain any one of these in detail.
10. What do you understand by the term 'perceptual maps'? How are they useful in positioning a product or brand?
11. What procedure would you use in developing perceptual maps?
12. Describe how you would go about developing a brand-positioning study for (a) shampoos; (b) magazines.
13. Critically examine the methodology used to reposition Singer sewing machine in the light of the write-up given in the chapter.
14. Is it advisable to combine market segmentation and positioning into a single study?

25 International Marketing Research

Learning Objectives

After reading this chapter, you should be able to understand:

- Need for International Marketing Research
- Distinguishing features to international marketing research
- Problems in international marketing research
- Organising international marketing research
- Information requirements for IMR
- Use of secondary data (Desk research)
- Collection of primary data (Field survey)
- Major sources of error
- Analysis and interpretation of data
- Preparation of report

International marketing research has been defined as research conducted to assist decision making in more than one country. The importance of international marketing research has been aptly emphasised by Milton L. Rusk' while releasing the publication of American Management Association, Marketing Research in International Operations, as far back as in 1960:

"Marketing abroad is no longer simply a matter of skimming the cream from the top of rich markets. Today, successful marketing abroad requires thorough market investigation and effective sales follow-through. Market investigation means market research; determining market possibilities, evaluating competitive conditions, directing local customs, tastes and preferences. On the basis of this research, marketing and sales plans and advertising programmes are shaped, products and corporate images succeed or fail."

This shows that international marketing is a highly complex operation which cannot be carried out efficiently and successfully unless it is based on sound research. At the simplest level, international marketing research involves research studies in single market outside the firm's domestic market. Multicountry research programmes are more elaborate and complex and need far more time for their completion. Multicountry research can be conducted either simultaneously or sequentially to enable marketing decision making in more than one country.

Although international marketing research is not totally different from domestic marketing research, there are certain crucial factors which suggest the need for the former.

WHY IS INTERNATIONAL MARKETING RESEARCH NECESSARY?

In the area of international marketing, the role of marketing research is crucial. It is the first step for any firm which wants to engage itself in international business. The following factors make it clear why international marketing research is necessary.

1. In order to identify which markets should be selected, marketing research will be very helpful in determining the market size, market potential, accessibility and competitive factors.
2. Marketing research will enable the identification of suitable products and the prospects of its acceptability.
3. In foreign markets, packaging needs to be appropriate to build the demand for the product. Research will enable to take right packaging decisions.
4. Research can even check the firm in making an inappropriate market entry. After proper analysis of business environment, research can guide the firm whether it should export its product by using agents or distributors, go for a joint ventures or open subsidiary units.
5. In pricing of the product, research can be quite helpful as it requires considerable amount of data collection and analysis.
6. Another issue that is important in international marketing is the positioning of the product. For this, research has to analyse socio-economic factors. In case the product has been wrongly positioned, it is unlikely to succeed.
7. In order to ensure that the product continues to have a favourable market, research has to be watchful in taking cognizance to changing business environment. It may even suggest promotional campaigns as and when necessary to push up the demand for the product.

WHAT IS DIFFERENT ABOUT INTERNATIONAL MARKETING RESEARCH?

The major differences that distinguish domestic marketing research from international marketing research can be clubbed under two heads, viz., national differences and comparability of research results. These are briefly discussed below.

National Differences

Within this group, several aspects are covered. These are differences in culture, race, climate, economy, religion, history, consumption pattern, marketing, condition. All these factors are relevant when a firm decides to enter a foreign country for business. Some of these are more important than others, for example, culture influences widely patterns of behaviour within a large group of people. This also influences buying behaviour of people. No doubt, the impact of these factors would vary from country to country. In view of this, when a firm has chosen a certain country for its business, it should be fully aware of those factors that have major influence on the population.

Comparability of Research

Quality research must give such results that cannot be questioned. In other words, any one who goes through the research report, feels that the study has been carried out objectively. In case of multicountry research studies, this aspect becomes all the more important. In such studies, the researchers should ensure the comparability of responses that are obtained with similar instruments of measurement. This, no doubt, is quite challenging which can be taken care of by an experienced and skilled researcher.

International Marketing Research (I.M.R.)

I.M.R. covers the entire gamut of marketing research studies. At one end can be a single country research, while at the other end can be extremely complex multicountry research.

1. **Single-Country Research:** At times the researcher is interested in formulating and implementing of marketing strategies in a foreign country market. This is undertaken when one finds that there is good scope of exporting products from the home country.
2. **Multicountry Research:** Multicountry research can take three different forms as discussed below.
   (a) *Independent Multicountry Research:* This is the most common form of I.M.R. Such studies are normally conducted by subsidiaries or branches of MNCs independently on the same product in a number of countries. This approach has two limitations. First, there is duplication of effort such as preparation of questionnaires, etc. Second, such studies are conducted at different time periods. They are not done simultaneously in a number of countries.
   (b) *Sequential Multicountry Research:* As the name implies, multicountry research is conducted in a sequential manner. First, one or two countries are taken up for study. On the basis of experience gained in these countries, other countries are subsequently involved in the research programme. This approach seems to be quite beneficial as the problems encountered in conducting research in the first one or two countries, can be avoided in subsequent countries. Another merit of this approach is that due to experience gained, the researcher can apply better focus on the subsequent countries. Yet, another merit is that costs of conducting the research are spread over a longer time period. It is advisable to have a well-prepared overall research plan right at the beginning so that research studies on different countries follow the same procedure and, as a result, spurious international differences can be avoided.
   (c) *Simultaneous Multicountry Research:* Here, as the name suggests research is undertaken in several countries at the same time. This approach is considered the "purest" form of international marketing research. This form of research is complicated and involves unique problems since the situation in each country can vary significantly. Obviously, this approach offers great challenge to the researcher who should be intelligent and dynamic in quickly understanding varied problems.

PROBLEMS IN INTERNATIONAL MARKETING RESEARCH[1]

There are special problems and conditions in export marketing research which differentiate it from the domestic marketing research.

First, marketing researcher may have to analyse several national markets instead of a single national market, if the company wants to be well informed. Since each of the national markets has unique characteristics, the marketing researcher has to bring them out distinctly in his analysis. As small markets may have low profit potential, it may be advisable to undertake marketing research on a modest scale in respect of such markets. The marketing researcher may have to use such research techniques which are suitable in view of modest profit potential. In fact, the decision to undertake marketing research and the amount to be spent on such research would involve the same approach as explained earlier in Chapter 3 on Value of Information.

Second, the problem of reliability of secondary data available in the concerned country/countries becomes extremely relevant. At times it is felt that the statistics available in developing countries are not realistic and they are manipulated in order to show a rosy or gloomy picture on account of political and other considerations.

Third, if research involves the collection of primary data through a survey in a foreign country, the export marketing researcher may sometimes find it difficult to collect such data. This may be on account of the reluctance of respondents to give the required information to foreigners who are strangers. This problem is further accentuated especially in rural areas which account for a sizeable proportion of total population and where the level of education is very low.

Fourth, when a survey is to cover two or more countries, differences in economic and social environment, demographic aspects, physical distribution facilities, legal constraints etc., would affect the comparability of data.

Fifth, the availability of media may also affect the comparability of data for two or more countries. In most of the developing countries, for instance, telephonic interviewing would be quite inappropriate as a large proportion of households do not own telephones. Further, as a vast majority of households do not own TV sets in developing countries, the effect of TV advertising may not be comparable with that in advanced countries where TV sets are owned by a good majority of households.

Finally, religious and cultural customs vary from country to country. These may pose obstacles to marketing researchers particularly when they undertake field surveys. For example, in the Middle East, interviewing housewives may pose a problem on account of the *purdah* system.

In view of these special difficulties in international marketing research, one has to be extremely careful in conducting such a study, particularly, if it is to be based on a field survey.

ORGANISING INTERNATIONAL MARKETING RESEARCH[2]

A company intending to enter overseas markets for its products has to ensure that marketing research is organised on sound lines. There are several methods that may be used in organising a

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[1] Based on Keegan, Warren J. *Multinational Marketing Management*, New Delhi, Prentice-Hall of India Pvt. Ltd., 1982, p. 214.

2 Based on Chisnall, Peter M., *Marketing Research*, London, McGraw-Hill Book Company, 1992 (IVth Ed.), p. 305.

marketing research study. The company has to know their strengths and limitations so that it can make a judicious choice. In this context, the alternative methods for conducting research are, using

— own staff;
— importing agents;
— research agencies in overseas markets;
— a domestic marketing research agency along with the services of a consultancy firm in the importing country; and
— the services of a consortium of research agencies.

Each of these methods has some advantages and limitations. As regards the use of own staff, it may be pointed out that it would be very expensive. As such, only large companies can afford to use this method. Most of the multinational companies use this method.

Using the services of importing agents may not give an objective assessment of the market as they may have other interests. This apart, as research is a highly specialised job, it is doubtful whether importing agents can give adequate information with absolute objectivity.

As regards the use of a research agency in overseas markets, its major advantage is that it will be very well informed of its home market. However, it may be difficult to select the right marketing research agency as complete information about different agencies may not be available to the exporting company. It is because of this reason, there is an element of risk in choosing an overseas marketing research agency.

Perhaps, the fourth method, viz., using a domestic marketing research agency along with the locally based consultancy firm offers some advantages over the preceding method. The method is, however, complicated on account of the difficulty in ensuring a meaningful link between the two organisations. Small and medium-sized companies which do not have their own trained research staff may find this method quite suitable.

An exporting company may hire the services of a consortium of research agencies. Apart from being expensive, the quality of service may considerably vary amongst the member firms. If the exporting company can ensure proper coordination amongst the member firms of the consortium, the method may be extremely useful in having adequate and reliable information of overseas markets.

In India, export marketing research is undertaken at different levels. First, there are several specialised corporations such as the State Trading Corporation, the MMTC, etc. Second, we have industry-wise export promotion councils for major industries. Third, there are specialised institutions such as the Indian Institute of Foreign Trade, the India Trade Promotion Organisation that are engaged in export marketing research. Fourth, there are consulting firms specialising in marketing research which may take up export marketing research on behalf of the sponsoring firm. Finally, large companies both in the public and the private sector too undertake such research on their own depending on their individual requirements.

As was mentioned earlier, it may perhaps be more appropriate for the above-mentioned agencies to seek the help of an overseas agency when research involves a field survey. Such a collaboration will improve the quality and comparability of primary data, when two or more countries are involved in the survey.

SCOPE OF EXPORT MARKETING RESEARCH[3]

The scope of any given export marketing research will depend on the following considerations:

(i) the objective of the proposed research;

(ii) the nature of the product, its market and marketing arrangements, and the availability of relevant data about them;

(iii) the availability of financial resources and time; and

(iv) the competence, experience and training of the marketing researcher.

It may also be noted that in most of the cases, marketing research agencies will indicate a compromise between the information *desirable* to obtain and the information *possible* to obtain given the factors listed in (ii), (iii) and (iv) above.

The marketing researcher has to organise his research in such a way that the study is completed within the stipulated time and budgetary allocation. He has to decide how much and what type of secondary data are to be used and how primary data, if necessary, are to be collected. Finally, he has to decide on the methods of analysing data. To a great extent, the quality of research will depend on the competence, experience and organising ability of the marketing researcher himself.

The discussion that follows first specifies information requirements for international marketers and then deals with the secondary data. Finally, it deals with the collection of primary data through a field survey.

INFORMATION REQUIREMENTS OF INTERNATIONAL MARKETERS[4]

Although the nature of marketing decisions does not differ from country to country, on account of environmental differences, information needs may vary from one country to another. A company intending to do business abroad may undertake studies in different spheres such as markets, promotion, distribution, price or products. Information requirement in each of these spheres will vary as will be evident from the discussion that follows:

Market information

When a company intends to test a market before entering it or even when giving it up, it needs information on market performance, market share, and sales analysis and forecasting. This information can be obtained through market research.

Product information

A company operating in foreign countries has to decide which product line it should add, which it should discontinue, and which needs to be strengthened. In order to take a sound decision on these issues, the company requires a good deal of information. Apart from product line information,

[3] Based on GATT International Trade Centre, *Export Marketing Research for Developing Countries*, Geneva, 1967, mimeographed, pp. 30–31.

[4] Based on Jain, Subhash C., *International Marketing Management*, Boston, PWS-KENT Publishing Company, Third Ed., 1990, Chapter 10, pp. 322–328.

the company may need information on individual products. For example, it may like to know the behaviour of product life cycles in different countries in respect of one or more of its products.

Promotional information

Marketing research can provide information on promotional activities of the company, i.e., advertising and direct selling. The company may have to decide how much expenditure on advertising is to be made, what media are to be used for advertising, which copy is to be used so that the best possible results can be obtained, etc. Likewise, marketing research can be helpful in taking decisions on personal selling such as number of salespersons to be appointed, their remuneration, formation of sales territories and the allocation of salespersons to these territories.

Distribution information

Marketing research can be helpful in providing information on the availability of channels and their relative desirability. Again, requisite information on warehousing, inventory, and transportation can be collected through proper marketing research studies.

Price information

Pricing a product is a crucial problem before a company. It may like to know what price is to be fixed for its product so that it can maximize its profit. The effect of price on the demand for its product has to be ascertained. Here, too, marketing research can find out the consumers' perception in respect of a given product's quality and price.

Environment information

Regardless of the nature of international marketing study, it is necessary that marketing researchers take into account different types of environment in a foreign country of interest. This means that they scan the economic, political, social, cultural and legal environments so that marketing strategies can be decided in the light of special features obtained in these environments.

General research information

The foregoing discussion briefly indicated the type of information needed in specific areas. However, in any overseas marketing research study, some general information is needed. This is spelt out below:

1. *General information* about (a) community-type conditions such as elections, cultural events, religious celebrations, etc. (b) business conditions such as business ethics and traditional associations (c) lifestyles and living conditions, i.e., social and cultural customs and taboos and (d) general economic conditions such as the standard of living of various groups of people and the economic infrastructure such as transportation, power supply, and communication.
2. *Industry information*: government policies affecting industry, availability of land and labour, current or potential competitors, local companies as also third country companies, etc.
3. *Study-related information*: collateral data generated to complete a particular marketing research study. This information will vary on account of the nature of study. *For example*, if a study relates to the introduction of a new product in a foreign market, it may need information on the existing products, technology available in the country, sources of raw materials, and possibilities of setting up joint ventures.

USE OF SECONDARY DATA (OR DESK RESEARCH)

Export marketing research can be undertaken on the basis of either secondary data or primary data or a combination of both types of data. In the literature on export marketing research, the term 'desk research' is used to indicate the collection and analysis of secondary data. Through proper desk research, it is possible to conduct a preliminary screening. This will enable the marketing researcher to identify those export markets which are potentially attractive. This preliminary screening should be reasonably comprehensive so that one may not overlook more prospective export markets. One should not only know the most promising overseas markets but should also know why certain markets do not need any further investigation.

International agencies such as the United Nations, International Monetary Fund, the OECD provide data on such items as population, education, national and per capita income and position with regard to foreign exchange. In particular, the OECD's World Trade Statistics and the United Nation's International Trade Statistics are useful sources of secondary data. In addition, national government publications are available on import regulations, customs duties and related legislation affecting marketing. Many countries bring out yearbooks or statistical abstracts that are immensely useful to an exporter.

Sources of Secondary Data in India

A major source of the most authentic data on foreign trade is the Government of India's publication entitled *Monthly Statistics related to India's Foreign Trade*. These statistics are published in separate volumes for export and import trade. The statistics contained in this publication are quite comprehensive. A potential exporter can know from this source and nature and extent of exports to different countries, the rate of change in exports, etc.

Another source of information on various aspects of export marketing is available in the research studies done by the Indian Institute of Foreign Trade, India Trade Promotion Organisation and Export Promotion Councils.

At times, the financial dailies such as *The Economic Times* bring out special features, each time devoted to a particular country, for different countries. They contain useful and most recent information.

Like export statistics, import statistics of the selected importing countries are important. Such statistics may be available in foreign embassies or consulates in India and chambers of commerce. Besides, Indian embassies abroad may furnish some broad information to a potential exporter on request. Major sources of secondary data are given in Appendix 1 to this chapter.

Secondary data are becoming more plentiful in quantity. In addition, their quality has improved over the years. Studies based on secondary data are obviously much cheaper. The marketing researcher should, therefore, explore fully the availability of secondary data. However, before using such data, he must ensure their reliability and suitability for the proposed research by evaluating such data. He must follow the same detailed procedure for their evaluation as described in Chapter 7 on Secondary Data.

COLLECTION OF PRIMARY DATA (FIELD SURVEY)

Sometimes the information required by an exporting firm is just not available. In such a case, the marketing researcher has to be extremely vigilant in organising it.

In order to conduct a field survey in a foreign country, the marketing researcher has to follow the same steps that are involved in a domestic survey. Since these steps have been explained earlier in Chapter 4 on "The Research Process", they are not repeated here. However, some additional precautions are needed. For example, when marketing research is to be undertaken in a country where English language is not commonly used, it is necessary to get the questionnaire translated in that foreign language. Proper translation of the questionnaire is very necessary. Again, for conducting the interviews, properly qualified interviewers have to be recruited on an ad-hoc basis for that survey only. It is advisable to hire the services of a professional marketing research agency in the country concerned. This will be extremely helpful to the firm as it will have to face several difficulties in conducting the field survey in a foreign land. However, it will indeed be quite expensive to avail the services of a professional marketing research agency. Only large firms which are keen to export their products in overseas markets can afford to do so. Even when a company is able to afford large expenditure on marketing research after it has been convinced that it will pay off, it may not be able to do so on account of restrictions on the release of that much of foreign exchange. However, in view of liberalisation policy of the government and increase in India's foreign exchange resources, the government may release the foreign exchange as needed.

A field survey in a foreign country can be of two types, viz., product-oriented survey and market-oriented survey.

Product-oriented Survey

A firm which is exploring the possibilities of selling its product or products in foreign markets may undertake a product-oriented survey. Keeping in mind its own product, it will try to identify those countries where this product is consumed, the extent and pattern of its consumption, price at which it is available in the overseas market, the countries currently exporting it and the magnitude of competition. It has to be a comprehensive survey. The types of data that may be collected for such a survey are shown in Appendix 2 to this chapter.

Market-oriented Survey

In a market-oriented survey, a firm may like to know which product or products can be sold in a particular market. Here, the firm has already identified one or more countries where it would like to export. It will be primarily interested in identifying the products that are currently imported in that market and the possibility of marketing any new product there. Such a survey may be extremely useful to an export organisation or a new unit which is interested in entering the export trade.

Need for Personal Visits

Even when primary data are being collected through a field survey without the visit of the exporter himself, it may be difficult to know the nature and extent of competition in the foreign markets. A personal visit to that country will provide the exporter with an opportunity of having discussions with knowledgeable persons and agencies. It will also enable him to form perceptions of consumption patterns and habits of the population as also of the current business practices in that country. Such information will be immensely useful for a comprehensive and perceptive export marketing study. Further, personal visits to foreign countries may also be helpful in setting up contacts which can be exploited in the subsequent marketing effort. It would be much better if these visits coincide with specific product fairs in the concerned countries.

MAJOR SOURCES OF ERROR IN INTERNATIONAL SURVEYS[5]

Since surveys conducted in foreign countries to collect primary data are not so easy as the domestic surveys, certain errors crop up in such surveys. It may, therefore, be worthwhile here to know the major sources of error so that one may avoid them to the extent possible. It may be noted that a detailed discussion on the sources of errors has been given in the chapter on the Research Process. However, here the emphasis is on the lack of comparability on account of cultural differences in different countries.

Definitional Error

Such an error arises on account of lack of conceptual, definitional, temporal and market structure equivalence. Conceptual differences may arise, for example, in respect of certain food products which are either not known in some countries or are used differently. Definitional equivalence is an offshoot of the conceptual problem. Further, temporal equivalence may be affected if the surveys are not conducted simultaneously in the concerned countries. The comparability of data may be vitiated on account of seasonal factors in some countries while they are non-existent in others.

Instrument Error

An instrument error may arise on account of problems of linguistic equivalence, contextual equivalence, instrument equivalence and response style equivalence. Linguistic equivalence may get distorted while translating a questionnaire in another language. A contextual equivalence may get distorted, for example, in the Middle East where the respondents may resent the visit of the interviewer to their homes on the ground that it is an intrusion into their privacy. As such, they may be reluctant to give the desired information. As regards instrument equivalence, it may be difficult to establish. But one may say that a telephone survey, for example, may not yield representative data for all countries. Finally, response style equivalence deals with the style of people responding to the interviewer. Respondents in some countries may be quite willing and cooperative while in others they may be reluctant and reserved. Between these two extremes, there may be several variations depending on the extent of cooperation.

Frame Error

This type of error arises on account of the varying sampling frames used for different countries. Some sampling frames, on the basis of which a sample is drawn, may be defective in the sense that they account for a relatively small proportion of the population. Further, the definitions of dwelling units and households may be different in different sampling frames.

Selection Error

This type of error arises in the process of selecting respondents in two or more countries. For example, if a study is undertaken to compare consumption behaviour in respect of say, breakfast cereal, in two countries A and B, it may happen that respondents in country A may be comparable with

[5] Based on Kirpalani, V.H., *International Marketing*, New Delhi, Prentice-Hall of India Pvt. Ltd., 1987, pp. 263–265.

those in country B, except their age. Country A may have proportionately more young respondents than in country B. This may have an impact on the consumer behaviour in the two countries. As a result, their consumer profiles are not strictly comparable.

Non-response Error

On account of the variation in response in two or more countries, the non-response error will arise. To a large extent, the magnitude of response will vary on account of educational and cultural differences in the countries covered in the survey.

Sampling Error

This type of error is the only one which is free from cultural differences in different countries. On the basis of statistical principles, the sampling error can be computed.

Further, one should note that it is extremely difficult that a survey will be completely free from any error. Even in a domestic survey, it is rare that all errors are completely eliminated. In a multinational survey, errors are bound to arise. All the same, the marketing researcher should try to minimise the varying types of errors so that the comparability of data can be maintained.

ANALYSIS AND INTERPRETATION OF THE DATA AND PREPARATION OF THE REPORT

When all the data from the secondary sources or/and through a field survey have been collected, it is necessary to process these data. Sometimes it is seen that poor data processing has reduced their utility despite the fact that enormous effort was made as also considerable expenditure was incurred in their collection. Proper processing of data will enable the researcher to have suitable statistical tables. Chapter 14 deals with this aspect in detail.

After the tabulation of data, the researcher has to ensure their analysis. There are different methods of analysis ranging from simple averages and percentages to a host of multivariate techniques. A judicious selection of one or more of these techniques in a given problem has to be made. Different techniques of data analysis have been discussed in detail in Chapters 14 to 19. As many export marketing research studies will be concerned with the export potential and demand forecast of a given product in an overseas market, it is necessary that sound forecasting methods are used. As mentioned earlier in Chapter 21, a number of subjective and objective methods of forecasting are available to the researcher. He has to ensure that the method he uses is the best, keeping in view the limitations, if any, of the data collected.

As regards interpretation, it may be pointed out that data analysis and interpretation are interlinked. Often analysis of the data and the interpretation of results are done simultaneously. The brief discussion on interpretation as given in the beginning of Chapter 20 is equally relevant here.

After the data are processed, tabulated, analysed and interpreted, the researcher has to prepare a report on the research study. Needless to say, the report should be objective and reasonably comprehensive. It should be written keeping in mind the objectives of the study. It may be emphasized that writing a good report is not as simple as it might appear before one actually attempts to write. Chapter 20 provides guidelines for the preparation of a research report. The researcher should particularly indicate the reliability as well as the limitations of the facts presented in the report. In addition, sufficient care must be exercised to ensure that the report enlightens the prospective exporting firm in respect of the following questions:

1. Will it be profitable for the concerned firm to enter the foreign market under consideration?
2. Are the products as currently produced by the firm acceptable in the markets surveyed? If not, what product modifications will be necessary in terms of quality, packaging, presentation and sizes?
3. At what competitive prices can the market potential be gainfully tapped?
4. What distributional strategy the firm will need to adopt in the concerned market?
5. What publicity and promotion will need to be undertaken by the firm?
6. In case an after sales service is needed for the given product, can it be entrusted to an existing local concern? If not, will the firm have to train people for the same?

Needless to say, if the report on export marketing research fails to provide a clear direction to the prospective exporting firm in respect of the foregoing questions, then all the efforts made and money spent on the study will be in vain.

Summary

To begin with, the chapter defines International Marketing Research (IMR), pointing out that it is not totally different from Domestic Marketing Research (DMR). There are two major aspects on which IMR differs from DMR. These are; (1) national differences and (2) problems of comparability of results. The chapter then deals with the classification of IMR, namely (a) Single-country research (b) multicountry research (c) sequential multicountry research, and (d) simultaneous multicountry research.

This is followed by a discussion on the problems normally faced in IMR. The chapter then explains how IMR is to be organised. The collection of both primary and secondary data along with the problems to be encountered in the process has been discussed.

Major sources of error in IMR have been discussed in some detail. The chapter then deals with the analysis and interpretation of data. Finally, the chapter focuses on the preparation of the research report.

Key Terms and Concepts

Single country research 542
Multi-country research 542
Desk research 547
Field survey 548
Definitional error 549
Instrument error 549
Sampling error 550

Questions

1. Discuss the importance of international marketing research.
2. What factors would you take into consideration when conducting marketing research in a foreign country?

3. “International marketing research is far more complex than the domestic marketing research.” Comment.
4. Assuming a specific topic/problem, you have decided to conduct a marketing research study in a foreign country, describe step-by-step how would you proceed.
5. Explain in some detail as to how you would proceed to shortlist possible overseas markets for your product.
6. What errors are likely to arise in an international field survey?
7. If you were to conduct a product survey for a prospective foreign market, what would be your data requirement for the same?
8. Describe the major challenges faced by researchers in obtaining information on an international marketing research study.
9. What are the national differences involved in an international research study?
10 “Regardless of the purpose of research it must be ensured that it makes valid comparisons between the countries covered.” Comment.

APPENDIX 1

MAJOR SOURCES OF SECONDARY DATA FOR INTERNATIONAL MARKETING

A. Information Available from International Agencies

1. The United Nations
   - (a) The Statistical Yearbook of the United Nations (Annual)
   - (b) Economic Survey of Europe (Annual)
   - (c) Economic Survey of Asia and the Far East (Annual)
   - (d) Economic Survey of Latin America (Annual)
   - (e) Economic Developments in the Middle East (Annual)
   - (f) World Economic Survey (Annual)
   - (g) World Trade (Annual)
2. GATT
   - (a) Analytical Bibliography—Market Surveys by products and by countries
   - (b) Guide to Sources of Information on Foreign Trade Regulations
   - (c) Compilation of Basic Information on Export Markets
   - (d) Compendium of Sources: International Trade Statistics
   - (e) World Directory of Industry and Trade Associations
   - (f) Directory of Product and Industry Journals
3. Organisation for Economic Cooperation and Development (OECD)
   - (a) OECD Economic Surveys
   - (b) OECD Economic Outlook (Semi-annual)
   - (c) Monthly Statistics of Foreign Trade
4. International Monetary Fund (IMF)
   - (a) International Financial Statistics (Monthly)
5. The World Bank
   - (a) World Bank: Annual Report
   - (b) Research publications on different economic aspects of developing countries
   - (c) Staff papers on various topics
6. International Chamber of Commerce (ICC)
   - (a) ICC/ESOMAR International Code of Marketing and Social Research Practice
   - (b) International Code of Direct Mail and Mail Order Sales Practice
   - (c) International Uniform Definitions for the Distributive Trade
   - (d) Marketing: Discipline for Freedom
   - (e) Media Information for Advertising Planning
   - (f) Advertising Agencies: Their Services and Relationship with Advertisers and Media
7. Economic Intelligence Unit, London
   - (a) Various commercial publications

B. National Governments

Statistics and market information available in the publications of the governments of concerned countries

C. Chambers of Commerce

Various Publications

D. India

(a) Monthly Statistics of the Foreign Trade of India
Vol. 1—Exports and Re-exports
Vol. 2—Imports
(published by the Department of Commercial Intelligence and Statistics, Govt. of India)
(b) Indian Trade Journal (Weekly) (DCIS)
(c) I.I.F.T.—Various Studies
(d) Export Promotion Councils —Various Studies
(e) Foreign Trade Bulletin (Monthly) published by I.I.F.T.
(f) National Council of Applied Economic Research: Studies on export marketing

E. Magazines and Newspapers

The Financial Times, London
The Economic Times and other Indian financial dailies
International Trade Forum — published quarterly by the International Trade Centre UNCTAD/GATT

F. Service Organisations

Service organisations such as large commercial banks, large accounting firms, consultants are also a major source of information on foreign markets.

APPENDIX 2

CHECKLIST ON OVERSEAS PRODUCT SURVEY

(a) Demand Potential

- Annual consumption (production + imports–exports)

(b) Projections, taking into account

- growth in population;
- growth in income;
- income distribution;
- domestic product plan;
- changes in consumer preferences;
- introduction of substitute/new products.

(c) Market Segment

- per capita income;
- age;
- education;
- profession;
- ethnic background;
- geographic location.

(d) Trading Parameters

- tariff rates;
- quotas;
- import licensing system;
- special product specific regulations, as for example relating to pharmaceuticals and edible items;
- membership of a customs union or similar trading arrangements;
- multilaterial preferential agreements such as GSP or Bangkok Agreement;
- bilateral trade agreements.

(e) Pricing

- prices of competing products;
- prices prevailing at various levels such as importers, distributors, wholesalers and retailers;
- mark-up at each stage of the distribution channel;
- agency commission;
- preferred method of quotation such as F.O.B. C.&F. C.I.F., and the preferred currency.

(f) Payment Terms

- D/A;
- D/P;
- letters of credit;
- credit period.

(g) Logistics

- transport packing;
- retail packaging;
- type of transportation available;
- frequency of transportation;
- freight rates;
- warehousing and cold storage facility.

(h) Promotion

- availability of media;
- rates;
- trade fairs and exhibitions

Source: Varshney, R.L. and B. Bhattacharyya: *International Marketing Management*, New Delhi, Sultan Chand & Sons, 1998, pp. 329–330.

26 Organised Retailing

Learning Objectives

After reading this chapter, you should be able to understand:

- The Concept of Retailing
- Importance of Retail Industry
- Growth of Organised Retailing
- Problems in Organised Retailing
- Customer Relationship
- Relationship Marketing
- Retailing Research
- Future Outlook

THE CONCEPT OF RETAILING

Let us start with a simple question: what is retailing? When a company produces a product, the objective is to sell it to a consumer. The transfer of the product from the producer to the ultimate consumer does not take place so directly. In fact, in between the producer and the consumer is a middleman or retailer who is a link between the two. A retailer can be any one--an individual, agent, agency, company or an organisation.

There can be several ways in which retailing can be done such as door-to-door visits, mail and the most sophisticated internet. One or more of these modes is used to approach the prospective customer. Here we are concered with organised retailing.

Unlike kirana or mom and pop stores, organised retail stores refer to outlets that sell consumer goods from food, personal care, home appliances and furniture, apparel and accessories ranging from discounted formats to luxury brands. Most of these are either family-owned businesses or corporations which have invested in multiple format chains.

The genesis of organised retail was scripted from south India. The south is considered to be the largest and most developed region for modern trade. No wonder then that four Southern states rank highest in penetration of retail outlets in India and a sizeable proportion of corporates' sales.

Organised Retail Formats

Format	Stocks	Value Proposition
Supermarkets/Convenience stores	Food and Household products	Convenience
Department stores	Multiple product categories, usually lifestyle driven, with apparel accessories predominating	Service and choice
Hypermarkets/Discount stores	Large stores big box format, with volume based discounted prices	Price and choice
Speciality store/category killers	Extensive range of products under a single category	Service

(*Source*: Technopark Analysis, Crisil Research)

Operations Performed in Retailing

Organised retailing is not merely stacking and selling the product. A number of functions are performed in retailing. Broadly, the main functions of retailing can be classified as retail marketing and merchandising management, customer service and operations.

To begin with, the retailer arranges an assortment of products that he has decided to offer to the prospective customers. He gets the products in bulk. As such he has to break the bulk quantity. Having done this, he has to hold this stock for sale. Apart from these, the retailer offers certain services to his customers such as granting credit, home delivery of the product sold, after-sales services and providing information in respect of a new product or service.

In a large scale retailing business, operations like vendor management, warehouse management and inventory management are part of supply chain management (SCM). The SCM functions are exclusively IT driven. As such, their use offers the competitive advantage over other retailers.

IMPORTANCE OF RETAIL INDUSTRY

In the advance countries, retail business is the largest industry, contributing over 8 percent of the GDP. In some developed countries, the share of retail business is as large as 40 percent of the market. In recent years the retail industry has registered an overwhelming increase mainly on account of exceptional growth in the service sector.

In India, the retail sector is the second largest employer, the first being agriculture. However, it mainly comprises small, independent and sole-proprietory shop, which are scattered all over the country. The organised retail sector is extremely small as we shall see shortly.

GROWTH OF ORGANISED RETAILING

Although the traditional grocery shops or Kiranawalas still dominate the retail market in India, accounting for as much as 96 per cent of the total retail trade, organised retailing is growing fast. According to an estimate, its annual growth is around 30 per cent, accounting for about Rs. 35,000 crore, or about 3 per cent of total retail sales.

In 2005, India had only 155 shopping malls operating. It has been projected that this number would be 600 by 2010 as shown in Figure 26.1. It can be seeen that there has been a very rapid increase in the number of malls. Further, at present the shopping malls are mostly confined to metros, but in the coming years, they would be set up in large non-metro cities and towns all over the country. At present, shopping malls are operating in a good number in Delhi, Gurgaon, Noida, Mumbai, Chennai, Kolkata, Bangalore, Hyderabad, Pune, Ahmedabad, Jaipur, Lucknow, Chandigarh, Ludhiana and Indore. Within the next two years, many other cities would have shopping malls. A recent announcement from Mukesh Ambani led Reliance group stated that the group would be investing as much as Rs. 1 lakh crore in setting up shopping malls even in moderate-size towns across the country.

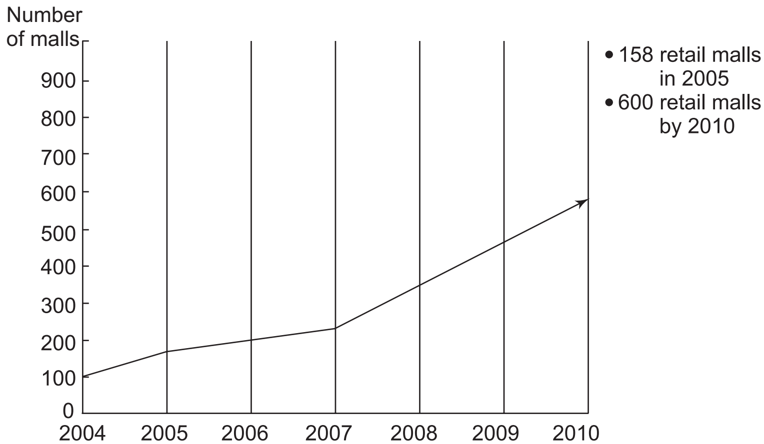

Figure 26.1 Growth of Shopping Malls in India

Out of 220 mall projects in pipeline to 2007, 125 are in the six major cities
· Mumbai · Delhi · Chennai · Kolkata ·Bangalore · Hyderabad
Source: IMAGES RETAIL Vol. 5, No. 9, September 2006, p. 75.

Factors Contributing to the Growth of Organised Retailing

With such an enormous growth of organised retail in a short period, the question that arises in one's mind is: What are the reasons for such a remarkable growth in organised retail?

1. **Urbanisation.** A major reason is urbanisation of the countryside. The rural population, which was 74.3% of the total population in 1991, declined to 72.19% in 2001 and it is expected at 71% in 2006 on the assumption that the same rate of decline continues in rural population.
2. **Convenience.** Earlier a consumer has to visit several shops to buy a variety of things. A major advantage of organised retail is that it offers much convenience in the form of one-stop-shop where he can get all his requirements.
3. **Quality Goods.** Another reason for the popularity of retail trade is that these retail stores sell quality products. A buyer has full faith in the genuineness of the product. Right from the date of their opening, these stores have always offered quality goods. This assurance over the years has built up an extremely favourable image of these stores in the minds of customers.

4. **Prompt After-sales Service.** The traditional stores are found to be reluctant to provide after-sales service or even when they provide such a service, there is too much of time lag. Customers may have to remind them from time to time to attend to their complaints. But this is not the case with organised retail stores. In fact, availability of quality goods, coupled with prompt after-sales service, has made organised retail chains distinctly different from the traditional stores.
5. **Rising Household Income.** This is perhaps the most important factor which induces the customer to go in for better and more decent products available in the market. The per capita income at current prices, which was Rs. 6012/- in 1991–92, had risen to Rs. 18988/- in 2002–03. This was more than 3 times of 1991–92 per capita income. This is for the country as a whole. The per capita income in urban India would obviously be higher than for the entire country. It is common knowledge that, as income increases, the aspirations of the common man too undergo a significant change. He starts using better things to have a more comfortable living. This is how after a span of few years he finds himself enjoying an improved standard of living.

Organised Retail to Grow in India

According to Crisil Research, total retail market in 2010–11 was Rs. 21.6 trillion. The share of different groups in the retail business was follows:

Food and grocery	65%
Beauty, personal care and pharma	12%
Clothing	6%
Consumer Durables	5%
Soft Furnishing	5%
Hard Furnishing	3%
Communication	2%
Footwear	2%
Books and Music	1%

Crisil Research hopes that organised retail will have a promising growth by 2014–15. The growth will be driven by higher penetration, expansion by organised players across different groups and geographies. In addition, a major factor for the growth of organised retail will be the changing consumer preferences. This will be further accelerated on account of shift of household incomes. For example, in 2010 households whose annual income was Rs. 1 lakh, accounted for 51 percent of total number of households. After 5 years in 2015 this figure is expected to decline to 39 percent. In this way, in other income categories, too, upward movement of households is expected. This will enable consumers to shift their preferences.

According to one source, India's retail industry was worth $ 323 billion by the end of 2011, making it the 10th biggest retail industry in the world in value terms. In next five years, it is expected to reach $ 469 billion.

Expanding Reach,[- Increasing Loss

						(Figures in Rs. Crore) Jan-Dec
Retailers	**Sales**		**% Increase**	**Loss**		**% Increase**
	2009–10	2010–11		2009–10	2010–11	
Reliance Retail	2599	3132	21	177	247	40
Aditya Birla Retail	1411	1637	16	541	423	22
Trent Hypermarket	290	520	79	29	51	76
Bharti Retail	133	470	253	170	266	56
Total	4,433	5,759	30	917	987	8

(*Source*: Sagar Malviya: "Retail Chains Expand Numbers as well as Losses in *The Economic Times*, 14 December 2011)

The table given above shows data on sales as well as on losses for four selected organised retailers for two years 2009–10 and 2010–11. It can be seen that there has been an overall increase of 30% in sales in 2010–11 compared to 2009–10. However, the retailers taken together sustained a loss of 8% in the corresponding period. This seems to be surprising as one would expect some profit in retail business. The main reason for this situation is that retail has a long gestation period before reaching breakeven point. In contrast to these retailers, retail chain such as Future Group's Big Bazaar opened most of their stores before the retail rush five years ago. In view of Big Bazar's early entry, when there was not such high competition, its gestation period was rather short.

Many corporate houses having retail chains feel that foreign direct investment would enable cash-starved domestic retailers to de-leverage their overly stretched balance sheets by bridging the gap between capital required for expansion and retailers' ability to raise capital.

PROBLEMS IN ORGANISED RETAILING

Organised retail has many problems which have to be looked into. In fact, here research can be quite helpful. Let us see what major problems confront an organised retailer.

1. **Non-availability of Appropriate Space.** As organised retail provides a number of products to the shoppers under one roof, its requirement for large space is very genuine. The prospective retailers have to search for suitable locations for their business. As there is no space available in central business districts, new retailers, planning to set up their stores, have to go to distant places. Even if some space is available in central business districts, the price will be too high on account of excessive demand for that space.

   Apart from this, there are some legal requirements which have to be complied with. The retailers have to get some research study done to determine the most suitable location keeping several relevant factors in mind of which cost factor will be most important.
2. **Inadequate Information about the Demographics.** Another problem faced by retailers is the non-availability of adequate and proper information about the demographics. In fact, the biggest challenge for retailers is to understand their consumers. Since India is a vast country, consumer behaviour is bound to be different in different parts of the country. Studies may have to be undertaken to develop customer profiles, their shopping preference, volume of

purchase and so forth. Electronic devices will have to be used to build up databases. It has to be ensured that databases are always up-to-date. That is to say, these databases have to be maintained on a continuing basis.

3. **Non-availability of Qualified Manpower.** A major requirement of retailers is to have skilled and trained front staff so that they are able to serve the customers well. Since many MNCs are planning to set up shopping malls in India, the demand for trained workforce is going to be very high. The image of the retailers depends to a large extent on the quality of their workforce, their behaviour with the customers, their promptness in handling any complaints or to sort out any problem/situation that may suddenly crop up.

   Great care has to be exercised in the recruitment and training of the workforce. This is one of the ways by which the image of the retailer can be enhanced.
4. **Interruptions in Supply Chain.** The large retailers cannot carry on their business smoothly unless there is a steady inflow of various products that are on sale. This means that the supply chain should not be interrupted. Contrary to expectations, it is highly fragmented with a large number of intermediaries squeezing the margin of all involved, which also includes the retailer. Apart from poor margins it results in cases of mishandling and thefts.

   The retailers have to set up dependable inventory management systems as well as well thought-out marketing plans. In the Western countries, the large retailers such as Wal-Mart, Sears, Marks and Spencers and McDonalds have managed to set up their own supply/distribution chains. Large retailers in India too have to follow this to enhance their business.
5. **Recourse to Advertising.** In order to promote business, retailers have to take recourse to advertising as it is a major tool for promotion. In the present economic environment and due to technological advancements, competition has significantly increased. In view of this, several issues crop up in advertising. First, what should be the size of advertising budget? Another issue is: what media is to be used, whether ad should be given in print or on TV or a combination of these and other media. Then comes the question of copy, i.e. what should be the message in the advertisement? These aspects have been disussed earlier in Chapter 23 on Advertising Research.

There is yet another issue, namely, the selection of ad agency. Here, the retailer has to select the ad agency very carefully. Expertise and experience, as also reputation of the ad agency would be very relevant while selecting an ad agency.

Finally, the retailer has to determine as to how far his advertisement or an ad campaign has been effective i.e. the measurement of advertising effectiveness.

CUSTOMER RELATIONSHIP

The essence of retailing is to identify the customer and to retain him by providing him quality goods and services at reasonable prices. The focus of retailing must be the customer. If this is overlooked, the retail business would not be able to flourish. In this context, it is interesting to note what the former Vice-Chairman and Chief Operating Officer Don Soderquist of the world's largest retail chain Wal-Mart has said.

He says: "Right from the beginning at Wal-Mart, the pre-eminent part of its decision-making process has always been on the customer." The author elsewhere in his book* emphasises on cus-

* Don Soderquist, *The Wal-Mart Way*, Delhi, Pearson Education, 2006.

tomer satisfaction. He says, "You can serve people without satisfying them, but it is impossible to satisfy them without serving them. Satisfaction is the goal, and at Wal-Mart, we determined to accept nothing short of that, because we know that when customers are satisfied over a long period of time, that's when we create trust. And trust is the foundation of every relationship in life." This amply shows that customer satisfaction is overwhelmingly important in retail business.

In an article**, Dennis Gardeman, who has over 30 years of experience in Retail Trade, emphasizes that retailers must have a focus in developing their retail business. He says: "Knowing what market is, knowing what your customer is, understanding your merchandise, understanding the tenant mix and the merchandise mix—all of this very important to bring focus into your business. But how do you begin to target that? Well, it would seem that all customers want 'more for less'— better, faster, cheaper." Figure 26.2 shows this clearly the expectations of the customers— 'More for Less'.

It should be obvious from the above that a successful retailer would be one who strives to give the best to his customers to keep them fully satisfied.

Fig. 26.2 Expectations of Customers from Retailers.
(*Source*: IMAGES RETAIL Vol. 5, No. 9, September 2006.)

PROSPECTS FOR ORGANISED RETAILING

Despite the foregoing problems faced by retailers, there are some factors that go in their favour. These are briefly explained here.

With GDP growth of around 8 percent and the per capita income above Rs. 50,000, the people in the country are well placed to escalate their consumption. Further, almost two-thirds of the

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** Gardeman, Dennis: "Hitting Bull's Eye: Retail Strategies" in IMAGES RETAIL, Vol. 5, No. 9, September 2006.

country's population is below 35 years of age whose life style is undergoing change. This, coupled with more than 50 percent of the country's population comprising middle class, would boost the demand for variety of products. Another factor favouring organised retailing is the entry of large diversified business houses into retail. Finally, the involvement of foreign direct investment (FDI) in single brand retail is expected to provide diversified brand offerings to consumers. At the same time, it would intensify competition among retailers. This would get further impetus in case the government permits the entry of foreign direct investment in multibrand retail.

According to Mr. Kumar Rajagopalan, CEO, Retailers Association of India, a number of favourable factors would result into new frenzy amongst retailers for attracting resoures in retail including people, space and merchandise. This is most likely to happen but it would take long time to reach optimum level.

RELATIONSHIP MARKETING*

Marketing managers have to take decisions to stimulate the marketing process. To be more specific, they would like that their goods and services (1) reach the right people, (2) at the right place and time, (3) at the right price, and (4) through the use of the right blend of promotional techniques.

Even though these criteria are used in decision-making by marketing managers, it must be noted that there is always an element of uncertainty. This uncertainty arises as one does not know the behaviour of the consumers. In order to minimize the uncertainty, marketing managers must be in the possession of useful and adequate information. The role of marketing research begins here as it provides relevant information to the decision maker.

Successful business enterprises are found to be using a business strategy known as relationship marketing. The objective of this strategy is to establish a long-term and fruitful relationship with customers. The question that arises here is: How a lasting relationship with the *customers can be built*? There are three factors that help in achieving this. These are:

(1) knowledge of the market, (2) effective training programmes and (3) employee empowerment and teamwork. Let us briefly explain these three factors.

1. **Knowledge of the Market.** Any business enterprise, serious about success in its marketing effort, must know its marketing environment. It must also have comprehensive information about its customers. In particular, it must know as to what are the needs and desires of its customers so that it can provide them satisfaction. Customer satisfaction is very vital for the survival and growth of any business and it cannot be achieved without detailed knowledge about customers and the overall marketing environment.
2. **Effective Training Programmes.** A lasting relationship between the company and the customers can be built when the employees of the company are skilled in their day-to-day job and helpful to the customers. Employees should be impressed upon that their role is very vital for the success of the company. In companies having a large number of employees, training programmes, keeping in mind the specific requirements of a group of employees, should be arranged. Such training programmes will be beneficial to both the company and its employees. Such training programmes should be organised from time to time. The objective of customer satisfaction can be achieved only when the company has a satisfied workforce.

* This section and the next one heavily draw on Hair, Joseph F., Robert P. Bush and David J. Ortinau, *Marketing Research*, New Delhi, Tata McGraw-Hill Publishing Company Limited, 2006, pp. 4–6 and 112–115.

3. **Employee Empowerment and Teamwork.** Another major step in the successful marketing operations of a company is to encourage its employees to develop a customer-friendly attitude. They should be able to solve any problem on-the-spot that is known as empowerment. In addition, whenever there is a common goal, employees of two or more departments within the same company should work as a harmonious team to handle the problem in a constructive manner.

The factors explained above, if put into practice by organisations, will prove to be very vital for implementing the relationship marketing strategy, which is popularly known as *customer relationship management*.

CUSTOMER RELATIONSHIP MANAGEMENT (CRM)

The objective of CRM is "to understand, anticipate and manage the needs of an organisation's current and potential customers." Accordingly, its focus is on the collection of information about customers and to provide them satisfaction by using that information. Thus CRM should eventually lead to customer satisfaction.

It must be emphasised that CRM is not to be confined to the business enterprise. In fact, all facets of the business including suppliers and retailers are covered by it.

Businesses are now undergoing a transformation. Earlier, they used to sell products and services on transaction basis. The emphasis was on the acquisition of customers. But now they are keen to have better understanding of customers by having a meaningful dialogue with them. Earlier, the small retailer used to treat customers on a one-to-one basis. In contrast, CRM now attempts to institutionalise it for a large number of customers. Although the focus is still on one customer at a time, it involves a larger number of customers. For this, CRM operates on customer interaction, that is the relationship between two parties—the business enterprise and the customer. However, as the former being a virtual entity, the relationship is based on customer's perception of the business enterprise. In view of this, storage and use of customer interaction information becomes an important input in CRM programmes. This information in CRM is known as customer knowledge.

Before launching a CRM programme, the business enterprise has to decide what type of relationship with customers it should have. Having decided this, it should interact with the customer to acquire information. Here, on account of technological support, the enterprise stores and integrates the customer data. This is followed by analysis of such data to determine the best customer segments based on profitability. In short, the objective is to have stronger relationships with profitable customers for maximum customer retention and growth.

Marketing Research and Customer Relationship Management

Marketing researcher obtains information about customers from a variety of sources such as demographic, psychographic, behavioural and preference data. All these varied data are integrated. In addition, communications from customers are maintained.

The role of marketing research is in the spheres of collecting, storing and analysing customer interaction information, i.e. customer knowledge. In CRM environment, the role of marketing research is thus unique. It has to transform its practice into one of *marketing intelligence*. This role, as can be seen, goes beyond the traditional marketing research practice of data collection to one where data collection strategic and transactional are to be in focus.

Summary

The chapter has first dealt with the concept of retailing and the operations performed in retailing. The importance of retail industry and the growth of organised retailing have been brought out. This is followed by a discussion on problems in organised retailing. The concepts of relationship marketing and customer relationship management (CRM) have been explained. The importance of database and the role of internet in retailing have been highlighted. The chapter ends with a broad indication as to what the future holds for organised retailing in India.

Key Terms and Concepts

Retailing 557
Organised Retailing 558
Customer Relationship 562
Database 562
Relationship Marketing 564
Customer Relationship Management (CRM) 565
Marketing Intelligence 565

Questions

1. What are the different operations that a retailer performs?
2. How does organised retailing differ from traditional retailing?
3. What factors have contributed to the growth of organised retailing in India?
4. What are the major problems faced in organised retailing?
5. "Instead of Customer Relationship, Customer Satisfaction should be the main focus in retailing." Comment.
6. In what way/s research in organised retailing can be conducted?
7. What is a database? What types of data are maintained in databases? What technique is used for this purpose?
8. Is CRM a research technique or a business strategy? Why is it important? How does it operate?

27 Ethical Issues in Marketing Research

Learning Objectives

After reading this chapter, you should be able to understand:

- Importance of ethics in business
- Some unethical examples pertaining to marketing research functions
- Ethical issues in relation to participants
- Ethical issues in relation to (a) sponsor (b) research staff
- Code of Ethics
- Ethics involving the protection of Marketing Research profession
- Corporate espionage

INTRODUCTION

According to the New Oxford Dictionary of English, the word 'ethics' means principles that govern a person's behaviour or the conducting of an activity. The word 'ethics' though plural, is usually treated singular, which means the branch of knowledge that deals with moral principles.

The objective of ethics in research is to ensure that no one is harmed or suffers from research activities. Both marketing and marketing research need to be carried out conforming to ethical norms or standards. As this text is on marketing research, the discussion that follows is focused on it.

Ethics as related to marketing research deals with the judgement in respect of two types of activities:

(1) Activities that are undesirable or inappropriate as they violate ethical norms. They should be avoided.

(2) Activities that need to be undertaken.

A simple example of No. (1) type of activities is the use of marketing research as a sales ploy. Here a product is sold or at least an attempt is made to sell it under the garb of marketing research. Obviously, this is an unethical activity and, as such, it should be avoided. As regards No. (2) activities, these are undertaken to find out solutions to given problems by conducting research, conforming to ethical norms.

UNETHICAL EXAMPLES IN MARKETING RESEARCH

A company sponsors a project with a marketing research agency (MRA), which submits a research proposal to the company. The research proposal has been accepted by the company and the MRA is asked to go ahead with the project. Now, a number of unethical practices can be involved. Let us see how unethical practices take place in some stages of marketing research.

1. The MRA has submitted the research proposal using high technical terms suggesting an advanced methodology for the project. This is done especially to impress upon the sponsors that it is an expert body and as such, it would do a descent job. The proposed study, in reality, did not need highly advanced methodology as a simple methodology would have been appropriate. Since the sponsors did not comprehend the methodology, they gave their acceptance to the research proposal.
2. While submitting the research proposal, the MRA gave an elaborate sample plan to carry out field investigation. However, in actual practice it did not adhere to that plan. Prior to conducting the field survey, it decided to reduce the sample size so that it can complete the project in a short time. In addition, it would cut its operational cost though its professional fee from the sponsors would remain the same.
3. Coming to field operations, the MRA has trained research staff, who have acquired sufficient experience in conducting the field survey. A well-designed questionnaire has been handed over to field workers to collect data from sample respondents. Some of them fill in a few questionnaires after contacting sample respondents. After having collected data from some respondents, some of the field workers may not contact other respondents. They may be tempted to fill in the questionnaires with fake data arbitrarily, sitting at home. They know that responses of other respondents would be more or less on the same lines as those of respondents interviewed earlier. This sort of practice is commonly known as 'interview cheating' and is resorted to by the field workers without the knowledge of the MRA or even the field supervisor.
4. When the data from the field survey have been collected, these are to be processed and analysed. The analysis and interpretation of data need a high level of statistical competence. When the MRA finds that the conclusions emerging from its analysis are very different from what the sponsors expect, it may even go to the extent of changing the data to suit the expectation of the sponsors. Thus, a report based on "doctored" data would undoubtedly be misleading.
5. Finally, the MRA is required to submit a research report to the sponsors. It can indulge in unethical activities at this stage too. It may not put in much effort in the preparation of the report. Some of the explanations contained in it, may cause confusion to the reader instead of making things clear. It may not give s comprehensive report to save its time. Thus, a sketchy report not containing adequate number of diagrams and charts, would hardly be useful to the sponsors.

From the foregoing discussion, it becomes evident that in different stages of marketing research, unethical practices can be resorted to without the knowledge of sponsors as some of them are not well informed and as such, they are unaware of unethical practices that go in the name of research.

The purpose of giving these examples is to give a broad idea of unethical activities that can take place in different stages of marketing research process. We now discuss ethics relating to different constituents of marketing research. There are three constituents in marketing research viz. participants, M.R. Agencies and sponsors or clients which are mostly business firms using market research findings. In addition, we will discuss ethics in relation to marketing research profession. We first deal with ethical issues relating to participants.

ETHICAL ISSUES IN RELATION TO PARTICIPANTS*

The terms 'respondents' and 'subjects' are also used instead of participants.

To begin with, while designing the research project, at times it is seen that the research conceals the objective of research, so much so that the information sought is for a different purpose than what is told to the respondent. He should be told as to what the object of the research study is.

In case when in a research study, a questionnaire is used to collect information, care should be taken to maintain a reasonable size. It should not be too lengthy, otherwise the respondent would be reluctant to participate. Further, questions should be clearly worded keeping in mind the ability of the respondents.

In case when a survey is being conducted in which depth interviews or focus group interviews are held, the researcher should not use secretly video or audio tape recorders to elicit information from the respondents. If such devices are to be used, then the respondents should be informed in advance in this respect. There should not be any intrusion in the privacy. This implies that the questions should be such that the respondent feels comfortable and does not think that any question is an intrusion in his personal life.

As the respondents give information by filling in questionnaire in good faith, the researcher should ensure that their identity is not disclosed. Above all, there should not be any intrusion in their privacy.

Right to Privacy

Right to privacy is a very important aspect in ethics. A researcher, whatever may be his area or subject of research, must know that every person has a right to privacy. In the U.S. law on privacy was first enacted in 1974. Another law was passed in 1980. Both these laws provide privacy and confidentiality of the respondents as well as the data collection in research.

A respondent, for example, cannot be compelled to answer a question if he thinks that it is an infringement into his privacy. He can even refuse to participate in any research. Further, when he participates in research his identity must remain undisclosed. In addition, whatever information he gives should not be passed on to another person or institution. The information that the participant provides is exclusively for the use in that particular research project.

It will be seen that confidentiality of data is very important for research. When a respondent finds that there is no assurance of confidentiality, he may back out from an ongoing research. Hence, confidentiality of participants assumes considerable importance. It may be noted that the right to privacy is more important than confidentiality.

In order to adhere to the right to privacy and confidentiality, the researcher should himself ensure the following:

1. The participants should be informed that they have their right to answer any question or even to participate in the study.

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* The discussion is on the lines of Copper, Donald, R. and Pamela S. Schindler: *Marketing Research: Concepts and Cases*, New Delhi. Tata McGraw-Hill Publishing Company Limited, 2006.

2. Before interviewing respondents, their permission must be obtained in advance. However, when research is related to observation of behaviour of respondents, it may not be necessary to seek their permission as this will defeat the very purpose of recording the day-to-day normal behaviour of respondents.
3. Interviewing should be within reasonable time limits. Prolonged interview would be uncomfortable to respondents and they can even withdraw themselves from participation. Interviewers must ensure that they do not exceed a reasonable time limit. Also time for interviews should not be inconvenient to the respondents.

ETHICS AND THE SPONSOR

Ethical issues are relevant when a company or an individual sponsors a research project. A sponsor or research client has the right to have a research report that has not violated any ethical norms.

When a business firm approaches a research agency and solicits a proposal for a problem it has been facing in reality it may not be interested in sponsoring research with the agency. The main objective of the company was to obtain expert advice without making any payment. In such a case, it is obvious that the firm has resorted to an unethical conduct. Having once rejected the proposal, it should not use it subsequently without making payment. Using the rejected proposal without payment for the professional service is obviously unethical.

One ethical consideration with the sponsors is that the report must be confidential. That is to say its contents have not been leaked out to any one. In fact, some sponsors even go to the extent that their own identity must remain undisclosed. Some sponsors insist that the purpose of the research study or survey should not be divulged.

A company, having developed a new product, is interested to know how would the market respond to it. It decides to run a test market. Instead of undertaking the test market exercise itself, it sponsors it to a market research firm. In this way, its identity would remain undisclosed. The company does not want its competitors to know that it is involved in the test market. At times it is seen that the competitor takes some steps so that the test market findings may become misleading, though such a step on his part is undoubtedly most unethical.

Right to Quality Research

A sponsor of a research study has the right to quality research. This is understandable as the cost of research is borne by the sponsor. A study done in a haphazard manner not covering all the relevant aspects, will not be acceptable to the sponsor. Submission of such a haphazard report by a market research agency is unethical.

Sponsor's right to quality research involves three considerations:

1. The research design for the specific objective for which research is sponsored, must be quite appropriate.
2. The researcher must provide the maximum value to the sponsor for the resources used in research.
3. Collection, analysis and interpretation of data must be appropriate keeping in regard the nature of the project sponsored.

As regards the research design, the researcher decides the type of research design for the proposed study. When a study can be carried out by using a simple design, the researcher should use it. It will be unethical on his part if he uses a very sophisticated design including latest techniques of handling data. This would not be in the interest of the sponsor as research would be much costlier than what it should be. At times there is temptation on the part of the researcher, who may plan and conduct the study in such a manner so that it maximizes his earnings. This too is obviously unethical.

Researcher must ensure that statistical techniques used are appropriate for the study. He has to exercise great care in using these techniques. Further, the analysis and interpretation of data should not be distorted. When the data are interpreted to arrive at a particular finding or conclusion, the researcher is guilty of being unethical. He should ensure that none of the findings goes beyond the scope of the study. Further, when charts, graphs and statistical tables are presented in the report, these should be done objectively.

While submitting the findings to the sponsor, it is possible that he may not be satisfied as he wanted to have different findings than what the report contains. Here, the researcher must convince the sponsor that all this research exercise has been done in an unbiased manner and, as such, he is not going to change the findings.

At times sponsors too are found to be engaged in an unethical activity. They may sponsor a particular project and advise the researcher to be objective in his approach. At the same time, they may send their representative to the researcher. In an informal conversation, the representative mentions that the findings of the study should be on some specific lines. When the research is being conducted within the company by its own research cell or department and the company's top management asks the research to provide a certain set of findings, the position of the research team especially the research head becomes very vulnerable. He may succumb to the pressure to avoid management's displeasure and to save his own job. In such a situation he would come out with another report manipulating data, thereby reaching altogether different conclusions. Such a research is obviously unethical as objectivity has been purposely sacrificed.

ETHICS AND MRA'S AND RESEARCH STAFF

A research team may consist of some research assistants who have to carry out varying operations such as the preparation of questionnaires, conducting field survey, tabulating the data, undertaking analysis and interpretation of data. Of course their performance is under the supervision of a senior researcher. The overall responsibility is of the researcher who comes in direct contact with the sponsor. The researcher would expect that the research team adheres to ethical norms while carrying out its operations. He should satisfy himself that the field survey was done well. The research assistants who conducted the survey have not used false or imaginary data and they have actually interviewed the respondents and recorded their responses faithfully.

Some research studies demand some technical knowledge on the part of research staff. Before such studies are actually assigned to the research team, the researcher should make necessary arrangement for training of assistants, especially with respect to that study. In general, the researcher should ensure that the research team working under him is fully competent in handling different tasks assigned to it. As regards field surveys, the researcher must put an experienced person as the field supervisor to ensure that the field survey is being done on proper lines without any bias.

CODES OF ETHICS

Many professional bodies have their own code of ethics which lays down rules and regulations for their members. It is necessary that members must abide by the code.

In order a code should be effective, it must satisfy the following four conditions:

1. The code should be regulative.
2. It should protect the interest of its profession as well as the public interest.
3. The code should be behaviour-specific in the sense that the behaviour of its members is subject to scrutiny by the professional body.
4. It should be enforceable. This is very important as a code that cannot be enforced is merely a dead document. Such a code will have no utility. A good code is one which is effective in maintaining professional values.

As regards marketing and marketing research, there are some professional bodies having their codes of ethics. Some of these are:

American Marketing Association (AMA)
Direct Marketing Association (DMA)
Marketing Research Association (MRA)
Council for American Survey Research Organisation (CASRO)
Market Research Society of India (MRSI)
Likewise, similar professional bodies in different countries have their own codes of ethics.

MRSI's Code of Conduct

Like the American Marketing Association's code of conduct for marketing research, the Market Research Society of India (MRSI) too has its own code. This is given under the following heads:

1. Responsibilities towards informants
   - Anonymity of informants
   - Rights of informants
   - Interviewing children
2. Relations with the General Public and the Business Community
3. The mutual responsibilities of clients and researchers
   - Property of marketing research records
   - Confidentiality
   - Publishing the results
4. Reporting Standards
   - Samples
   - Data collections
   - Presentation of results
5. Additional requirements of public opinion polls
6. Implementation of the code

Under each of these heads, rules have been laid down so that the members of the MRSI know their responsibility towards ethical research.

*Ethical Issues Involving Protection of the Research Profession**

There is debate as to whether marketing research is a profession or not. Donald S. Tull and Del I. Hawkins believe that the long-run viability of marketing research depends on its being recognized as a profession. All of the issues we have described thus far affect the professional status of marketing research. In addition, three other considerations emerge.

1. **Use of Accepted Research Procedures**
   Marketing researchers should follow right research procedure to maintain the status of their profession. Whenever there is a departure from the normal research procedure, they should clearly indicate it in their report. It is worth emphasizing that research that leads to wrong managerial decisions would bring a bad name to the profession itself.
2. **Certification**
   One finds that there are no rules and regulations concerning qualifications required for marketing researchers. Again, there are hardly any rules for membership in most professional marketing research societies or organizations. As a result, any one can claim that he is a marketing researcher. Obviously this is undesirable for the sound growth of marketing research profession. It is necessary to stipulate some form of certification to enter this profession.
3. **Inappropriate Use of Marketing Research Techniques**
   Marketing research agencies or firms are found using marketing research techniques in areas that are even remotely not associated with marketing. For example, opinion polls are frequently organised on different subjects. These influence the ability of candidates to gain support from the public or to raise funds. Many political campaigns use marketing research to further their political status in the public. Such practices need to be curbed.

CORPORATE ESPIONAGE

Though corporate espionage is beyond the scope of marketing research, it is discussed here briefly to give a broad idea of this unethical activity.

Corporate espionage means that a company is involved in spying to obtain confidential information pertaining to its competitive company or companies. As the competition in the present age of globalization is becoming more and more intense, every company wants to move ahead of its rival. This is possible when it is able to procure confidential information pertaining to the rival company's business plans, such as launching a new product, the volume of sale, the quality of manpower and so on.

The espionage is done in a very subtle manner so that the rival company has no inkling that its operations are being very closely watched. Sometimes, the company offers a lucrative salary to the rival company's key person so that he may resign that company and join this one. As this man would be in possession of a lot of information and secrets that would put the new company at a great advantage to face competition.

Sometimes it may not be necessary to offer a job to the key player in the rival company. He may be lured to pass on secret documents, photographs, drawings and specifications for some

* Tull, Donald S. and Del I. Hawkins: *Marketing Research*: *Measurement and Method*, New Delhi, Prentice-Hall of India Pvt. Ltd., 1998, pp. 794–795.

monetary consideration. Another type of information may pertain to rates quoted for a tender, or enquiries being received for future orders. When the competition is severe between two or three leading companies in an industry, unethical practices of this type are frequently resorted to. This is on account of the difficulty to get information or data using fair methods. But that should not be a justification for indulging in unethical practices.

Table 27.1 deals with major ethical issues under four groups. It gives a fairly good idea of their legitimate rights. Non-compliance of these would give rise to unethical issues/practices and undermine the quality of research severely.

Table 27.1 Some Ethical Issues in the Research Process

Research Proposal	1. Sponsor's right to non-disclosure of purpose
	2. Sponsor's right to reject research proposal
	3. Researcher's right to absence of sponsor coercion
	4. Researacher's right to absence of sponsor deception
Research Design	1. Sponsor's right to proper and feasible research design
	2. Sponsor's right to absence of sponsor coercion
	3. Researcher's right to protection of proprietary methodologies
	4. Participant's right to informed consent
Data Collection	1. Sponsor's right to honest and quality work
	2. Researcher's right to choose data collection methods
	3. Researcher's right to participant's non-deception
	4. Participant's right to privacy
Research Reporting	1. Sponsor's right to proper analysis and honest reporting
	2. Sponsor's right to non- disclosure of findings
	3. Researcher's right to absence of sponsor coercion
	4. Participant's right to confidentiality

Adapted from Exhibit 7-1 (p.172) in Donald R. Cooper and Pamela S. Schindler: *Marketing Research–Concept and Cases*, TMH, 2006.

Summing Up

Before closing our discussion on ethics in marketing research, it may be mentioned that there arise certain situations during the course of research that pose ethical dilemmas. It becomes difficult sometimes to decide whether they are ethical. As such one has to be careful in dealing with such situations.

At the end, it may be emphasized that constituents involved in marketing research should not only be clear about ethical norms in their respective fields of activity but should also adhere to those norms. In this way, they will contribute towards building up a favourable image of marketing research profession in the public.

Summary

At the outset, the chapter lays emphasis on the compliance of ethical norms in all marketing and marketing research operations. It then gives some examples from marketing research where ethical considerations or norms were almost completely ignored. This is followed by a discussion on ethical issues in relation to various functionaries, viz., sponsors, participants, marketing research agencies, and the research staff. Taking marketing research as an independent profession, the chapter discuses three issues namely, use of accepted research procedures, certification and use of marketing techniques, The chapter ends with a brief discussion on corporate espionage, which appears to have escalated in recent years.

Key Terms and Concepts

Ethics 567
Sponsor 570
Quality Research 570
Code of Ethics 572
Corporate Espionage 573

Questions

1. You are a senior consultant in a marketing research firm. A sponsor has approached you to conduct a survey on an FMCG. He wants you to prepare a research proposal for the proposed study. Describe the ethical issues involving the sponror as well as your research firm.
2. Describe the ethical issues involoing the protection of respondents.
3. Describe the ethical issues involving the protection of (a) client and (b) public.
4. How can marketing research profession be free from unethical operations?
5. What do you understand by 'Corporate espionage'? Is it different from standard observation techniques?

CASE STUDY 1

BRAND TRACKING[1]

Of late, the Indian economy has opened up as a result of liberalisation policy of the government. This has resulted in the entry of many brands some of which are international. These brands pertain to Fast Moving Consumer Goods (FMCGs), consumer durables and consumer semi-durables. The competition among the brands has further become intense on account of improved communication channels. The consumer, today, is far more informed than hitherto.

Under these circumstances, a company engaged in the manufacture of washing machine, would like to know the performance of its brand/s. This can be known only through a systematic study. It has assigned you this study. You are expected to offer your considered advice on the following:

1. Should brand tracking be continuous or intermittent?
2. What measures can be used in measuring the brand performance?
3. How long should the company track the performance of its brand?
4. Should the company confine itself to the tracking of its brand alone or should it extend it to other brands as well?

Question

Develop a suitable methodology of the proposed study in the light of the foregoing questions.

1 Based on R. Suresh and K. Narendran: *Brand Performance: Is there an Utopian Measure?*, Paper presented in the MRSI Annual Seminar at New Delhi, May 8–9, 1998.

CASE STUDY 2

TASTY FOODS LIMITED

Tasty Foods Ltd. is engaged in the manufacture of different food products. Its R and D Department has recently come out with a new soya bean snack. The main strength of this product is the highly nutritious value of protein-rich soya beans.

While the R and D Department is happy to have developed a highly nutritious snack especially useful for children, the company management wants to be certain that the new snack will have a good market in the country. In order to ensure that the new product is successfully launched in the market, the Managing Director (MD) is thinking of hiring the professional services of a Marketing Research Agency (MRA). In consultation with the MRA, the MD decided to convene a meeting of Marketing Manager (MM), Production Manager (PM) and the MRA, to be represented by its chief executive. The meeting was held in MD's chamber and it turned out to be a prolonged session.

A few excerpts from the discussions held in that meeting are given below:

MD : I feel certain that our new soyabean snack is going to be very successful in the market. The project is unique in the sense that no soya bean based snack is presently available in the market. In view of this, test marketing of this product seems rather unnecessary to me. We can do without it. Moreover, it will save a good deal of time as the new product can be introduced in the market almost immediately.

PM : I fully support the views expressed by our MD. Let me emphasise that our R and D Department has taken considerable pains in developing this new product. It has come through a long succession of concept and product tests. Test marketing would obviously delay the process of marketing the product.

MM : Since our new product is going to be our major achievement, it is desirable to have detailed information about it. It will be to our advantage if we know our consumer target and their major characteristics.

MRA : I know some cases where a new product was regarded as a 'strong' product by the R and D and the Production Department. But when it was commercially launched, it turned out to be a failure. The concerned companies learnt a bitter lesson. I am of the opinion that the product in question must be test marketed to avoid any such disappointment at a later stage.

MD : Suppose we decide to go in for test marketing, what are we going to get from such an exercise? We must be clear as to what test marketing is expected to do for us.

MRA : The MD has raised a basic question. The company must be clear about the objectives of test marketing. Are you looking at test marketing to decide whether the new product should be launched nationally or not? Alternatively, are you looking at it as a rehearsal before an extensive launch? This means that you are interested in knowing what is likely to go wrong and how this can be prevented/improved.

MM : I think both these objectives mentioned by MRA are relevant in our case. In fact, the results of test marketing will indicate whether we should launch the product nationally or drop it altogether. I think it is advisable to decide the nature of information to be collected so that test marketing can be really helpful to us.

MD : Let us then have test marketing. But before it is undertaken, we must specify our data requirement. I suggest the MRA and MM should meet and discuss this fully.

Questions

1. There are different types of market tests. Which one would you use and why?
2. What data would you collect in the test market?
3. How would you collect the required data?
4. How would you analyse the test market data? Be specific.
5. What problems are likely to arise in the test market? How would you resolve them?

CASE STUDY 3

BRIGHT ADVERTISING AGENCY

The Bright Advertising Agency was approached by a leading manufacturing company in India regarding one of its consumer durable products, viz., washing machines. On behalf of its client company, the BAA has completed a research project. The study is aimed at ascertaining the effectiveness of advertising.

The BAA carried out an experiment in which three different advertising copies were developed: A_1—price reduction; A_2—listing of major features of the product; and A_3—free quarterly servicing for two years. Two media plans were tested under similar conditions: B_1—magazines; and B_2—newspapers.

The BAA carried out the experiment in such a way that each copy was tried with one medium at a time. In the following table, the columns represent different advertising copies while rows represent media plans. The table shows the data resulting from the experiment. The data relate to number of washing machines sold as a result of a particular combination of advertising copy and media plan. The two figures in each cell indicate that there were two replications for each treatment.

Advertising Copy

Media Plan	A_1	A_2	A_3
B_1	(34, 30)	(32, 26)	(25, 24)
B_2	(33, 32)	(30, 32)	(22, 20)

Questions

1. You are required to analyse the data obtained in the experiment, using 0.05 as the level of significance.
2. What are your conclusions?
3. Based on your conclusions, what would be your recommendation/s to the client?

CASE STUDY 4

HIGH FASHION-WEAR

Mr. Ashok Anand has recently completed a course from the prestigious National Institute of Fashion Technology (NIFT). Ever since he joined the NIFT, he had been thinking to do something on his own instead of seeking a job after the completion of the course. However, soon after his studies he found himself in an odd situation. He was unable to set up his own enterprise on account of financial constraints and, as such, accepted a job with a readymade garment unit in Delhi.

The readymade garment unit, where Ashok Anand is working, is doing reasonably well. It has been catering to the domestic market. Since Anand has specialised in highly sophisticated fashion-wear, the firm has now become interested in exploring the possibility of exporting fashion-wear. The firm has sufficient financial resources to enter the foreign markets but it wants to go cautiously as it has no prior experience of overseas markets. It is particularly interested to know the export potential for ladies fashion dresses that would be easily acceptable among the college going girls and working women in the West.

Questions

The firm has approached you to take up this assignment. It would like you to submit a detailed research proposal of the proposed study.

Prepare a proposal clearly indicating whether a survey of overseas market is contemplated or the study will be based exclusively on secondary data. Since entering the overseas market will require a long-term commitment on the part of the exporting firm, your proposal should cover various aspects that are relevant. Also indicate what hurdles you are likely to encounter in your study and how you would resolve them.

CASE STUDY 5

THE MODERN INDIAN WOMAN

As we all know, Indian economy is now showing very favourable results and has a very promising outlook for the future. The per capita net national product (NNP), which was Rs. 7690 in 1993–94, has considerably increased in recent years. As a result of India shining, people's buying behaviour is also undergoing a change. Many persons, who were traditional-ridden opposing the use of new and descent products of daily use, have started liking those very products. In short, considerable change in the outlook and behaviour of people is distinctly visible.

An organisation, exclusively devoted to women's welfare in India, is interested to know the present status of women in different parts of the country. By its very nature, this study would be very comprehensive requiring huge resources both in terms of money and manpower. Obviously, its scope would be quite wide covering various aspects that are relevant to women.

In particular, this women's organisation would like to know their economic condition, whether they are employed or not. Further, it is keen to ascertain the values and attitudes of women, how far they like or dislike household tasks, what are their preferences in buying clothes, consumer durable goods, entertainment and so forth.

As the proposed survey is going to be vast, the women's organization wants that to begin with a short survey in one metropolitan city. It hopes that the problems encountered in this survey will be useful while embarking on the detailed survey a little later.

Questions

1. If this assignment is given to you, how would you proceed?
2. Specify the type of information to be collected and from whom.
3. The type of sample design and size as also its break-up by states and cities should be described.
4. Finally, prepare some dummy tables that can be used when you get the desired information.

CASE STUDY 6

ETHICAL ISSUES IN MARKETING RESEARCH

At times we find that both in marketing and marketing research, unfair practices take place. There is now increasing awareness in the public of different ways by which such practices are resorted to.

The American Marketing Association's Code of Ethics contains principles of ethical practice of marketing research for the guidance of its members. The AMA expects its members to conduct themselves in conformity with the code in all their marketing research activities. The Marketing Research Society of India (MRSI) too has a code of conduct for its members.

Below are given eleven situations/cases wherein ethical issues are involved:

1. A marketing research firm assured its sample respondents that it would conduct an anonymous survey. As such their identity would remain undisclosed. However, it used an ultraviolet ink on each questionnaire as a result of which every respondent could be identified though the identity mark was invisible. Later on when it came to the notice of some one, the firm justified the use of an ultraviolet ink on the ground that it wanted to identify defaulting respondents so that it could send them reminders. Some people sharply reacted to this and said that such a practice was a clear deception as the firm acted against its explicit assurance to respondents.
2. A marketing research firm has recently taken up a study of some department stores. It has asked one of its members to visit these stores and pose as a customer and observe the buying behaviour of customers. No one knows that he or she is being observed by some one.
3. A large manufacturing company dealing in some cosmetic products has its own marketing research cell. However, it generally uses marketing research as a sales ploy. Its investigators try to push up the sale of its products to households when they visit them while conducting a field 'survey'.
4. A marketing research firm does not bother about ethical problems. It uses such data and research techniques as would produce the findings acceptable to its clients or to justify a particular decision.
5. A study is undertaken by a team of marketing researchers. A survey is planned but it has been decided that the purpose of research, as also its sponsorship, should not be disclosed to the respondents. This is because the team of marketing researchers feels that such a disclosure would influence the respondents to such an extent that the proposed research would be of no use.
6. An interviewer has been assigned the job of contacting some specific households chosen in the sample. He visits some households and in respect of others, fills in fictitious data, which are passed off as genuine. Nobody except the interviewer knows that some data are fictitious.
7. A marketing research firm accepts an assignment from one of its clients even though it knows that it would not be possible to submit the report within the stipulated time.
8. A business firm is interested in sponsoring a study with a research firm. It invites research proposals from four different consultants. It then incorporates the ideas included in different proposals in one single proposal submitted by the lowest bidder and assigns him this research study.

9. A project director seeks the permission of the Marketing Research Director to use ultraviolet ink in pre-coding questionnaires in a mail survey. He points out that although the letter refers to an anonymous survey where the identity of the respondent would be undisclosed, he needs the identification of the respondent so that cross tabulation of data can be undertaken. The Marketing Research Director gives him the permission to use ultraviolet ink.
10. An interviewer adopts an unusual practice with a view to getting the cooperation of the respondent. He assures the respondent that as soon as the survey report is ready, he will send him a copy of the same. While making such a promise to the respondent, the interviewer has no intention whatsoever to follow it up.
11. A research firm sometimes uses such devices as giving huge statistical data in appendices and drafting a report full of technical jargon to give an impression that it is a perfect study or that the team engaged in the research is very competent.

Question

Identify the ethical issue in each of the above-mentioned situation/case and indicate what you would do.

CASE STUDY 7

OPPORTUNITIES AND CHALLENGES BEFORE ORGANISED RETAILERS

Organised retailing in India is poised for exponential growth. It is expected to experience new paradigms due to changing dynamics in areas such as demand, supply, technology, supply chain management, government policy. What are the underlying opportunities and challenges in this sector?

It is said that as consumerism is rapidly growing, rural consumers will be the biggest beneficiaries. At the same time, the retailer is expected to provide value to the customers, associates, employees and consumers. It may be noted that it is difficult to sustain retail business with such dynamics and changes taking place in the market. The need of the hour is flexibility in business so that it can change according to the needs of the market.

With fast changes in rural market, some large companies are ready to enter the organised retail business in small cities and towns. The question is, how far they would succeed. If they enter this field, they have to decide whether they should focus on value retailing or lifestyle retailing.

Retail cannot develop by setting up only malls. In order to promote retail we also have to promote India as a shopping destination. For this, it is necessary to give Indian retail an Indian face. While we bring in foreign formats to grow, it is very important that India develops her own format rather than just to imitate foreign malls.

Questions

1. Do you think that setting up malls by big corporations in rural areas would be the right approach, particularly when a large proportion of rural population is illiterate, tradition-bound and has an extremely meager disposable income? Give reasons for your answer.
2. How can technology help in the growth of retail business? Answer with specific examples.
3. What is CRM? What type of information would a retailer require in order to pursue it.
4. What should be the role of marketing research in handling CRM programme? Be specific.

CASE STUDY 8

MAGAZINE READERSHIP SURVEY

The figures given below relate to three business magazines. These are from the latest Indian Readership Survey (IRS) for the second quarter of 2011.

			(Readership in '000)
	Business Today	**Business India**	**Business World**
Quarter 2, 2010	338	224	163
Quarter 4, 2010	370	216	183
Quarter 2, 2011	333	178	199

These figures indicate that excepting Business World, the other two magazines have shown a decline in the readership during the period Q 2, 2010 to Q 2, 2011. The decline was more severe in case of Business India as compared to Business Today.

In view of this disappointing result, Business India is seriously considering to undertake a comprehensive survey to collect information directly from its readers. The objective is to arrest the declining readership. In order to carry out this task on a professional basis, it has approached a marketing research firm for a research proposal for its consideration.

Questions

1. Assuming that you have to do this research, a comprehensive proposal has to be prepared.
2. Specify the type of information to be collected from respondents.
3. A detailed questionnaire is to be prepared.
4. Explain the sample design that you would use.
5. Out of a number of methods for data collecting. Which one would you use? Why?

CASE STUDY 9

THE SKIN CARE MARKET

The skin care market has been one of the most promising segments of the baby care market in India. According to an estimate the total value of this market was Rs. 175 crore in 2008 which rose to Rs. 194 crore in 2009.

Some of the companies engaged in the manufacture and sale of baby skin care market in India are Dabur India Ltd., Johnson's Johnson, Wipro and Oriflame. The market share of Dabur Lal Tel was 34% while that of three products of Johnson's Johnson were as follows:

Baby Lotion	21.9%
Baby Oil	17.9%
Baby Cream	11.8%

These figures relate to the year 2008. Although the total share of these three products comes to 51.6% which is far greater than Dabur's for one product 34%, Johnson's Johnson feels there is good scope for its products.

As such it is very keen to increase its market share in respect of each of these products. However, there are some challenges before the company, one of which is that in semi–urban and rural areas its products are not so well received. The company feels that some effective research in the prevailing market conditions is called for.

Questions

1. Indicate an appropriate marketing research problem.
2. As a marketing researcher, what type of study would you undertake?
3. Assuming that a decision in favour of survey has been taken, develop a sampling plan for the same?
4. Which survey method would be appropriate?
5. How would you handle non-responses?

Appendix

STATISTICAL TABLES

Appendix Table 1 Random Numbers

	First Thousand									
	1–4	**5–8**	**9–12**	**13–16**	**17–20**	**21–24**	**25–28**	**29–32**	**33–36**	**37–40**
1	23 15	75 48	59 01	83 72	59 93	76 24	97 08	86 95	23 03	67 44
2	05 54	55 50	43 10	53 74	35 08	90 61	18 37	44 10	96 22	13 43
3	14 87	16 03	50 32	40 43	62 23	50 05	10 03	22 11	54 38	08 34
4	38 97	67 49	51 94	05 17	58 53	78 80	59 01	94 32	42 87	16 95
5	97 31	26 17	18 99	75 53	08 70	94 25	12 58	41 54	88 21	05 13
6	11 74	26 93	81 44	33 93	08 72	32 79	73 31	18 22	64 70	68 50
7	43 36	12 88	59 11	01 64	56 23	93 00	980 04	99 43	64 07	40 36
8	93 80	62 04	78 38	26 80	44 91	55 75	11 89	32 58	47 55	25 71
9	49 54	01 31	81 08	42 98	41 87	69 53	82 96	61 77	73 80	95 27
10	36 76	87 26	33 37	94 82	15 69	41 95	96 86	70 45	27 48	38 80
11	07 09	25 23	92 24	62 71	26 07	06 55	84 53	44 67	33 84	53 20
12	43 31	00 10	81 44	86 38	03 07	52 55	51 61	48 89	74 29	46 47
13	61 57	00 63	60 06	17 36	37 75	63 14	89 51	23 35	01 74	69 93
14	31 35	28 37	99 10	77 91	89 41	31 57	97 64	48 62	58 48	69 19
15	57 04	88 65	26 27	79 59	36 82	90 52	95 65	46 35	06 53	22 54
16	09 24	34 42	00 68	72 10	71 37	30 72	97 57	56 09	29 82	76 50
17	97 95	53 50	18 40	89 48	83 29	52 23	08 25	21 22	53 26	15 87
18	93 73	25 95	70 43	78 19	88 85	56 67	16 68	26 95	99 64	45 69
19	72 62	11 12	25 00	92 26	82 64	35 66	65 94	34 71	68 75	18 67
20	61 02	07 44	18 45	37 12	07 94	95 91	73 78	66 99	53 61	93 78

(Contd.)

21	97 83	98 54	74 33	05 59	17 18	45 47	35 41	44 22	03 42	30 00
22	89 16	09 71	92 22	23 29	06 37	35 05	54 54	89 88	43 81	63 61
23	25 96	68 82	20 62	87 17	92 65	02 82	35 28	62 48	91 95	48 83
24	81 44	33 17	19 05	04 95	48 06	74 69	00 75	67 65	01 71	65 45
25	11 32	25 49	31 42	36 23	43 86	08 62	49 76	67 42	24 52	32 45

Second Thousand

	1–4	5–8	9–12	13–16	17–20	21–24	25–28	29–32	33–36	37–40
1	64 75	58 38	85 84	12 22	59 20	17 69	61 56	55 95	04 59	59 47
2	10 30	25 22	89 77	43 63	44 30	38 11	24 90	67 07	38 82	33 28
3	71 01	79 84	95 51	30 85	03 74	66 59	10 28	87 53	76 56	91 49
4	60 01	25 56	05 88	41 03	48 79	79 65	59 01	69 78	80 00	36 66
5	37 33	09 46	56 49	16 14	28 02	48 27	45 47	55 44	55 36	50 90
6	47 86	98 70	01 31	59 11	22 73	60 62	61 28	22 34	69 16	12 12
7	38 04	04 27	37 64	16 78	95 78	39 32	34 93	24 88	43 43	87 06
8	73 50	83 09	08 83	05 48	00 78	36 66	93 02	95 56	46 04	53 36
9	32 62	34 64	74 84	06 10	43 24	20 62	83 73	19 32	35 64	39 69
10	97 59	19 95	49 36	63 03	51 06	62 06	99 29	75 95	32 05	77 34
11	74 01	23 19	55 59	79 09	69 82	66 22	42 40	15 96	74 90	75 89
12	56 75	42 64	57 13	35 10	50 14	90 96	63 36	74 69	09 63	34 88
13	49 80	04 99	08 54	83 12	19 98	08 52	82 63	72 92	92 36	50 26
14	43 58	48 96	47 24	87 85	66 70	00 22	15 01	93 99	59 16	23 77
15	16 65	37 96	64 60	32 57	13 01	35 74	28 36	36 73	05 88	72 29
16	48 50	26 90	55 65	32 25	87 48	31 44	68 02	37 31	25 29	63 67
17	96 76	55 46	92 36	31 68	62 30	48 29	63 83	52 23	81 66	40 94
18	38 92	36 15	50 80	35 78	17 84	23 44	41 24	63 33	99 22	81 28
19	77 95	88 16	94 25	22 50	55 87	51 07	30 10	70 60	21 86	19 61
20	17 92	82 80	65 25	58 60	87 71	02 64	18 50	64 65	79 64	81 70
21	94 03	69 59	78 02	31 80	44 99	41 05	41 05	31 87	43 12	15 96
22	47 46	06 04	79 56	23 04	84 17	14 37	28 51	67 27	55 80	03 68
23	47 85	65 60	88 51	99 28	24 39	40 64	41 71	70 13	46 31	82 88
24	57 61	63 46	53 92	29 86	20 18	10 37	57 65	15 62	98 69	07 56
25	08 30	09 27	04 66	75 26	66 10	57 18	87 91	07 54	22 22	20 13

Source: Reprinted from Kendall, M.G. and B. Babington Smith, *Tables of Random Sampling Numbers*, with the kind permission of the Cambridge University Press.

Appendix Table 2 Cumulative Normal Distribution

$$\Phi(x) = \int_{-\infty}^{x} \frac{1}{\sqrt{2}} e^{-t2/3}\, dt$$

x	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6369	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8351	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

(Contd.)

Appendix Table 2 *(Contd.)*

x	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
X		1.282	1.645	1.960	2.326	2.576	3.090	3.291	3.891	4.417
(ΦX)		.90	.95	.975	.99	.995	.999	.9995	.99995	.999995
$2[1 - \Phi(X)]$		.20	.10	.05	.02	.01	.002	.001	.0001	.00001

Source: Taken from Table 2 of R.A. Fisher and F. Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, published by Longman Group UK Ltd, London (previously published by Oliver and Boyd Ltd, Edinburgh) and by permission of the authors and publishers.

Appendix Table 3 Distribution of χ^2 Probability

X	.99	.98	.95	.90	.80	.70	.50	.30	.20	.10	.05	.02	.01	.001
1	$.0^3157$	$.0^3628$	.00393	.0158	.0642	.148	.455	1.074	1.642	2.706	3.841	5.412	6.635	10.827
2	.0201	.0401	.103	.211	.446	.713	2.386	2.408	3.219	4.605	5.991	7.824	9.210	13.815
3	.115	.185	.352	.584	.1005	1.414	2.366	3.665	4.642	6.251	7.815	9.837	11.345	16.266
4	.297	.429	.711	1.064	1.649	2.195	3.357	4.878	5.989	7.779	9.488	11.668	13.277	18.467
5	.554	.752	1.145	1.610	2.343	3.000	4.351	6.064	7.289	9.236	11.070	13.388	15.086	20.515
6	.872	1.134	1.635	2.204	3.070	3.828	5.348	7.231	8.558	10.645	12.592	15.033	16.812	22.457
7	1.139	1.564	2.167	2.833	3.822	4.671	6.346	8.383	9.803	12.017	14.067	16.622	18.475	24.322
8	1.646	2.032	2.733	3.490	4.594	5.527	7.344	9.524	11.030	13.362	15.507	18.168	20.090	26.125
9	2.088	2.532	3.325	4.168	5.380	6.393	8.343	10.656	12.242	14.684	16.919	19.679	21.666	27.877
10	2.558	3.059	3.940	4.865	6.179	7.267	9.342	11.781	13.442	15.987	18.307	21.161	23.209	29.588
11	3.053	3.609	4.575	5.578	6.989	8.148	10.341	12.899	14.631	17.275	19.675	22.618	24.725	31.264
12	3.571	4.178	5.226	6.304	7.807	9.034	11.340	14.011	15.812	18.549	21.026	24.054	26.217	32.909
13	4.107	4.765	5.892	7.042	8.634	9.926	12.340	15.119	16.985	19.812	22.362	25.472	27.688	34.528
14	4.660	5.368	6.571	7.790	9.467	10.821	13.339	16.222	18.151	21.064	23.685	26.873	29.141	36.123
15	5.229	5.985	7.261	8.547	10.307	11.721	14.339	17.322	19.311	22.307	24.996	28.259	30.578	37.697
16	5.812	6.614	7.962	9.312	11.152	12.624	15.338	18.418	20.465	23.542	26.296	29.633	32.000	39.252
17	6.408	7.255	8.672	10.085	12.002	13.531	16.338	19.511	21.615	24.769	27.587	30.995	33.409	40.790
18	7.015	7.906	9.390	10.865	12.857	14.440	17.338	20.601	22.760	25.989	28.869	32.346	34.805	42.312
19	7.633	8.567	10.117	11.651	13.716	15.352	18.338	21.689	23.900	27.204	30.144	33.687	36.191	43.820
20	8.260	9.237	10.851	12.443	14.578	16.266	19.337	22.775	25.038	28.412	31.410	35.020	36.566	45.315
21	8.897	9.915	11.591	13.240	15.445	17.182	20.337	23.858	26.171	29.615	32.671	36.343	38.932	46.797
22	9.542	10.600	12.338	14.041	16.314	18.101	21.337	24.939	27.301	30.813	33.924	37.659	40.289	48.268
23	10.196	11.293	13.091	14.848	17.187	19.021	22.337	26.018	28.429	32.007	35.172	38.968	41.638	49.728
24	10.856	11.992	13.848	15.659	18.062	19.943	23.337	27.096	29.553	33.196	36.415	40.270	42.980	51.179
25	11.524	12.697	14.611	16.473	18.940	20.867	24.337	28.172	30.675	34.382	37.652	41.566	44.314	52.620
26	12.198	13.409	15.379	17.292	19.820	21.792	25.336	29.246	31.795	35.563	38.885	42.856	45.642	54.052
27	12.879	14.125	16.151	18.114	20.703	22.719	26.336	30.319	32.912	36.741	40.113	44.140	46.963	55.476
28	13.565	14.847	16.928	18.939	21.588	23.647	27.336	31.391	34.027	37.916	41.337	45.419	48.278	56.893
29	14.256	15.574	17.708	19.768	22.475	24.577	28.336	32.461	35.139	39.087	42.557	46.693	49.588	58.302
30	14.953	16.306	18.493	20.599	23.364	25.508	29.336	33.530	36.250	40.256	43.773	47.962	50.892	59.703
40	22.164	23.838	26.509	29.051	32.345	38.872	39.335	44.165	47.269	51.805	55.759	60.436	63.692	73.402
50	29.707	31.644	34.764	37.789	41.449	44.314	34.335	54.723	58.164	63.167	67.505	72.613	76.154	86.661
60	37.485	39.699	43.188	46.459	50.641	53.809	59.335	65.227	68.972	74.397	79.082	84.580	88.379	99.607

Source: Table IV of R.A. Fisher and F. Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, published by Longman Group UK Ltd, London (previously published by Oliver and Boyd Ltd, Edinburgh) and by permission of the authors and publishers.

Appendix Table 4 Upper Percentiles of the t Distribution

df \ 1–	.75	.90	.95	.975	.99	.995	.9995
1	1.000	3.078	6.314	12.706	31.821	63.657	636.619
2	.816	1.886	2.920	4.303	6.965	9.925	31.598
3	.765	1.638	2.353	3.182	4.541	5.841	12.941
4	.741	1.533	2.132	2.776	3.747	4.604	8.610
5	.727	1.476	2.015	2.571	3.365	4.032	6.859
6	.718	1.440	1.913	2.447	3.143	3.707	5.959
7	.711	1.415	1.895	2.365	2.998	3.499	5.405
8	.706	1.397	1.860	2.306	2.896	3.355	5.041
9	.703	1.383	1.833	2.262	2.821	3.250	4.781
10	.700	1.372	1.812	2.228	2.764	3.169	4.587
11	.697	1.363	1.796	2.201	2.718	3.106	4.437
12	.695	1.356	1.782	2.179	2.681	3.055	4.318
13	.694	1.350	1.771	2.160	2.650	3.012	4.221
14	.692	1.345	1.761	2.145	2.624	2.977	4.140
15	.691	1.341	1.753	2.131	2.602	2.947	4.073
16	.690	1.337	1.746	2.120	2.583	2.921	4.015
17	.689	1.338	1.740	2.110	2.567	2.898	3.965
18	.688	1.330	1.734	2.101	2.552	2.878	3.922
19	.688	1.328	1.729	2.093	2.539	2.861	3.883
20	.687	1.325	1.725	2.086	2.528	2.845	3.850
21	.686	1.323	1.721	2.080	2.518	2.831	3.819
22	.686	1.321	1.717	2.074	2.508	2.819	3.792
23	.685	1.319	1.714	2.069	2.500	2.807	3.767
24	.685	1.318	1.711	2.064	2.492	2.797	3.745
25	.684	1.316	1.708	2.060	2.485	2.787	3.725
26	.684	1.315	1.706	2.056	2.479	2.779	3.707
27	.684	1.314	1.703	2.052	2.473	2.771	3.690
28	.683	1.313	1.701	2.048	2.467	2.763	3.674
29	.683	1.311	1.699	2.045	2.462	2.756	3.659
30	.683	1.310	1.697	2.042	2.457	2.750	3.646
40	.681	1.303	1.684	2.021	2.423	2.704	3.551
60	.679	1.296	1.671	2.000	2.390	2.660	3.460
120	.677	1.289	1.658	1.980	2.358	2.617	3.373
	.674	1.282	1.645	1.960	2.326	2.576	3.291

Source: From Table III or R.A. Fisher and F. Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, published by Longman Group UK Ltd, London (previously published by Oliver and Boyd, Edinburgh) and by permission of the authors and publishers.

Appendix Table 5 Percentiles of the F Distribution $F_{.95}(n_1, n_2)$ $\alpha = 0.05$

n_1 = degrees of freedom for numerator

n_2 = degrees of freedom for denominator

n_2 \ n_1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	5.53	4.50	4.46	4.43	4.40	4.36
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.96	1.93	1.88	1.84	1.79	1.73	1.67
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

$F_{99}\ (n_1, n_2)\ \alpha = 0.01$

n_1 = degrees of freedom for numerator

n_2 = degrees of freedom of denominator

n_2 \ n_1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	4052	4999.5	5403	5625	5764	5859	5928	5982	6022	6056	6106	6157	6209	6235	6261	6287	6313	6339	6366
2	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39	99.40	99.42	99.43	99.45	99.46	99.47	99.47	99.48	99.49	99.50
3	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35	27.23	27.05	26.87	26.69	26.60	26.50	26.41	26.32	26.22	26.13
4	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66	14.55	14.37	14.20	14.02	13.93	13.84	13.75	13.65	13.56	13.46
5	16.26	13.27	12.06	11.39	10.96	10.67	10.46	10.29	10.16	10.05	9.89	9.72	9.55	9.47	9.38	9.29	9.20	9.11	9.02
6	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.72	7.56	7.40	7.31	7.23	7.14	7.06	6.97	6.88
7	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.782	6.62	6.47	6.31	6.16	6.07	5.99	5.91	5.82	5.74	5.65
8	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.67	5.52	5.36	5.28	5.20	5.12	5.03	4.95	4.86
9	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.11	4.96	4.81	4.73	4.65	4.57	4.48	4.40	4.31
10	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.71	4.56	4.41	4.33	4.25	4.17	4.08	4.00	3.91
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.40	4.25	4.10	4.02	3.94	3.86	3.78	3.69	3.60
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.16	4.01	3.86	3.78	3.70	3.62	3.54	3.45	3.36
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	3.96	3.82	3.66	3.59	3.51	3.43	3.34	3.25	3.17
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94	3.80	3.66	3.51	3.43	3.35	3.27	3.18	3.0	3.00
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.67	3.52	3.37	3.29	3.21	3.13	3.05	2.96	2.87
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.55	3.41	3.26	3.18	3.10	3.02	2.93	2.84	2.75
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.46	3.31	3.16	3.08	3.00	2.92	2.83	2.75	2.65
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.37	3.23	3.08	3.00	2.92	2.84	2.75	2.66	2.57
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.30	3.15	3.00	2.92	2.84	2.76	2.67	2.58	2.49
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.23	3.09	2.94	2.86	2.78	2.69	2.61	2.52	2.42
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31	3.17	3.03	2.88	2.80	2.72	2.64	2.55	2.46	2.36
22	7.95	5.72	4.83	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.12	2.98	2.83	2.75	2.67	2.58	2.50	2.40	2.31
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30	3.21	3.07	2.93	2.78	2.70	2.62	2.54	2.45	2.35	2.26
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.03	2.89	2.74	2.66	2.58	2.49	2.40	2.31	2.21
25	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22	3.13	2.99	2.85	2.70	2.62	2.54	2.45	2.36	2.27	2.17
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09	2.96	2.81	2.66	2.58	2.50	2.42	2.33	2.23	2.13
27	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15	3.06	2.93	2.78	2.63	2.55	2.47	2.38	2.29	2.20	2.10
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03	2.90	2.75	2.60	2.52	2.44	2.35	2.26	2.17	2.06
29	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09	3.00	2.87	2.73	2.57	2.49	2.41	2.33	2.23	2.14	2.03
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98	2.84	2.70	2.55	2.47	2.39	2.30	2.21	2.11	2.01
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	2.80	2.66	2.52	2.37	2.29	2.20	2.11	2.02	1.92	1.80
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.50	2.35	2.20	2.12	2.03	1.94	1.84	1.73	1.60
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	2.47	2.34	2.19	2.03	1.95	1.86	1.76	1.66	1.53	1.38
∞	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32	2.18	2.04	1.88	1.79	1.70	1.59	1.47	1.32	1.00

Source: Table A4 of R.A. Fisher and F. Yates, *Statistical Tables for Biological, Agricultural and Medical Research*, published by Longman Group UK Ltd., London (Previously published by Oliver and Boyd Ltd., Edinburgh) and by permission of the authors and publishers.

Appendix Table 6 Critical Values of *T* in the Wilcoxon Matched-Pairs Test

N	Level of Significance for One-Tail Test		
	.025	.01	.005
	Level of Significance for Two-Tail Test		
	.05	.02	.01
6	0	—	—
7	2	0	—
8	4	2	0
9	6	3	2
10	8	5	3
11	11	7	5
12	14	10	7
13	17	13	10
14	21	16	13
15	25	20	16
16	30	24	20
17	35	28	23
18	40	33	28
19	46	38	32
20	52	43	38
21	59	49	43
22	66	56	49
23	73	62	55
24	81	69	61
25	89	77	68

Appendix Table 7 Partial Table of Critical Values of U in the Mann-Whitney Test

Critical Values for One-Tail Test at $\alpha = .025$ or a Two-Tail Test at $\alpha = .05$

n_1 \ n_2	9	10	11	12	13	14	15	16	17	18	19	20
1												
2	0	0	0	1	1	1	1	1	2	2	2	2
3	2	3	3	4	4	5	5	6	6	7	7	8
4	4	5	6	7	8	9	10	11	11	12	13	13
5	7	8	9	11	12	13	14	15	17	18	19	20
6	10	11	13	14	16	17	19	21	22	24	25	27
7	12	14	16	18	20	22	24	26	28	30	32	34
8	15	17	19	22	24	26	29	31	34	36	38	41
9	17	20	23	26	28	31	34	37	39	42	45	48
10	20	23	26	29	33	36	39	42	45	48	52	55
11	23	25	30	33	37	40	44	47	51	55	58	62
12	26	29	33	37	41	45	49	53	57	61	66	69
13	28	33	37	41	45	50	54	59	63	67	72	76

(Contd.)

Appendix Table 7 *(Contd.)*

n_1 \ n_2	9	10	11	12	13	14	15	16	17	18	19	20
14	31	36	40	45	50	55	59	64	67	74	78	83
15	34	39	44	49	54	59	64	70	75	80	85	90
16	37	42	47	53	59	64	70	75	81	86	92	98
17	39	45	51	57	63	67	75	81	87	93	99	105
18	42	48	55	61	67	74	80	86	93	99	106	112
19	45	52	58	65	72	78	85	92	99	106	113	119
20	48	55	62	69	76	83	90	98	105	112	119	127

Critical Values for One-Tail Test at $\alpha = .05$ or a Two-Tail Test at $\alpha = .10$

n_1 \ n_2	9	10	11	12	13	14	15	16	17	18	19	20
1											0	0
2	1	1	1	2	2	2	3	3	3	4	4	4
3	3	4	5	5	6	7	7	8	9	9	10	11
4	6	7	8	9	10	11	12	14	15	16	17	18
5	9	11	12	13	15	16	18	19	20	22	23	25
6	12	14	16	17	19	21	23	25	26	28	30	32
7	15	17	19	21	24	26	28	30	33	35	37	39
8	18	20	23	26	28	31	33	36	39	41	44	47
9	21	24	27	30	33	36	39	42	45	48	51	54
10	24	27	31	34	37	41	44	48	51	55	58	62
11	27	31	34	38	42	46	50	54	57	61	65	69
12	30	34	38	42	47	51	55	60	64	68	72	77
13	33	37	42	47	51	56	61	65	70	75	80	84
14	36	41	46	51	56	61	66	71	77	82	87	92
15	39	44	50	55	61	66	72	77	83	88	94	100
16	42	48	54	60	65	71	77	83	89	95	101	107
17	45	51	57	64	70	77	83	89	96	102	109	115
18	48	55	61	68	75	82	88	95	102	109	116	123
19	51	58	65	72	80	87	94	101	109	116	123	130
20	54	62	69	77	84	92	100	107	115	123	130	138

Appendix Table 8 Critical Values of D in the Kolmogorov-Smirnov One-Sample Test

Sample Size	Level of Significance for D = Maximum $[F_0(X) - F_e(X)]$				
n	.20	.15	.10	.05	.01
1	.900	.925	.950	.975	.995
2	.684	.726	.776	.842	.929
3	.565	.597	.642	.708	.828
4	.494	.525	.564	.624	.733
5	.446	.474	.510	.565	.669
6	.410	.436	.470	.521	.618

(Contd.)

Appendix Table 8 *(Contd.)*

Sample Size	Level of Significance for D = Maximum $[F_0(X) - F_e(X)]$				
n	**.20**	**.15**	**.10**	**.05**	**.01**
7	.381	.405	.438	.486	.577
8	.358	.381	.411	.457	.543
9	.339	.360	.388	.432	.514
10	.322	.342	.368	.410	.490
11	.307	.326	.352	.319	.468
12	.295	.313	.338	.375	.450
13	.284	.302	.325	.361	.433
14	.274	.292	.314	.349	.418
15	.266	.283	.304	.338	.404
16	.258	.274	.295	.328	.392
17	.250	.266	.286	.318	.381
18	.244	.259	.278	.309	.371
19	.237	.252	.272	.301	.363
20	.231	.246	.264	.294	.356
25	.21	.22	.24	.27	.32
30	.19	.20	.22	.24	.29
35	.18	.19	.21	.23	.27
Over 35	$\frac{1.07}{\sqrt{n}}$	$\frac{1.14}{\sqrt{n}}$	$\frac{1.22}{\sqrt{n}}$	$\frac{1.36}{\sqrt{n}}$	$\frac{1.63}{\sqrt{n}}$

Glossary

Accuracy A criterion to judge whether the data are free from any errors.

Aided Recall An approach to questioning which attempts to stimulate a respondent's memory.

Allowable Error The magnitude of sampling error in the estimate of the parameter that is acceptable to the researcher.

Alternative Hypothesis A hypothesis which takes a value of a population parameter different from that used in the null hypothesis.

Analysis of Variance A statistical technique used to test a hypothesis regarding the difference between two or more means.

Applied Research Research undertaken to answer questions about specific problems with a view to facilitating managers in decision making.

Area Sampling A form of cluster sampling in which areas such as census tracts and blocks, form the primary sampling units. The population is divided into mutually exclusive areas using maps. A random sample of areas is then selected.

Attitude An individual's disposition to consistently respond to a particular manner to one or more aspects on which his responses are being sought.

Attribute A characteristic or property of a person or an object.

Audimeter A mechanical device which is used for recording a particular TV channel or radio programme.

Basic Research Research which aims at expanding the frontiers of knowledge in a given subject or is undertaken to verify whether a given theory holds good.

Bayesian Probability A probability based on a person's subjective judgement.

Baye's Rule A formal mechanism for revising prior probabilities in the light of new information.

Bipolar Scale A scale which is bounded at each end by adjectives that are antonyms such as good-bad, clean-dirty.

Bivariate Analysis A statistical analysis involving two variables at a time.

Blind Use Test A test in which respondents are asked to indicate their preference by using two or more alternative brands without knowing the brand names.

Case Study Method The exploratory research technique involving a detailed study of one or a few situations relevant to the researcher's problem.

Causal Research Research undertaken to ascertain cause-and-effect relationships among variables.

Census A study covering all elements of a given population.

Central Limit Theorem A theory which states that as a sample size increases, the distribution of sample means tends to take the form of a normal distribution.

Chi-Square Test A statistical technique used to test significance in the analysis of frequency distribution.

Cluster Analysis A group of multivariate techniques used to identify similar entities on the basis of their characteristics. The clusters thus identified have a high internal (within-cluster) homogeneity and a high external (between-cluster) heterogeneity.

Cluster Sampling A sample design in which a cluster of elements is the primary sampling unit instead of individual elements in the population.

Coding The process of classifying and categorising of respondents with numerical scores.

Coefficient of Determination (r^2) A statistical device which measures the proportion of the total variation of the dependent variable that can be attributed to the relationship with the independent or predictor variable or variables. It varies from 0 to 1.

Concept Testing A form of research which involved exposing respondents to the concept and getting their reactions in respect of, say, a new product.

Conditional Probability The probability of event B occurring, given that event A has occurred.

Confidence Interval A specified range of numbers within which a population value is likely to fall.

Conjoint Analysis A dependent method of multivariate analysis which is suitable in case of ordinarily scaled dependent variable and nominally scaled independent variables. It also helps in finding out the best combination of attributes.

Construct Validity The ability of a measure to confirm a set of related hypotheses generated from a theory based on the concepts.

Consumer Panel A sample of individuals or households who record their purchases, attitudes or behaviour in a diary over time.

Content Validity The appropriateness of a measuring instrument for obtaining the information desired.

Contingency Coefficient A statistic used to measure the extent of association between two sets of data, one or both of which are nominally scaled.

Contrived Observation Observation in which the investigator creates a desired situation before observation.

Control Group In an experiment, a group of individuals who are exposed to the control condition and not to the experimental treatment.

Convenience Sample A sample selected by the researcher on the basis of his convenience.

Convergent Validity When two independent measures of the same concept yield similar results.

Correlation Coefficient (r) A measure which indicates the extent of association between two variables. It varies from –1 to +1.

Criterion Variable Dependent variable.

Cross-sectional Study A study involving a sample of elements from the population of interest at a single point in time.

Cross Tabulation A tabulation having a joint frequency distribution relating to two or more variables.

Decision Tree A flow diagram indicating the decision process. It is usually drawn with standard symbols. The square node indicates a decision point while branches from a circular node represent possible outcome or states of nature.

Degrees of Freedom The number of elements that can be chosen freely.

Delphi Technique A method of forecasting in which a group of experts is brought together. The experts have access to each other's opinion but they are not informed about the majority opinion.

Dependent Variable A variable whose value depends on the level of the independent variable.

Depth Interview An unstructured and extensive interview in which the respondent is encouraged to talk freely with the interviewer so that his inner feelings are disclosed.

Discriminant Analysis A statistical technique used to classify persons or objects into two or more categories on the basis of intervally scaled predictor variables.

Discriminant Validity The ability of a measurement instrument not to correlate with other variables that are not measuring the same concept. It is the opposite of convergent validity.

Disguised Observation A form of observation in which subjects are wholly unaware that they are being observed by someone.

Disproportionate Stratified Sampling A sample design in which the sample sizes in different strata do not form the same proportion of the respective population sizes of the strata.

Double-Barreled Questions A question in which two questions are asked as one.

Dummy Variable A variable that takes on the values of either 0 or 1. It is used to denote characteristics or attributes that cannot be quantified.

Econometric Model System of equations which describes the operation of an economic system.

Editing The process of making data suitable for coding and tabulation, ensuring completeness, consistency and reliability.

Eigen Value The column sum of squares for a factor, representing the variance that a factor has accounted for.

Estimation A situation in which the presence of a certain characteristic in a given population is to be estimated.

Euclidean Distance A measure to ascertain the similarity between two objects. It is the length of a straight line between them.

Event One of the possible outcomes of an experiment.

Expected Value The value obtained by multiplying each consequence by the probability of its occurrence and summing the products.

Expected Value of Perfect Information The expected value under certainty minus the expected value of the optimal act under uncertainty.

Experiment An investigation in which one or more variables are manipulated with a view to testing a hypothesis.

Experiment Error A measure of the apparent variation in performance of test units treated alike by the experimenter after the effect of 'extraneous' forces is removed from the data.

Experimental Group The group of subjects exposed to an experimental treatment.

Experimental Treatments Alternative manipulations of an independent variable in an investigation.
Exploratory Research Investigation undertaken to clarify and define the nature of a problem for a detailed research, if necessary. This research is generally based on secondary data.
Exponential Smoothing A method of forecasting which involves a single weighting factor called alpha.
Ex Post Facto Study A study in which the researcher starts with some currently existing condition and then tries to ascertain the factor or factors that caused it.
External Data Data which originate outside an organisation for which the study is being done.
External Validity The ability of an experiment to predict the results in situations external to the actual experimental context.
F-Statistic The statistic used in the analysis of variance for testing differences is groups.
F-Test A procedure used to determine if there is more variability in the score of one sample than in the score of another sample.
Face Validity A form of content validity that is determined entirely by judgement of 'non-experts' such as respondents or executives.
Factor An underlying dimension (construct) that summarises the original set of observed variables.
Factor Loadings The correlation between the original variables and the factors, and the key to understanding the nature of a particular factor.
Factor Matrix A table showing the factor loadings of all variables on each factor.
Factorial Design A design with more than one factor (treatment).
Field Experiments Experiments carried out in natural settings.
Filter Question A question which is part of a questionnaire that screens out respondents who are not to be asked any subsequent questions.
Finite Population Correlation A correction factor used while determining sample size from a finite population. The usual practice is to apply it when sample size is more than 5 per cent of the population.
Focus Group Interview An interview involving a small group of people, which is conducted in an unstructured manner allowing the participants to express themselves freely on a given subject.
Forced Choice Scale A rating scale which does not include a 'no opinion' or 'undecided' category thus requiring the respondent to indicate a position on the scale.
Frequency Distribution A table that shows the number of responses that a question or item has received from the respondents.
Goodness of Fit A statistical test involving the chi-square statistic for determining whether some observed pattern of frequencies conforms to an expected pattern.
Grand Mean In analysis of variance, the mean of all observations across all treatment groups.
Graphic Scale A scale in which the respondent indicates his rating by a mark on a line that runs from one extreme of the attribute to the other such as 'very good' and 'very poor'.
Histogram A form of bar chart in which the height of the bars represents the absolute or relative frequency of occurrence of the variable of interest.
History The specific events which are external to an experiment but concurrent to it and which may affect the criterion or response variable.

Hypothesis An unproven proposition or supposition that tentatively explains a phenomenon.

Independent Variable A variable that presumably causes a change in a dependent variable.

Input-Output Analysis Models which are concerned with the flow of goods among industries in an economy or among branches of a large organisation.

Instrumentation Effect Any change in the measuring devices used in an experiment that may influence two or more measurements.

Interaction Error An experimental error that occurs when respondents react differently to the independent variable on account of an earlier measurement.

Intercept The value on the Y axis (criterion variable axis) where the line defined by the regression equation $Y = a + b X$ crosses the axis. It is described by the constant term 'a' in the equation.

Interdependent Technique A classification of statistical techniques in which all variables are analysed as a single set, rather than as dependent and independent variables. An example is factor analysis.

Internal Validity The extent to which results in an experiment are caused by the treatment variables as distinct from extraneous variables.

Interval Estimate The estimate of an interval in which an unknown population characteristic is expected to lie, for a given level of significance.

Interval Scale A scale of measurement in which the distances among the numbers correspond to the distances among the objects or events in respect of the characteristic being measured; intervals between numbers are taken as equal.

Interviewer Bias Bias in the responses arising on account of the effect of the interviewer in a field survey. It may arise on account of such factors as age, sex, opinion, mannerism of the interviewer, etc.

Joint Probability The probability of two events occurring together or in succession.

Judgement Sample A non-probability sample based on the judgement of the researcher who thinks that the sample respondents thus chosen would contribute to answering the research question.

Laboratory Experiment A research investigation in which the experimental treatment is introduced in a laboratory or artificial environment.

Laboratory Test Market A type of test market in which respondents are taken on a simulated shopping trip in a laboratory facility and then are asked to fill in a questionnaire.

Latin Square Design A statistical experimental design in which two or more extraneous variables in addition to the independent variable are controlled.

Leading Question A question which reflects the viewpoint of the researcher or suggests what the answer should be.

Least-Squares Method A method of fitting a trend line which minimises the sum of the squares of the error between the estimated points on the trend line and the actual observed points that were used to fit the line.

Likert Scale A scale by the Likert method in which subjects are given a number of statements and asked to indicate their agreement or disagreement with those statements. Their responses to all statements are then summed up to obtain a total score.

Longitudinal Study A survey of respondents undertaken at two or more points of time aimed at studying changes over time.

Mail Survey A survey based on the responses received from sample respondents who had received questionnaires by mail earlier.

Marketing Information System (MIS) A set of procedures and methods for regular collection and analysis of data with a view to assisting the management in its marketing decisions.

Marketing Research (MR) The systematic gathering, recording and analysing of data about problems relating to the marketing of goods and services.

Market Potential The amount of sales for the product or service which one may expect if the market were fully developed.

Master Sample A sample from which repeated sub-samples can be chosen as and when required from the same area or population.

Maturation Effect An effect on the results of an experiment caused by changes in the experimental subjects during the experiment.

Mean A measure of central tendency which is obtained by adding all observations in a series and dividing the aggregate by the number of observations.

Median A measure of central tendency for ordinal data. When a series is arranged in order of magnitude, it is the value of the middle item.

Measures of Dispersion Measures indicating the extent of variability in a given series. Such measures are the standard deviation, coefficient of variation, inter-quartile range, etc.

Mechanical Observation Observation made with the help of mechanical devices such as the motion picture camera, the audimeter, the eye camera and the pupilometer.

Metric Data Quantitative data. Also known as interval and ratio data. For example, a person's height and weight are considered metric data.

Mode A measure of central tendency for nominal data. It is the category having the maximum frequency.

Monadic Tests Tests in which respondents are asked to rate an item on a rating scale without comparing it with any other item.

Mortality Effect An experimental error that occurs when some respondents withdraw from an experiment before its completion, thereby affecting its validity.

Moving Average An average that is updated as new information becomes available. For example, a three-monthly moving average sales of a product will first be based on the sales effected in January, February and March. This will be followed by the average for February, March and April, and so on.

Multi-collinearity A problem arising in multiple regression analysis when two or more independent variables are correlated with each other.

Multi-dimensional Scaling An approach to measurement in which respondents' perceptions of the similarity of objects and their preferences among the objects are measured in multi-dimensional space.

Multiple-Choice Questions A question which requires the respondent to choose one of the several answers listed in the question itself or following the question.

Multiple Correlation Coefficient In multiple regression, the correlation coefficient between the observed $Y_i s$ and the estimated $Y_i s$.

Multiple Regression A technique of analysing data, which simultaneously investigates the effect of two or more independent variables on a single intervally scaled variable. It is an extension of the simple regression technique to more than one independent variable.

Multi-phase Sampling A sample design in which some information is collected from the entire sample and detailed or additional information is collected from only a part of the original sample. The sampling unit in each phase remains the same.

Multi-stage Sampling A sample design in which a sample is drawn in two or more stages sequentially. The sampling unit in each stage tends to be different. For instance, first draw a sample of localities. This is to be followed by a sample of households from the localities chosen earlier.

Multivariate Analysis The analysis of data involving more than two variables at a time.

Multivariate Analysis of Variance (MANOVA) A method of analysing multivariate data which is suitable in case of two or more intervally scaled dependent variables and one or more intervally scaled independent variables.

Nominal Scale A scale in which numbers are used only to identify or categorise objects or events without ordering the categories.

Non-metric Data Also called qualitative data or nominal and ordinal data. Examples of such data are sex (male, female) or occupation (teacher, clerk, doctor, engineer).

Non-parametric Statistics Statistical procedures which do not make any assumptions about the distribution of the population and which use data based on nominal or ordinal scale.

Non-probability Sampling Any sampling method which is not based on the random selection of elements in the population. Examples of such a sample are quota sampling, convenience sampling, etc.

Non-response Error An error on account of the refusal of respondents to give the information sought.

Non-sampling Error Any errors that arise in a research study that are not due to sampling. Such errors can arise in several ways while tabulating, coding and interpreting the data.

Normal Distribution A distribution of a continuous random variable where the curve has a single peak, and which is bell-shaped and symmetrical around a vertical line drawn at the mean, which is located at the centre. The two tails of the distribution extend indefinitely and never touch the horizontal axis.

Null Hypothesis A statement about a status quo which states that any change from the status quo will be on account of random error alone.

Observation A method of collecting data on the basis of the respondent's behaviour and action.

Omnibus Panel A fixed sample of respondents who are interviewed on different variables over a period of time.

One-tailed Test A statistical hypothesis test in which the alternative hypothesis is specified such that only one direction of the possible distribution of values is considered.

Open-ended Question A question which require the respondent to answer it in his own words and which does not bind the respondent to select an answer from amongst a set of alternatives.

Order Bias The bias of responses caused by the order in which questions are presented in a questionnaire, or the order in which alternatives in a multiple-choice question are given.

Ordinal Scale A scale of measurement in which objects or alternatives are arranged in a certain order such as 'more than' or 'less than'.

Paired Comparison A measurement technique wherein the respondent is asked to show his preference between two objects at a time.

Panel Study A study based on the data collected from the same sample of individuals/households over time.

Parameter A quantity which remains constant in each case considered, but varies in different cases.

Payoff The benefit which results from a given combination of state of nature and decision alternative.

Perceptual Map The visual representation of a respondent's perceptions of two or more dimensions or features of objects which could be brands, products or services.

Point Estimate A statistical estimate of a parameter involving only a single value.

Population The aggregate of the elements from which a sample is to be drawn.

Portfolio Tests A 'before' test for finding the suitability of an advertisement copies and then asked to recall them.

Position Bias The tendency on the part of respondents to prefer responses on account of their position in the list containing all responses. For example, respondents may prefer answers occurring in the middle positions or at the extreme ends in a list of several responses.

Posterior Probability A probability that has been revised on the basis of new information.

Precision The desired size of the confidence interval when a population parameter is to be estimated. The concept is also useful in determining sample size.

Predictive Validity A measure of validity which shows the extent to which the future level of some variable can be predicted by either a current measurement of the same variable or another one.

Predictor Variable Independent variable.

Pre-testing The practice of administering a questionnaire to a small number of respondents with a view to avoiding any ambiguity or bias contained in it.

Pre-posterior Analysis A method of analysis wherein the researcher evaluates alternative research studies prior to undertaking the research.

Primary Data Data collected specifically for the study currently undertaken.

Prior Analysis An analysis involving the use of probabilities of outcomes assigned on the basis of present judgement, without collecting any additional information.

Probability The chance that a certain event will occur.

Probability Sampling A sampling technique in which sampling units are selected by chance and for which there is known, non-zero probability of selection.

Projective Technique An indirect means of questioning that necessitates a subject to rely on his own motivations, attitudes, emotions, needs, etc., in responding to the question.

Proportion Stratified Sample A stratified sample in which sample size in each stratum is in proportion to the relative population size in each stratum.

Purposive Sample A non-probability sample in which selection of sample units is made with some specific objective or objectives in mind.

Qualitative Forecasting Methods Methods of forecasting based on judgements or opinions of well-informed people.

Questionnaire A schedule containing various items on which information is sought from respondents.

Quota Sample A non-probability sample which contains a pre-specified quota of certain characteristics of a population.

Random Error An error in the measurement on account of the transient aspects of the respondents or measurement setting.

Random Sample Probability sample.

Randomisation A procedure in experimentation in which the assignment of subjects and treatments to groups is based on chance.

Randomised Block Design An experimental design in which test units are blocked on the basis of some pre-specified criterion and then assigned to different treatments within each block.

Rating Scale A scale normally used to measure the respondent's attitude towards an object, his preference or dislike toward some attribute, and the degree to which an object contains a particular attribute. The respondent is asked to indicate the position on a continuum or among ordered categories corresponding to his attitude.

Ratio Scale A scale of measurement in which items are ranked so that numerically equal scale distances represent equal distances in the attribute being measured.

Recall Test Procedures in advertising used to ascertain respondents' ability to recall, unaided or aided, advertisements to which they have previously been exposed.

Recognition Tests Procedures in advertising used to find respondents' ability to recognise advertisements which were previously shown to them in an interview.

Regression Coefficient The numerical value of any parameter estimate that is directly associated with the independent variable or variables. For example, in the linear model $Y = a + b X$ the value b is the regression coefficient for the variable X.

Reliability The extent to which the measurement process is free from errors and therefore gives consistent results.

Replicated Sampling A sample design in which several random sub-samples are selected from the population instead of one full sample.

Research Design A detailed plan of research indicating the methods and procedures to be used for collecting and analysing data on a given subject and reporting results.

Research Process The series of stages or steps involved in a research project.

Research Proposal A plan for conducting a research project on a specified subject, covering such aspects as sampling, collection of data, methods of analysing data, etc.

Research Report A report on a research study containing its findings directed to a specific audience.

Research Supplier A commercial marketing research service which undertakes projects on behalf of its clients on some consideration. It is known by varying names.

Respondent The person who is contacted by an interviewer for obtaining the desired information or the person who provides answers to questions in a mail questionnaire.

Response Bias Error that occurs on account of wrong answers given by respondents. This may arise on account of several reasons such as respondent's desire to please the interviewer, consideration of prestige, tiredness, etc.

Response Rate The extent of response received from respondents in a particular survey. It is measured by the proportion of the number of questionnaires completed to the total number of persons interviewed or contacted.

Retail Store Audit Data collected periodically by research firms from a sample of stores. Its employees visit the stores, check the stocks and record deliveries in order to estimate retail sales.

Sample A subset or some part of a population.

Sampling Statistics Measures computed from sample data.

Sampling Distribution The frequency distribution of all possible samples of a certain size drawn from a particular population.

Sampling Error The difference between the population parameter and the observed probability sample statistic.

Sampling Fraction The proportion of the number of elements included in a sample to the total number of elements contained in a population.

Sampling Frame A complete list of elements comprising the population from which a sample is to be selected.

Sampling Unit The element or elements available for selection in a sample such as a store, product, or person.

Scale Any series of items that are progressively arranged according to value or magnitude; a series into which an item can be placed according to its magnitude.

Scalogram Analysis A method for scaling attitude items. It holds that attitude items can be arranged such that a subject who responds positively to a particular item also does so to all other items having a lower rank.

Scatter Diagram A diagram showing the different values of the two variables plotted.

Scientific Method An objective method of systematic and comprehensive investigation on a specific topic or problem.

Seasonal Index A measure of the effects of seasonal fluctuations.

Secondary Data Statistics collected in a previous study.

Semantic Differential Scale A self reporting scale requiring the respondent to rate an object on a number of itemised rating scales bounded on each end by one of the two bipolar adjectives.

Sentence Completion Technique A projective technique in which the respondent is given an incomplete sentence and asked to complete it with the first words that come to his mind.

Significance Level The probability level which is too low to justify the acceptance of a null hypothesis.

Simple Random Sampling A probability sampling procedure where each element of the population has an equal chance of being selected.

Simulated Test Market A laboratory based method used for forecasting sales of a given product. The consumers are exposed to it in a laboratory setting.

Snowball Design A judgemental sample design in which respondents selected earlier are asked to identify other sample members.

Solomon Four-Group Design An experimental design which comprises four groups (two treatment; two control) and six measurements (two pre-measurements and four post-measurements). In this design both extraneous variable effects and interactive testing effects are under control.

Spearman's Rank Correlation Coefficient A statistic used in ordinal data to measure the extent of relationship between two variables.

Split-Ballot Technique A technique used in the collection of data through questionnaires. It uses two or more versions of a questionnaire so that the effect of position bias in multiple choice questions can be reduced.

Split-Half Reliability A measure of reliability in which one half of the items are compared with the other half. In case the results show substantial variation, the reliability of the instrument is considered to be doubtful.

Spurious Relationship The observed relationship between variables, which disappears when the data are analysed in greater detail.

Standard Deviation The square root of the variance in a series. It shows how the data are spread out.

Standard Error of Estimate A term used in regression analysis to indicate the extent of variation in the dependent variable that remains unexplained by the regression equation.

Standard Error of the Mean The standard deviation of a sampling distribution of the mean. It is calculated by dividing the population standard deviation by the square root of the sample size.

Staple Scale A scale of attitude measurement having a ten-interval rating ranging from + 5 to –5. Respondents are asked to indicate their rating in respect of the object of interest.

Statistic A measure or characteristic of a sample.

Statistical Efficiency A measure used to compare two or more sampling plans. If two sampling plans having the same sample size are to be compared, then the sampling plan which gives a smaller standard error of estimate, is regarded more statistically efficient.

Stratified Sampling A probability sampling method in which sub-samples are drawn from two or more strata comprising the population. The strata are more or less homogeneous.

Syndicated Service A marketing research firm that provides standardised information to its clients on a subscription basis.

Systematic Error An error in measurement that affects it in a systematic way. It is also known as constant error.

Systematic Sampling A sampling method in which a sample is drawn in such a way that it is systematically spread over all the elements of population.

t Test A method of testing a hypothesis when sample size is small.

Tabulation Presentation of data collected in an orderly and summarized form.

Test Marketing An experimental procedure which involves the testing of a product in a selected area or areas to ascertain the desirability of introducing it in the entire market.

Test-Retest Reliability A method of estimating reliability which involves the administering of the same scale respondents on two different occasions. The greater the similarity in the responses at both times, the greater is the reliability.

Test Unit The entities in an experiment to whom the treatments are presented and whose response to the treatments is measured.

Testing Effect A situation when the respondent being aware of a test becomes too sensitive and does not respond naturally.

Thematic Apperception Test (TAT) A projective technique consisting of one or more copyrighted pictures depicting a situation which the respondent is asked to describe.

Thurstone/Equal-Appearing Interval Scale A scale developed by having a group of knowledgeable persons first categorise a set of statements pertaining to a subject of interest and then selecting those statements that were similarly categorised. When the scale is administered to the respondents, they are asked to select those statements to which they agree.

Time Series Analysis A method of forecasting in which data are arranged in relation to time, such as annual sales data.

Treatment The independent variable that the researcher manipulates to see what effect it has on the dependent variables.

Two-tailed Test A statistical hypothesis test in which the alternative hypothesis is stated in such a way that it includes both higher and lower values of the parameter than the value specified in the null hypothesis.

Type I Error An error caused by rejecting a null hypothesis which is true.

Type II Error An error caused by failing to reject a null hypothesis which is not true.

Unaided Recall A questioning approach in which the respondent is asked to remember an object of interest without any cues from the researcher.

Unconditional Probability The probability of an event which is independent of other events. It is also known as marginal probability.

Univariate Analysis Analysis of data involving only one variable.

Validity The ability of a test to measure what it intends to measure.

Variable A property that takes on different numerical values at different times.

Variance A measure of the dispersion indicating the extent to which elements of a sample or population differ from the average element.

Weighted Moving Average A moving average in which the data used to compute the average are given different weights. One way of assigning weight is to give greater weightage to more recent data especially while forecasting.

Word Association Test A projective technique in which the respondent is given a list of words, one at a time, and asked to mention the first word that comes to his mind.

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