MARKETING RESEARCH

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UNIT 1

1.1 AN INTRODUCTION TO MARKETING RESEARCH

Marketing is a restless, changing, and dynamic business activity. The role of marketing itself has changed dramatically due to various crises material and energy shortages, inflation, economic recessions, high unemployment, dying industries, dying companies, terrorism and war, and effects due to rapid technological changes in certain industries. Such changes, including the Internet, have forced today's marketing executive to becoming more market driven in their strategic decision-making, requiring a formalized means of acquiring accurate and timely information about customers, products and the marketplace and the overall environment. The means to help them do this is marketing research.

Green and Tull have defined marketing research as follows:

"**Marketing research** is the systematic and objective search for, and analysis of, information relevant to the identification and solution of any problem in the field of marketing."

Marketing research is "**the process or set of processes that links the producers, customers, and end users to the marketer through information used to identify and define marketing opportunities and problems; generate, refine, and evaluate marketing actions; monitor marketing performance; and improve understanding of marketing 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.

It is the systematic gathering, recording, and analysis of qualitative and quantitative data about issues relating to marketing products and services. The goal of marketing research is to identify and assess how changing elements of the marketing mix impacts customer behaviour. The term is commonly interchanged with market research; however, expert practitioners may wish to draw a distinction, in that market research is concerned specifically with markets, while marketing research is concerned specifically about marketing processes.

1.1.1Characteristics

First, marketing research is **systematic**. Thus, systematic planning is required at all the stages of the marketing research process. The procedures followed at each stage are methodologically sound, well documented, and, as much as possible, planned in advance. Marketing research uses the scientific method in that data are collected and analysed to test prior notions or hypotheses. Experts in marketing research have shown that studies featuring multiple and often competing hypotheses yield more meaningful results than those featuring only one dominant hypothesis.

Marketing research is **objective**. It attempts to provide accurate information that reflects a true state of affairs. It should be conducted impartially. While research is always influenced by the researcher's research philosophy, it should be free from the personal or political biases of the researcher or the management. Research which is motivated by personal or political gain involves a breach of professional standards. Such research is deliberately biased so as to result in predetermined findings. The objective nature of marketing research underscores the importance of ethical considerations. Also, researchers should always be objective with regard to the selection of information to be featured in reference texts because such literature should offer a comprehensive view on marketing. Research has shown, however, that many marketing textbooks do not feature important principles in marketing research

1.1.2 Features of Marketing Research

1. Systematic and continuous activity/process: MR is a continuous process. This is natural as new marketing problems are bound to come from time-to-time in the course of marketing of goods and services. One type of research is not adequate to resolve all marketing problems. Similarly, new research projects will have to be undertaken to solve new marketing problems and challenges.
2. Wide and comprehensive in scope: Marketing research is wide in scope as it deals with all aspects of marketing of goods and services. Introduction of new products, identification of potential markets, selection of appropriate selling techniques, study

of market competition and consumer preferences, introduction of suitable advertising strategy and sales promotion measures, are some areas covered by MR.

3. Emphasizes on accurate data collection and critical analysis: In marketing research, suitable data should be collected objectively and accurately. The data collected must be reliable. It should be analysed in a systematic manner. This will provide comprehensive picture of the situation and possible solutions.
4. Offers benefits to the company and consumers: Marketing research is useful to the sponsoring company. It raises the turnover and profit of the company. It also raises the competitive capacity and creates goodwill in the market. It enables a company to introduce consumer-oriented marketing policies. Consumers also get agreeable goods and more satisfaction due to marketing research activities.
5. Commercial equivalent of military intelligence: MR is a type of commercial intelligence activity. It facilitates planned activities in the field of marketing. It is similar to military intelligence where systematic study of the situation is made before taking any military action. Marketing research acts as the intelligence tool of management.
6. Tool for managerial decisions: MR acts as a tool in the hands of management for identifying and analysing marketing problems and finding out solutions to them. It is an aid to decision-making. It suggests possible solutions for the consideration and selection by managers. Marketing research, is an aid to judgment and never a substitute for it.
7. An applied research: MR is applied knowledge. It is concerned with specific marketing problem and suggests alternative solutions and possible outcome of each alternative.
8. Reduces the gap between the producers and consumers: MR is an essential supplement of competitive marketing. It is useful for understanding the needs and expectations of consumers. It reduces the gap between producers and consumers and adjusts the marketing activities to suit the needs of consumers.
9. Marketing research has limitations: Marketing research is not an exact science. It only suggests possible solutions to marketing manager for consideration and selection.

10. Use of different methods: MR can be conducted by using different methods. Data can be collected through survey or by other methods. The researcher has to decide the method which is suitable for the conduct of research project. This selection is important as the quality of research work depends on the method used for the research purpose

Twenty Different Types of Marketing Surveys

1 -Market Description Surveys

To determine the size and relative market share of the market. Such studies provide key information about market growth, competitive positioning and tracking share of market.

2 -Market Profiling-Segmentation Surveys

To identify who the customers are, who they are not, and why they are or are not your customers. This is often a descriptive market segmentation and market share analysis

3 - Stage in the Purchase Process / Tracking Surveys

Where is the customer in the adoption process? This information shows market Awareness Knowledge –Intention – Trial – Purchase – Repurchase of the product.

4 - Customer Intention - Purchase Analysis Surveys

Directed at understanding the current customer. What motivates the customer to move from interest in the product to actual purchase? This is a key to understanding customer conversion, commitment and loyalty.

5 - Customer Attitudes and Expectations Surveys

Does the product meet customer expectations? What attitudes have customers formed about the product and/or company. Used to direct advertising and improve customer conversion, commitment and loyalty.

6 - Customer Trust - Loyalty – Retention Analysis Surveys

Especially for high priced consumer goods with long decision and purchase processes (time from need recognition to purchase), and depth of consumer attitudes formed about the product and/or company.

7 - New Product Concept Analysis Surveys

Concept test studies are appropriate in the initial screening of new product concepts. Likes and dislikes about the concept and evaluation of acceptability and likelihood of purchase are especially useful measures.

8 - New Product Acceptance and Demand Surveys (Conjoint Analysis)

Primarily for estimating demand for new products that can be described or have been developed in drawing or concept, but have not yet been developed physically. Develops develop market share estimates of market potential for the alternative potential products.

9 - Habits and Uses Surveys

Directed at understanding usage situations, including how, when and where the product is used. Habits and uses studies sometimes include a real or virtual pantry audit.

10 - Product Fulfilment Surveys (Attribute, Features, Promised Benefits)

Evaluation of the product's promised bundle of benefits (both tangible and image). Are expectations created for the product by advertising, packaging and the produce appearance fulfilled by the product?

11 - Product Positioning Surveys (Competitive Market Position)

A "Best Practices" study of "How does the market view us relative to the competition?" Competitive positioning analyses often compare the attributes and benefits that make up the product using multidimensional scaling.

12 - Brand Equity Analysis Surveys

What is psychological value that a brand holds in the market place? Brand equity is a composite of brand awareness, brand quality, brand associations and brand loyalty measures.

13 - Advertising Value Identification and Analysis Surveys

Advertising value analysis focuses on mapping the hierarchical attributes, benefits and values that are associated with and portrayed by an advertisement. Means-end analysis is often part of this type of study.

14 - Advertising Message Effectiveness Surveys (Media and Message)

Message effectiveness testing identifies the impressions, feelings, and effectiveness in moving the respondent to a desired goal (increased awareness, more product information, trial, repeat purchase).

15 - Sales Force Effectiveness Surveys

A combination of measures that focus on the sales activities, performance and effectiveness in producing the desired and measurable effect or goal. Often measured as a 360-degree survey completed by the sales person, the client (evaluating the sales call) and the supervisor responsible for evaluating the sales person.

16 - Sales Lead Generation Surveys

Sales lead generation surveys for (1) assuring timely use and follow-up of sales leads, (2) qualifying sales leads (thereby saving valuable sales force time) and (3) providing more effective tracking of sales leads.

17 - Customer Service Surveys

Akin to customer satisfaction surveys, but focus in detail on the actual customer service that was received, the process involved in receiving that service and the evaluation of the participants in the service process.

18 - Customer Service Representative (CSR) Surveys: Attitudes, Burnout, Turnover and Retention:

CSRs hold attitudes that reflect on their job-related activities including (1) the allocation of time; (2) solutions to customer needs; (3) how to improve their job; (4) best practices; (5) How well internal departments help customers. CSRs often exhibit frustration, burnout and high turnover and surveys focus on CSR retention, reducing costs and increasing the quality of customer relationships.

19 - Sales Forecasting and Market Tracking Surveys

Sales forecasting and market tracking studies can include expert opinion (experts estimate the market), judgmental bootstrapping (expert based rules describing how to use

available secondary market information), conjoint analysis (estimation of consumer intentions based on product attributes that are important in the decision), and intentions evaluations (consumer self-reported intentions of future purchases) are to be made.

20 - Price Setting Surveys and Elasticity of Demand Analysis

Price surveys estimate the elasticity of demand and show optimal price points, including prices too low or too high. Price surveys may estimate the demand for different product or service segments, or different usage situations.

Each of the above surveys focuses on a specific area of research and involves the development of conceptual models directed at predicting or explaining a specific type of behaviour that is being measured. This level of specificity is desirable for several reasons. Within the research process, this specificity brings:

1. **Clarification.** Explication usually results in the clarification of relationships and interactions. The need for more rigorous definitions of key variables often becomes apparent.
2. **Objectivity.** The process of explicating the modelled behaviour often discloses rationalizations and unfounded opinions that had not been recognized as such before.
3. **Communication.** Discussion helps to identify problems and common points of reference when different people hold alternative implicit models of the same problem situation.
4. **Improvement of models.** Explicit models can be tested in differing situations to see if the results are reproducible. The degree and range of adaptability can thus be extended.
5. **Guide to research needs.** Formulating models explicitly can better pinpoint information gaps and, thus, aid in determining the nature of research needs.

While varying information is required for the different types of marketing research projects, the key to conducting a successful research project lies with the researcher and the client. They must come to a common understanding of the nature of the exact research problem, and then agree on the information required to answer this problem. This requires identifying the appropriate questions, respondents, methodology, analysis and reporting.

1.2 Marketing research as a tool of management:

Marketing research assists in the overall management of the marketing function. A marketing manager must prioritize the more important and pressing problems selected for solution, reach the best possible solution based on the information available, implement the solution, modify the solution when additional information so dictates, and establish policy to act as a ready-made solution for any recurrence of the problem.

Marketing research often focuses on understanding the "Customer" (purchasers, consumers, influencers), the "Company" (product design, promotion, pricing, placement, service, sales), and can also be expanded toward the environment to include "Competitors" (and how their market offerings interact in the market environment).

Within this "Company-Customer-Competition" environment, many types of marketing research can be conducted, much of which is focused on using surveys for

- Monitoring customers and markets
- Measuring awareness, attitudes, and image
- Tracking product usage behaviour
- Diagnosing immediate business problems
- Supporting strategy development

The purpose of marketing research (MR) is to provide management with relevant, accurate, reliable, valid, and up to date market information. Competitive marketing environment and the ever-increasing costs attributed to poor decision making require that marketing research provide sound information. Sound decisions are not based on gut feeling, intuition, or even pure judgment.

Managers make numerous strategic and tactical decisions in the process of identifying and satisfying customer needs. They make decisions about potential opportunities, target market selection, market segmentation, planning and implementing marketing programs, marketing performance, and control. These decisions are complicated by interactions between the controllable marketing variables of product, pricing, promotion, and distribution. Further complications are added by uncontrollable environmental factors such as general economic conditions, technology, public policies and laws, political environment, competition, and

social and cultural changes. Another factor in this mix is the complexity of consumers. Marketing research helps the marketing manager link the marketing variables with the environment and the consumers. It helps remove some of the uncertainty by providing relevant information about the marketing variables, environment, and consumers. In the absence of relevant information, consumers' response to marketing programs cannot be predicted reliably or accurately. Ongoing marketing research programs provide information on controllable and non-controllable factors and consumers; this information enhances the effectiveness of decisions made by marketing managers.

Traditionally, marketing researchers were responsible for providing the relevant information and marketing decisions were made by the managers. However, the roles are changing and marketing researchers are becoming more involved in decision making, whereas marketing managers are becoming more involved with research. The role of marketing research in managerial decision making is explained further using the framework of the DECIDE model.

Market Research is an essential tool which assists in making strategic decisions. It reduces the risks involved in making decisions as well as strategies. Companies either do this research in house or outsource this process to business experts or organizations who have dedicated and trained resources to perform this. In the recent years an increasing trend of such market research companies assisting business strategists have come up. Some major benefits are -

1. Marketing research assists in providing accurate and latest trends related to demand, consumer behaviour, sales, growth opportunities etc.
2. It helps in better understanding of the market, thus helps in product design, features and demand forecasts
3. It assists in studying and understanding the competitors, thus identifying unique selling propositions for a business.

Advantages of Marketing Research

1. **Indicates current market trends**: Marketing research keeps business unit in touch with the latest market trends and offers guidance for facing market situation with confidence. It facilitates production as per consumer demand and preferences.

2. **Pinpoints deficiencies in marketing policies**: MR pinpoints the deficiencies as regards products, pricing, promotion, etc. It gives proper guidance regarding different aspects of marketing. They include product development, branding, packaging and advertising.
3. **Explains customer resistance**: MR is useful for finding out customer resistance to company's products. Suitable remedial measures are also suggested by the researcher to deal with the situation. This makes the products agreeable to the consumers.
4. **Suggests sales promotion techniques**: Marketing research enables a manufacturer to introduce appropriate sales promotion techniques, select most convenient channel of distribution, suitable pricing policy for the products and provision of discounts and concessions to dealers. It facilitates sales promotion.
5. **Guidance to marketing executives**: Marketing research offers information and guidance to marketing executives while framing marketing policies. Continuous research enables a company to face adverse marketing situation boldly. It acts as an insurance against possible changes in market environment.
6. **Selection and training of sales force**: Marketing research is useful for the selection and training of staff in the sales Organisation. It suggests the incentives which should be offered for motivation of employees concerned with marketing.
7. **Facilitates business expansion**: Marketing research enables a business unit to grow and expand its activities. It creates goodwill in the market and also enables a business unit to earn high profits through consumer-oriented marketing policies and programmes.
8. **Facilitates appraisal of marketing policies**: Research activities enable marketing executives to have an appraisal of the present marketing policies in the fight of research findings. Suitable adjustments in the policies are also possible as per the suggestions made.
9. **Suggests marketing opportunities**: Marketing research suggests new marketing opportunities and the manner in which they can be exploited fully. It identifies existing and emerging market opportunities.

10. **Facilitates inventory study**: Marketing research is useful for the evaluation of company's inventory policies and also for the introduction of more efficient ways of managing inventories including finished goods and raw materials.
11. **Provides marketing information**: MR provides information on various aspects of marketing. It suggests relative strengths and weaknesses of the company. On the basis of such information, marketing executives find it easy to frame policies for the future period. MR provides information, guidance and alternative solutions to marketing problems.
12. **Suggests distribution channels**: Marketing research can be used to study the effectiveness of existing channels of distribution and the need of making suitable changes in the distribution system.
13. **Creates progressive outlook**: Marketing research generates a progressive and dynamic outlook throughout the business Organisation. It promotes systematic thinking and a sense of professionalization within the company. It also creates enthusiasm among executives concerned with marketing. This brings success and stability to the whole business unit.
14. **Social significance**: Marketing research is of paramount importance from the social angle. It acts as a means by which the ultimate consumer literally becomes king of the market place.

Importance of Marketing Research

Marketing research is fast growing in its importance due to increasing competition, fast moving technological developments and changing consumer needs, expectations and attitudes. The importance of marketing research is universally accepted. The status of marketing research in business management is identical to the position of brain in a human body.

The following points suggest the importance of marketing research: -

1. **Planning and execution of marketing plan**: A business unit can plan and execute all activities right from manufacturing to marketing with reasonable accuracy and confidence due to the guidelines available through marketing research.
2. **Quick and correct decision-making**: MR facilitates quick and correct decision-making by marketing managers. It enables management to take quick and correct marketing decisions.
3. **Effective solutions on marketing problems**: MR provides effective solutions to marketing problems. MR is the radiology and pathology of marketing operations of business. It diagnoses the business ailments and suggests measures to remove them. Marketing researcher acts like business doctor and prescribes treatment for business elements.
4. **Huge spending on MR**: Large companies spend crores (1 Crore = 10 million) of rupees on marketing research activities. New techniques and methods are used in the conduct of research activities in an accurate manner. This suggests the growing importance of MR.

Limitations of Marketing Research

1. **Offers suggestions and not decisions**: Marketing research is not a substitute for decision-making process. Ready-made decisions on marketing problems are not provided by the researcher. Marketing research does not solve any marketing problems directly. It only aids management in decision-making and problem-solving process.
2. **Fails to predict accurately**: In marketing research, efforts are made to predict the possible future situation. For this, certain research studies are undertaken. However, the predictions arrived at may not be perfect. Future is always uncertain and exact prediction about the future is just not possible through marketing research.
3. **Cannot study all marketing problems**: Marketing research cannot study all marketing problems particularly where it is difficult to collect relevant data. Similarly, research study is not possible where value judgments are involved. Thus, all

marketing problems are not researchable and all research problems are not answerable. MR is not a 'panacea'.

4. **Resistance to research by marketing executives**: Researchers study marketing problems and offer guidance to marketing executives in their decision-making process. However, some executives are reluctant to use the solutions suggested by the researchers. They feel that such use will act as a threat to their personal status. Marketing executives also feel that researchers give solutions which are academic in character and lack practical utility.
5. **Time-consuming activity**: MR is a time-consuming activity. The research work takes longer period for completion and the findings when available may prove to be outdated. Even data collected very soon become old due to fast changing market environment.
6. **Costly/expensive activity**: MR activity is costly as research work requires the services of experts. Advanced training in economics, computer technology, sociology, etc. is also necessary on the part of research staff. Even giving responsibility of research work to an advertising agency or to a management consultant is costly.
7. **Dearth of qualified staff**: For scientific MR, professional marketing researchers with proper qualifications, experience and maturity are required. Research work is likely to be incomplete /unreliable in the absence of such expert staff.
8. **Complexity of the subject**: MR fails to give complete and correct guidance to the management on marketing issues. This is because MR is not an exact science. It is concerned with the study of human behaviour which is always difficult to predict. As a result, the conclusions drawn and recommendations made are not cent per cent correct.
9. **Uncertainty of conclusions**: Consumer is the focal point in marketing research. However, consumer's buying motives are difficult to judge precisely and accurately. This brings some sort of uncertainty in the conclusions drawn from the MR.
10. **Limitations of data used**: MR process solely depends on the data collected and used for analysing the marketing problem, for drawing conclusions and making

recommendations. However, the whole process will come in danger if data collected are inadequate and unreliable.

11. **Limited practical utility**: MR is mainly an academic exercise. Researchers take more interest in research work rather than in supplying information and guidance to marketing managers in decision-making process. Many research reports are rather bulky and unintelligible. This brings down the practical utility of marketing research.
12. **Miscellaneous Limitations**: Problems developed due to changing marketing environment cannot be solved quickly through MR. Research report may be bulky, technically worded and difficult. Its execution is difficult at lower levels.

The limitations of marketing research (noted above) do not suggest that it is a redundant activity. It only suggests that the marketing research activity should be conducted with proper care and caution. This will make research activity meaningful and result-oriented.

1.3 RELEVANCE OF MARKETING RESEARCH IN THE INDIAN CONTEXT

Currently in India, the national economy and marketplace are undergoing rapid changes and transformation. A large number of reasons could be attributed to these changes. One of the reasons in these changes in the Indian Market Scenario is Globalization, and the subsequent and resulting explosive growth of global trade and the international competition. The marketing function, which was earlier restricted to creating awareness and building differentiators among products, has expanded and become central to the creation of these new products.

The other reason for these changes in the Indian Market Scenario is the technological change. This is an important factor because the technological competitiveness is making, not only the Indian market, but also the global marketplace cutthroat.

In the Indian Marketing Scenario, the market success goes to those companies that are best matched to the current environmental imperatives. Those companies that can deliver what the people want and can delight the Indian customers are the market leaders.

Today the companies are operating in such a marketplace where survival of the fittest is the law. In order to win, the companies are coming out with various new and evolving

strategies because the Indian market is also changing very fast. It is to capture the Indian market, that the Indian and the Multi-National Companies are using all of their resources.
The size of the Indian Market Research industry is still very small compared to the Indian advertising industry. However, the growth of the Indian Market Research industry during the last 20 years has been very substantial.

Large corporate is now spending anywhere from $5 m to $100 m on market research and analysis. Research agencies too have tried to complement the changing needs of clients with professional management, consolidation and creation of value through both delivery mechanisms and interpretation. The increasing use of technology has led to standardization and consolidation in the research industry, thus preparing the ground for greater outsourcing.

The Indian MRO space comprises over 110 vendors and most of these offer 'non-market research' services also. However, interestingly, the leaders in the category are largely market research-focused firms and not necessarily the diversified BPO and KPO firms. Indian MRO vendors began with servicing fairly "standardized" research needs and are steadily moving up the value chain.

Value Notes estimates that Indian MRO revenues stand at $148 m in FY07, and are expected to grow at a CAGR of 36% to touch $800 m by FY12. According to Arun Jethmalani, CEO, Value Notes, "This period (up to 2010) will witness value growth due to capacity addition in high-end services. Initially, the services outsourced were in modular format and delivered through short-term project based engagements. However, over time vendors have begun providing services in both transactional and tactical level activities performed by research agencies. There is a clear industry trend towards "integrated" services".

Going forward, Indian MRO companies are poised to move from research back-office operations to becoming strategic partners in executing research.

Focus of the Indian marketing research are

- Understanding consumers - The trends of the customers are tracked by the market research agencies. Their needs, perceptions, projected demands are all studied and marketing strategies are formed accordingly.

- Investigating market - This method helps in mapping the market conditions and demands are estimated.
- Conceptualizing product development - Positioning strategies, product and service strategies are formed accordingly after taking into consideration the marketing research results.

Problems faced by Marketing Research in India

1. Objectives are unclear, leading to conflicting or unrealistic expectations. This often is due to imprecise or too many goals.

   Result: muddy research, weak data.
2. Sample has quality issues (participants are not sufficiently qualified or authenticated, or do not pay adequate attention), or needed sample size is unmet.

   Result: weak data, insufficient data (sample too small for use in extrapolation), research loses credibility.
3. Instrument is poorly designed. Long, complicated questionnaire design (or rambling discussion guides for focus groups or in-depth interviews) confuses participants with awkward question sequences and poor answer options.

   Result for quantitative: low response rates, high dropout rates, and respondent fatigue, pencil whipping, weak data.

   Result for qualitative: muddy, biased interviews or focus groups; disengaged participants.
4. Data analysis is conducted with more attention to techniques than results; either the choice of analytics is poor or is misaligned with client needs.

   Result: misleading data, low usefulness.
5. Poor matching of methodology to goals and audience needs (incorrect use of qualitative or quantitative methods).

   Result: misleading data, low usefulness.
6. Schedules slip significantly; research is completed too late to support intended decisions.

Result: research loses credibility, agency loses credibility. Internal sceptics or cynics derail the final presentation.

Result: research loses credibility.

7. Internal clients unable to apply the research as originally intended; “actionability” of research is called into question.

   Result: research is “shelved,” research loses credibility.

8. Research firm's representatives are unable to establish required level of credibility with client or internal clients.

   Result: research is "shelved," research loses credibility, agency loses credibility.

9. Programming (for online or telephone data collection) is done hastily, and questionnaire logic is not enforced nor approved by client. Entire questions are missing, and answer options are not properly presented.

UNIT II

2.1 BASIC CONCEPTS

WHAT IS RESEARCH?

Research is a systematic and objective investigation of a subject or problem in order to discover relevant information or principles. It can be considered to be either primarily fundamental or applied in nature. Fundamental research, frequently called basic or pure research, seeks to extend the boundaries of knowledge in a given area with no necessary immediate application to existing problems, for example, the development of a research method that would be able to predict what people will be like x years in the future. In contrast, applied research, also known as decisional research, attempts to use existing knowledge to aid in the solution of some given problem or set of problems.

MEANING OF RESEARCH

Research in common parlance refers to a search for knowledge. Once can also define research as a scientific and systematic search for pertinent information on a specific topic. In fact, research is an art of scientific investigation.

The Advanced Learner's Dictionary of Current English lays down the meaning of research as "**a careful investigation or inquiry especially through search for new facts in any branch of knowledge**."

Redman and Mory define research as a "**systematized effort to gain new knowledge**."

Some people consider research as a movement, a movement from the known to the unknown. It is actually a voyage of discovery. We all possess the vital instinct of inquisitiveness for, when the unknown confronts us, we wonder and our inquisitiveness makes us probe and attain full and fuller understanding of the unknown. This inquisitiveness is the mother of all knowledge and the method, which man employs for obtaining the knowledge of whatever the unknown, can be termed as research.

Research is an academic activity and as such the term should be used in a technical sense. According to Clifford Woody research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organizing and evaluating data;

making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis. D. Slesinger and M. Stephenson in the Encyclopedia of Social Sciences define research as "the manipulation of things, concepts or symbols for the purpose of generalizing to extend, correct or verify knowledge, whether that knowledge aids in construction of theory or in the practice of an art." Research is, thus, an original contribution to the existing stock of knowledge making for its advancement. It is the pursuit of truth with the help of study, observation, comparison and experiment. In short, the search for knowledge through objective and systematic method of finding solution to a problem is research. The systematic approach concerning generalization and the formulation of a theory is also research. As such the term 'research' refers to the systematic method consisting of enunciating the problem, formulating a hypothesis, collecting the facts or data, analyzing the facts and reaching certain conclusions either in the form of solutions(s) towards the concerned problem or in certain generalizations for some theoretical formulation.

SCOPE AND SIGNIFICANCE OF RESEARCH

"All progress is born of inquiry. Doubt is often better than overconfidence, for it leads to inquiry, and inquiry leads to invention" is a famous Hudson Maxim in context of which the significance of research can well be understood. Increased amounts of research make progress possible. Research inculcates scientific and inductive thinking and it promotes the development of logical habits of thinking and organization.

Research provides the basis for nearly all government policies in our economic system. For instance, government's budgets rest in part on an analysis of the needs and desires of the people and on the availability of revenues to meet these needs. The cost of needs has to be equated to probable revenues and this is a field where research is most needed. Through research we can devise alternative policies and can as well examine the consequences of each of these alternatives. Decision-making may not be a part of research, but research certainly facilitates the decisions of the policy maker. Government has also to chalk out programmers for dealing with all facets of the country's existence and most of these will be related directly or indirectly to economic conditions.

Research has its special significance in solving various operational and planning problems of business and industry. Operations research and market research, along with motivational research, are considered crucial and their results assist, in more than one way, in taking business decisions. Market research is the investigation of the structure and development of a market for the purpose of formulating efficient policies for purchasing, production and sales. Operations research refers to the application of mathematical, logical and analytical techniques to the solution of business problems of cost minimization or of profit maximization or what can be termed as optimization problems. All these are of great help to people in business and industry who are responsible for taking business decisions.

Research with regard to demand and market factors has great utility in business. Given knowledge of future demand, it is generally not difficult for a firm, or for an industry to adjust its supply schedule within the limits of its projected capacity. Market analysis has become an integral tool of business policy these days. Business budgeting, which ultimately results in a projected profit and loss account, is based mainly on sales estimates which in turn depends on business research. Once sales forecasting is done, efficient production and investment programs can be set up around which are grouped the purchasing and financing plans. Research, thus, replaces intuitive business decisions by more logical and scientific decisions.

Basic Research Issues

As technology advances, marketing researchers are continually looking for ways to adapt new technology to the practice of research. Both hardware and software are involved in such adaptations. However, researchers must never forget that research basics cannot be overlooked. Rather, what must be done is to adapt the new techniques and technologies to these basics. All studies must address the following basic issues (Anderson, Berdie, & Liestman, 1984):

1. **Ask the right questions.** This is the essence of project design, and the heart of proper planning. The research planner must remember that every project is unique, and as such must be tailored to the user's needs.

2. **Ask the right people**. Sample design should be such that only those people who are of interest to the research user are contacted, and such that those who are contacted are reasonably representative of the group of interest.
3. **Ask questions the right way**. It is not enough to be able to ask the right questions; they must be asked in the right way. This is the essence of questionnaire design. The researcher can use all the aids available from the new technologies, but if the wording of the questions is not clear to the respondents, the results will be useless. One basic that is overlooked all too often is pretesting the questionnaire; this is crucial for ensuring that responses are the ones that are needed to address the problem.
4. **Obtain answers to questions**. The process of data collection is central to all marketing research. Techniques used should be selected for how each bear on nonresponse and response alike.
5. **Relate answers to the needs of the research user/client.** Data seldom speak for themselves. Proper data analysis is needed if a study is to have any value to the user. Here there is a risk of letting advanced techniques become the master of the researcher rather than the opposite. Common sense is a valuable tool for the researcher when considering alternative analysis approaches for any project.
6. **Communicate effectively and in a way that the client understands.** Many good projects are ruined in this stage. The information that is reported to the user should be in a form that is understandable to the user so that he or she can tell that it is relevant to the issues at hand.

2.2 RESEARCH AND SCIENTIFIC METHOD

Scientific method is a decision-making approach that focuses on being objective and orderly in testing ideas before accepting them. With the scientific method, managers don't just assume that their intuition is correct. Instead, they use their intuition and observations to develop hypotheses—educated guesses about the relationships between things or about what will happen in the future. Then they test their hypotheses before making final decisions.

A manager who relies only on intuition might introduce a new product without testing consumer response. But a manager who uses the scientific method might say, "I think

(hypotheses) that consumers currently using the most popular brand will prefer our new product. Let's run some consumer tests. If at least 60 percent of the consumers prefer our product, we can introduce it in a regional test market. If it doesn't pass the consumer test there, we can make some changes and try again."

The scientific method focuses an orderly research process. Some managers don't carefully specify what information they need. They blindly move ahead—hoping that research will provide "the answer." Other managers may have a clearly defined problem or question but lose their way after that. These hit-or-miss approaches waste both time and money.

For a clear perception of the term research, one should know the meaning of scientific method. The two terms, research and scientific method, are closely related. Research, as we have already stated, can be termed as "an inquiry into the nature of, the reasons for, and the consequences of any particular set of circumstances, whether these circumstances are experimentally controlled or recorded just as they occur. Further, research implies the researcher is interested in more than particular results; he is interested in the repeatability of the results and in their extension to more complicated and general situations." On the other hand, the philosophy common to all research methods and techniques, although they may vary considerably from one science to another, is usually given the name of scientific method. In this context, Karl Pearson writes, "The scientific method is one and same in the branches (of science) and that method is the method of all logically trained minds … the unity of all sciences consists alone in its methods, not its material; the man who classifies facts of any kind whatever, who sees their mutual relation and describes their sequences, is applying the Scientific Method and is a man of science." Scientific method is the pursuit of truth as determined by logical considerations. The ideal of science is to achieve a systematic interrelation of facts. Scientific method attempts to achieve "this ideal by experimentation, observation, logical arguments from accepted postulates and a combination of these three in varying proportions." In scientific method, logic aids in formulating propositions explicitly and accurately so that their possible alternatives become clear. Further, logic develops the consequences of such alternatives, and when these are compared with observable phenomena, it becomes possible for the researcher or the scientist to state which alternative is most in

harmony with the observed facts. All this is done through experimentation and survey investigations which constitute the integral parts of scientific method.

Experimentation is done to test hypotheses and to discover new relationships. If any, among variables. But the conclusions drawn on the basis of experimental data are generally criticized for either faulty assumptions, poorly designed experiments, badly executed experiments or faulty interpretations. As such the researcher must pay all possible attention while developing the experimental design and must state only probable inferences. The purpose of survey investigations may also be to provide scientifically gathered information to work as a basis for the researchers for their conclusions.

The scientific method is, thus, based on certain basic postulates which can be stated as under:

- It relies on empirical evidence;
- It utilizes relevant concepts;
- It is committed to only objective considerations;
- It presupposes ethical neutrality, i.e., it aims at nothing but making only adequate and correct statements about population objects;
- It results into probabilistic predictions;
- Its methodology is made known to all concerned for critical scrutiny are for use in testing the conclusions through replication;
- It aims at formulating most general axioms or what can be termed as scientific theories.

Thus, "the scientific method encourages a rigorous, impersonal mode of procedure dictated by the demands of logic and objective procedure." Accordingly, scientific method implies an objective, logical and systematic method, i.e., a method free from personal bias or prejudice, a method to ascertain demonstrable qualities of a phenomenon capable of being verified, a method wherein the researcher is guided by the rules of logical reasoning, a method wherein the investigation proceeds in an orderly manner and a method that implies internal consistency.

2.3 TYPES OF RESEARCH

The basic types of research are as follows:

(i) **Descriptive vs. Analytical**: Descriptive research includes surveys and fact-finding enquiries of different kinds. The major purpose of descriptive research is description of the state of affairs as it exists at present. In social science and business research we quite often use the term Ex post facto research for descriptive research studies. The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or what is happening. Most ex post facto research projects are used for descriptive studies in which the researcher seeks to measure such items as, for example, frequency of shopping, preferences of people, or similar data. Ex post facto studies also include attempts by researchers to discover causes even when they cannot control the variables. The methods of research utilized in descriptive research are survey methods of all kinds, including comparative and correlational methods. In analytical research, on the other hand, the researcher has to use facts or information already available, and analyze these to make a critical evaluation of the material.

(ii) **Applied vs. Fundamental**: Research can either be applied (or action) research or fundamental (to basic or pure) research. Applied research aims at finding a solution for an immediate problem facing a society or an industrial/business organization, whereas fundamental research is mainly concerned with generalizations and with the formulation of a theory. "Gathering knowledge for knowledge's sake is termed 'pure' or 'basic' research." Research concerning some natural phenomenon or relating to pure mathematics are examples of fundamental research. Similarly, research studies, concerning human behavior carried on with a view to make generalizations about human behavior, are also examples of fundamental research, but research aimed at certain conclusions (say, a solution) facing a concrete social or business problem is an example of applied research. Research to identify social, economic or political trends that may affect a particular institution or the copy research (research to find out whether certain communications will be read and understood) or the marketing research or evaluation research are examples of applied research. Thus, the central

aim of applied research is to discover a solution for some pressing practical problem, whereas basic research is directed towards finding information that has a broad base of applications and thus, adds to the already existing organized body of scientific knowledge.

(iii) Quantitative vs. Qualitative: Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity. Qualitative research, on the other hand, is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. For instance, when we are interested in investigating the reasons for human behavior (i.e., why people think or do certain things), we quite often talk of 'Motivation Research', an important type of qualitative research. This type of research aims at discovering the underlying motives and desires, using in depth interviews for the purpose. Other techniques of such research are word association tests, sentence completion tests, story completion tests and similar other projective techniques. Attitude or opinion research i.e., research designed to find out how people feel or what they think about a particular subject or institution is also qualitative research. Qualitative research is especially important in the behavioral sciences where the aim is to discover the underlying motives of human behavior. Through such research we can analyze the various factors which motivate people to behave in a particular manner or which make people like or dislike a particular thing. It may be stated, however, that to apply qualitative research in practice is relatively a difficult job and therefore, while doing such research, one should seek guidance from experimental psychologists.

(iv) Conceptual vs. Empirical: Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones. On the other hand, empirical research relies on experience or observation alone, often without due regard for system and theory. It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment. We can also call it as experimental type of research. In such a research, it is necessary to get at facts firsthand, at their source, and actively to go about doing certain things to stimulate the production of desired

information. In such a research, the researcher must first provide himself with a working hypothesis or guess as to the probable results. He then works to get enough facts (data) to prove or disprove his hypothesis. He then sets up experimental designs which he thinks will manipulate the persons or the materials concerned so as to bring forth the desired information. Such research is thus characterized by the experimenter's control over the variables under study and his deliberate manipulation of one of them to study its effects. Empirical research is appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.

(v) **Some Other Types of Research:** All other types of research are variations of one or more of the above stated approaches, based on either the purpose of research, or the time required to accomplish research, on the environment in which research is done, or on the basis of some other similar factor. Form the point of view of time, we can think have research either as one-time research or longitudinal research. In the former case, the research is confined to a single time-period, whereas in the latter case the research is carried on over several time-periods. Research can be field-setting research or laboratory research or simulation research, depending upon the environment in which it is to be carried out. Research can as well be understood as clinical or diagnostic research. Such research follows case-study methods or in-depth approaches to reach the basic causal relations. Such studies usually go deep into the causes of things or events that interest us, using very small samples and very deep probing data gathering devices. The research may be exploratory or it may be formalized. The objective of exploratory research is the development of hypotheses rather than their testing, whereas formalized research studies are those with substantial structure and with specific hypotheses to be tested. Historical research is that which utilizes historical sources like documents, remains, etc. to study events or ideas of the past, including the philosophy of persons and groups at any remote point of time. Research can also be classified as conclusion-oriented and decision-oriented. While doing conclusion oriented research, a researcher is free to pick up a problem, redesign the

enquiry as he proceeds and is prepared to conceptualize as he wishes. Decision-oriented research is always for the need of a decision maker and the researcher in this case is not free to embark upon research according to his own inclination. Operations research is an example of decision oriented research since it is a scientific method of providing executive departments with a quantitative basis for decisions regarding operations under their control.

2.4 MARKET RESEARCH METHODS OF COLLECTION OF DATA

The type of information you want to gather about your customers, market or competitors will influence the research methods you choose. There are different ways to gather information (from primary or secondary sources) and different types of information to gather (quantitative and qualitative).

PRIMARY RESEARCH

Primary research (or field research) gathers original information directly for your purpose, rather than being gathered from published sources. Primary research includes:

- surveys
- direct observations
- Interviews and focus groups that are developed and conducted by you or your researcher.

Primary research gives you control over the type of questions you ask and information you gather. Primary research results can be extremely valuable; however, they can also be much more time-consuming and costly to gather than secondary research.

SECONDARY RESEARCH

Secondary research (or desk research) gathers existing information through available sources. Secondary research examples include:

- information on the internet
- existing market research results
- existing data from your own stock lists and customer database

- Information from agencies such as industry bodies, government agencies, libraries and local councils.

Secondary research allows you to make the most of existing information about your market. However, it can be a challenge to find the information you really need. Learn more about different research resources for business and industry.

You may use secondary research to get an initial understanding of your market. It is often faster to analyse than primary data because, in many cases, someone else may have already started analysing it. However, when using secondary research be careful how you interpret it, as it may have been collected for a different purpose or from a market segment that isn't relevant to your business. Also make sure that any secondary information isn't out-of-date, as the market can change quickly and this will affect your results.

QUANTITATIVE RESEARCH

Quantitative research gathers numerical data. Quantitative research includes:

- surveys on customer return frequency
- sales figures
- industry product sales numbers
- online or phone questionnaires
- Financial trends.

You can use this approach to identify the size of your market and how much it might be worth to your business, and to find areas for sales growth. Quantitative research can also help you understand the demographics of customers, such as their age and gender.

Quantitative research often produces a lot of statistics. These are useful as an overview of your market, but make sure you don't rely solely on statistics in your research. Consider all of the information you have. For example, the 'average' price your target market suggested it would pay for a product could be distorted if a few a participant selected a very high amount (i.e. not reflecting the high number who would not pay that much).

QUALITATIVE RESEARCH

Qualitative research gathers views and attitudes. Qualitative research includes:

- focus groups with customers and potential customers to understand their feelings and attitudes towards your products and services
- formal and informal conversations with customers about their satisfaction with your business
- Visits and reviews of competitors to understand their products and customer service practices.

You can use this approach to get a better understanding of your customers' interests, needs and habits, and identify opportunities for growing sales and improving customer service. Analysing qualitative data requires a different approach and can take longer to interpret than quantitative data because of the nature of the information.

2.6 THE BASIC RESEARCH PROCESS

How is marketing research actually conducted? What are the general steps in completing a research project? These questions are answered in the steps of the research process. While the steps are shown as a linear process, some of the steps may be performed simultaneously, such as selecting data collection techniques and sample design. There are other times when “later” decisions influence decisions that are made early in the research planning process. For example, desired analysis techniques often influence the selection of data collection techniques (e.g. Measurement) and sample design.

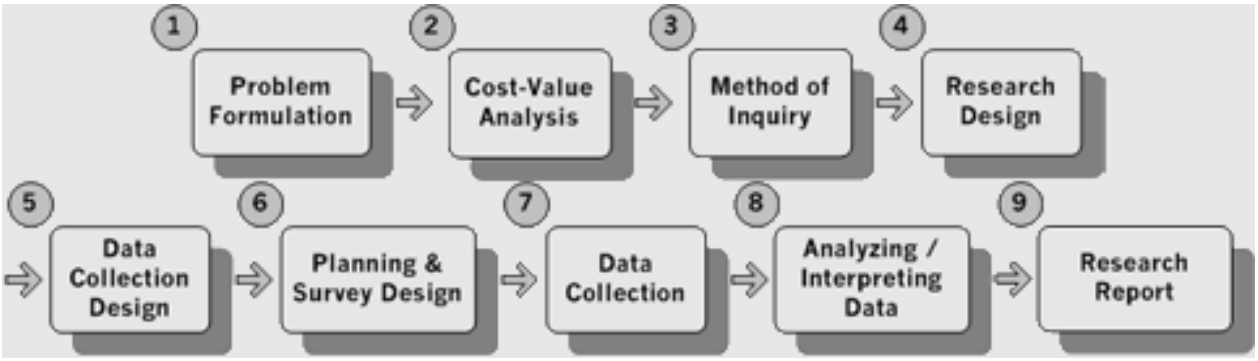


Fig No:1 Research process

It is important to carefully plan the research process and formally recognize the relationship between the stages. The researcher should write a formal plan for the project, including the background information and statement of objectives, which then becomes the master guide for implementing and controlling the research project. Each step in this research process will now be introduced.

STAGE 1: PROBLEM FORMULATION

In a very real sense, problem formulation is the heart of the research process. As such, it represents the single most important step to be performed. From the researcher's point of view, problem formulation means translating the management problem into a research problem. As previously discussed, in order to formulate an appropriate research problem, theresearcher must understand the origin and nature of management's problem and then be able to rephrase it into meaningful terms from an analytical point of view. This involves timely and clear communication between manager and researcher. The end result of problem formulation is a statement of the management problem that is analytically meaningful and that often points the way to alternative solutions. An accurate problem formulation specifies the types of information needed to help solve the management problem. In short, quality thinking about a problem prior to data collection largely determines the quality of data collection, analysis and problem solving.

Closely related to problem formulation is the development of a working hypothesis, or an assertion about a state of nature. While hypotheses are crucial for basic research because they tell the researcher what to do, the concept of a hypothesis can also be useful in decisional research to direct the development of the research problem statement. In most cases, the marketingresearcher will not explicitly state hypotheses for the research. It has been suggested that research problems and hypotheses meet the following criteria:

1. The problem statement expresses a relationship between two or more variables.
2. The problem is stated clearly and unambiguously in question form.
3. The problem statement implies possibilities of empirical testing.

Properties of good hypotheses:

1. The hypothesis is a statement about the relationship between two or more variables in declarative statement form.
2. The hypothesis carries clear implications for testing the stated relationship (i.e., variables must be measurable or potentially measurable).

How to Formulate the Research Problem

Problem formulation is much easier when specific components of the research problem are defined:

1**. Specify the Research Objectives**

Objectives guide the researcher in developing good, useful research, and they help the client evaluate the completed project. Objectives range from the very general, such as profit maximization, to the highly specific, such as measuring market interest in a new product. It is rare that the objectives are well explained to the researcher. However, the researcher needs to take the initiative to develop a clear statement of objectives. Each study should have a very limited and manageable set of objectives that focus on the problem being solved. Two or three well targeted objectives is preferable to many that are ill-conceived. Fewer the objectives make it easier to keep track of progress toward the objectives, to ensure that each is properly addressed, and to determine the best methodology. If there are too many objectives separate studies may be appropriate.

2. The Environment or Context of the Problem

Consider the problem of deciding whether to introduce a new consumer product. The marketing researcher must work closely with the client in transforming the client's problem into a workable research problem. The researcher's efforts should be oriented toward helping the manager decide whether any investigation is justified based on the potential value of the research findings versus their cost. The researcher must be aware of, and assist in, the identification of objectives, courses of action, and environmental variables, insofar as they affect the design of the research investigation. If the research is undertaken and if the resulting findings are to be utilized (i.e., have an influence on the user's decision making), the

manager and researcher must have a productive and trusting relationship that is based on the researcher's ability to perform and deliver the research as promised.

3. The Nature of the Problem

Every research problem may be evaluated on a scale that ranges from very simple to very complex. The degree of complexity depends on the number of variables that influence the problem. Understanding the nature of the problem helps a researcher ensure that the right problem is being investigated and that a marketing plan can be developed to solve the problem. A thorough preliminary investigation using focus groups of consumers, salespeople, managers, or others close to the problem may produce much needed insight.

4. Alternative Courses of Action

A course of action specifies a behavioural sequence that occurs over time, such as the adoption of a new package design, or the introduction of a new product. Such a program of action becomes a commitment, made in the present, to follow some behavioural pattern in the future. It is usually desirable to generate as many alternatives as possible during the problem formulation stage and state them in the form of research hypotheses to be examined. A hypothesis often implies a possible course of action with a prediction of the outcome if that course of action is followed. Once the nature of the problem has been agreed upon, the course of action must be specified. This involves:

1. Determining which variables affect the solution to the problem
2. Determining the degree to which each variable can be controlled
3. Determining the functional relationships between the variables and which variables are critical to the solution of the problem.

The following example shows the results of a failure to follow through with these aspects of the problem situation model.

5. The Consequences of Alternative Courses of Action

A set of consequences always relate to courses of action and even to the occurrence of events not under the control of the manager. One of the manager's primary jobs is to

anticipate and communicate the possible outcomes of various courses of action that may result from following the research.

6. Degrees of Uncertainty

Most marketing problems are characterized by a situation of uncertainty as to which course of action is best. Years of experience may allow the decision-making manager to assign various "likelihoods of occurrence" to the various possible outcomes of specific courses of action.

A carefully formulated problem and statement of research purpose is necessary for competent research. The statement of purpose involves a translation of the decision maker's problem into a research problem and the derivation of a study design from this problem formulation. The research problem provides relevant information concerning recognized (or newly generated) alternative solutions to aid in this choice.

STAGE 2: METHOD OF INQUIRY

Market researchers look to the scientific method as the source of their investigative methods. Even though this method is not the only one used, it is the standard against which other investigative methods are measured. The scientific method makes great use of existing knowledge both as a starting point for investigation and as a check on the results of the investigations (i.e., a test of validity). Its most distinctive characteristic is its total lack of subjectivity. The scientific method has evolved objective and rigid procedures for verifying hypotheses or evaluating evidence. It is analytical in its processes and is investigator-independent. Thus, the scientific method is for the most part logical and objective, and frequently makes extensive use of mathematical reasoning and complicated experiments.

The goal of a scientific methodologist, also called an objectivist, is to run a hypothesis test using publicly stated procedures that are investigator-independent.

- Formulate a problem
- Develop a hypothesis
- Make predictions based on the hypothesis
- Devise a test of the hypothesis

- Conduct the test
- Analyse the results

Even though the terminology used is that associated with basic research, the process described is analogous to that of decision making. Although the steps are the same, there are differences in the way in which the steps are performed and in the underlying assumptions about behaviour. For example, the essential difference between the objectivist and the subjectivist is the latter's allowance for use of subjective judgments both when collecting data and when analysing data

This objectivist-subjectivist distinction has very practical meaning, particularly when considering the use of outside research suppliers. There are commercial research firms that tend to specialize in one or the other method of inquiry. Objectivist-based research is often called quantitative research, whereas subjectivist-based research is often called qualitative research.

STAGE 3: RESEARCH METHOD

Whether a particular method of inquiry is appropriate for a research problem depends in large part on the nature of the problem itself and the extent or level of existing knowledge. In addition to selecting a method of inquiry, the research planner must also select a research method.

Two broad methodologies can be used to answer any research question–experimental research and non-experimental research. The major advantage of experimental research lies in the ability to control extraneous variables and manipulate one or more variables by the intervention of the investigator. In non-experimental research, there is no intervention beyond that needed for purposes of measurement.

STAGE 4: RESEARCH DESIGN

Research design is defined as the specific methods and procedures for acquiring the information needed. It is a plan or organizational framework for doing the study and collecting the data. Research designs are unique to a methodology. We discuss research design in depth later in this document and in Chapter 3.

STAGE 5: DATA COLLECTION TECHNIQUES

Research design begins to take on detailed focus as the researcher selects the particular techniques to be used in solving the problem formulated and in carrying out the method selected. A number of techniques available for collecting data can be used. Some techniques are unique to a method of inquiry. For example, many of the qualitative research techniques, such as projective techniques, are used only in subjectivist-type research. In general, data collection uses either communication or observation.

Communication involves asking questions and receiving responses. This process can be done in person, by mail, by telephone, by e-mail, and over the Internet. In most instances, this constitutes the broad research technique known as the survey. In contrast to this process, data may be obtained by observing present or past behaviour. Regarding past behaviour, data collection techniques include looking at secondary data such as company records, reviewing studies published by external sources, and examining physical traces such as erosion and accretion.

In order to collect data from communication or observation there must be a means of recording responses or behaviour. Thus, the process of measurement and the development of measurement instrument are closely connected to the decision of which data collection technique(s) should be used. The relationship is two-way. That is, the structure and content of the measurement instrument can depend on the data collection technique, and measurement considerations often influence technique selection.

STAGE 6: SAMPLE DESIGN

Rarely will a marketing research project involve examining the entire population that is relevant to the problem. For the most part, practical considerations (e.g., absolute resources available, cost vs. value, etc.) dictate that one uses a sample, or subset of the relevant population. In other instances, the use of a sample is derived from consideration of the relevant systematic and variable errors that might arise in a project.

In designing the sample, the researcher must specify three things:

- Where the sample is to be selected
- The process of selection

- The size of the sample

The sample design must be consistent with the relevant population, which is usually specified in the problem-formulation stage of the research process. This allows the data obtained from the sample to be used in making inferences about the larger population.

The process of sample selection may be done by probability or non-probability methods.

In probability sampling every element in the population has a known nonzero probability (chance) of being selected for inclusion in a study. In contrast, a non-probability sample is one selected on the basis of the judgment of the investigator, convenience, or by some other means not involving the use of probabilities.

STAGE 7: DATA COLLECTION

Data collection begins after the previous six stages of the research process are complete. Data collection, whether by communication or observation, requires the use of data collection personnel which then raises questions regarding managing these people. Because data collection can be costly, firms often utilize outside limited-service research suppliers, particularly when the extent of in-house research activity does not warrant the cost of having permanent data collection personnel. Also, project design may require specialized data collection, which might best be obtained from an outside supplier.

The working relationship between the data collection agency (a so-called field service) and the research supplier or client is a major factor affecting the quality of fieldwork and data collection.

A study of marketing research firms found that the major barriers to the communication of information from clients to research suppliers to field service firms were insufficient information supplied by the client, the research supplier as an intermediary between client and field service firm, and lack of client interest in data collection (Segal & Newberry, 1983).

The major suggestion for improving communication is for clients to provide more information to both suppliers and field service firms. Another way to overcome communication barriers is for the field service to be consulted on such major issues as scheduling, costs, and purpose of the study. Finally, it was suggested that two-way

communication with suppliers be established or strengthened. Although this study was conducted more than 20 years ago, these are enduring problems that exist today.

STAGE 8: ANALYSIS AND INTERPRETATION

Data that are obtained and presented in the same form as originally collected are seldom useful to anyone. Data must be analysed. The data must be edited, coded, and tabulated before performing formal analyses such as statistical tests. The types of analyses that can be properly performed depend upon the sampling procedures, measurement instruments, and data collection techniques used. Consequently, it is imperative that the techniques of analysis, associated descriptive or prescriptive recommendation types, and presentation formats be selected prior to data collection.

STAGE 9: THE RESEARCH REPORT

The culmination of the research process is the research report. It includes a clear, accurate, and honest description of everything that has been done and the results, conclusions, and— whenever possible—recommendations for courses of action. Two critical attributes of the report are that it provides all the information readers need using language they understand (completeness) and that it contains selective information chosen by the researcher (conciseness). These attributes are often in conflict with each other.

Two approaches can be taken to ensure that this conflict is not a problem. One approach involves preparing two reports: (1) a technical report that emphasizes the methods used and underlying assumptions, and presents the findings in a detailed manner; and (2) a popular report that minimizes technical details and emphasizes simplicity.

The second approach is concerned with how the report is communicated. Because people vary a great deal in how they are affected by different forms of communication, the ideal reporting process should try to encompass all major forms. Thus, a written report, by itself, may be inadequate and only an invitation to inaction. There are simply a lot of people who, for various reasons, don’t respond to the printed worst. There are still more that, although they may respond, will often misunderstand the meaning of what is written. For these reasons, it is vitally necessary to get management to sit down with the research

manager, or with the researcher and the outside research firm, in a face-to-face reporting situation.

2.7 PLANNING THE RESEARCH PROJECT

Stage 1 – Choosing the project

This involves formulating a clearly defined and delineated research topic. The more clearly your research topic is defined at the start of your project, the better. This will give you confidence and clarity in what you are trying to achieve, and will allow you to monitor your progress more effectively. If you're not sure of what you're trying to achieve, then how will you know whether you're on schedule or not – whether you're on course or not?

Stage 2 – Initial literature review

The literature review is a critical early stage in your project. A literature review has many purposes. It enables you to find out what research has been undertaken in the field, what is 'known' and what the important questions are that others are investigating or have suggested for research. It helps you to understand the history of your field, to know how ideas have developed, changed, appeared and disappeared over time. You will become aware of the range of methodologies that have been used to research your field, both in the past and in the present, and you should start to develop a critical view of the advantages and disadvantages of different approaches. It will also enable you to discover who else is working in the field and what they are working on. Most importantly, though, it will help you to look at your initial ideas for your research and develop and refine them to produce the project that you will undertake. It is almost the most important stage of the project, for if you do this thoroughly and well you will be saved many potential problems later on.

Stage 3 – Finalising the research questions

Ideally your research questions will emerge from the literature review. The literature review will have shown you what is already known in the field and what important topics need to be researched.

Stage 4 – Choosing and developing the methodology

Whatever your subject and field, there will be a range of different research methods available to you. At this stage, you need to choose the best approach to enable you to answer your research question. Many students though, unfortunately, start with an idea of the methods they want to use and then apply them to their research question whether or not they are the best way forward. The correct way forward, of course, is to read and reflect very broadly on possible research methods and then choose what is most appropriate, even if this involves you in learning new approaches or techniques.

Stage 5 – Piloting the methodology

Whatever method you use, you will need to pilot your methodology. Piloting is practising, checking that you can use the method correctly and that it will work in the circumstances in which you are using it to provide usable data. Piloting usually suggests changes and modifications to the methods you are using, sometimes large, sometimes small, and so is an essential process

Stage 6 – Organising the data collection

Do not be put off by the word 'data'. By data we are talking about the evidence you will use to arrive at your conclusions, and there are many types of data. Your data could be experimental results, field data or survey data or they could come from direct observations of social situations. The data could be quantitative, qualitative or a combination of both types. Stage 6 involves making the arrangements to collect that data.

Stage 7 – Data collection

Collecting the data can be a short or a long process – for example a project on the behaviour of apes may take many months of detailed observation and recording, while some experimental projects may take only a few weeks or even days to complete.

Stage 8 – Data analysis

Data analysis includes the systematic organising of the data and its presentation in a form that readers of your project can understand. It also includes the interpretation of the data

to identify the important ideas or new bits of knowledge that they reveal. Each discipline will have descriptive and analytical techniques, ranging from statistical analysis to computer modelling to presentational methods to qualitative analysis. You will need to choose the methods best suited to the data you have collected, and will need to be able to justify your choice of methods.

Stage 9 – Drawing conclusions and interpretations

Stage 8 involved very detailed analysis and interpretation, working with the detail of the data and drawing out important ideas about every part of the topic that has been studied. Stage 9 is the 'big picture' stage of the research, where the detailed interpretations are drawn together to try to 'answer' the overall research question. It will certainly involve a critical reflection on the conclusions you have drawn and the methods you have used, and will probably make recommendations for future research in the field. In social science fields, it may include recommendations for policy-makers and practitioners about future practice and policy.

Stage 10 – Preparing the final thesis

Writing of the thesis is covered in more detail in writing a thesis. The final stage of the project, though, is assembling the final version of the thesis. You will have produced drafts of individual chapters throughout the project, and these can be assembled into the first draft of the overall thesis or dissertation. At this stage, though, the work needs to be prepared for submission – making sure the whole work is coherent; writing, re-writing and editing; assembling diagrams, tables or charts; completing and checking the bibliography and appendices; preparing the contents and the abstract; printing and binding the work. This all takes a significant amount of time, which needs to be built into the planning of the project.

UNIT III

3.1 DATA COLLECTION METHODS:

Success of marketing research project depends upon quality and relevance of data. And, quality of data, to a major extent, depends upon methods and techniques used for collecting data. Selection and use of methods for conducting marketing research require a great deal of experience and expertise. Overall suitability of different methods plays a vital role in their selection.

It is important to note that for collection of the secondary data, no need to use specific methods. They are easily collected from various published sources. The problem of method selection arises in case of primary data. So, discussion on data collection methods is relevant to primary data only. Practically, sample-based survey methods are used. Selection of an appropriate sample is important decision in almost all the methods for primary data collection.

Commonly used methods have been depicted in Figure:

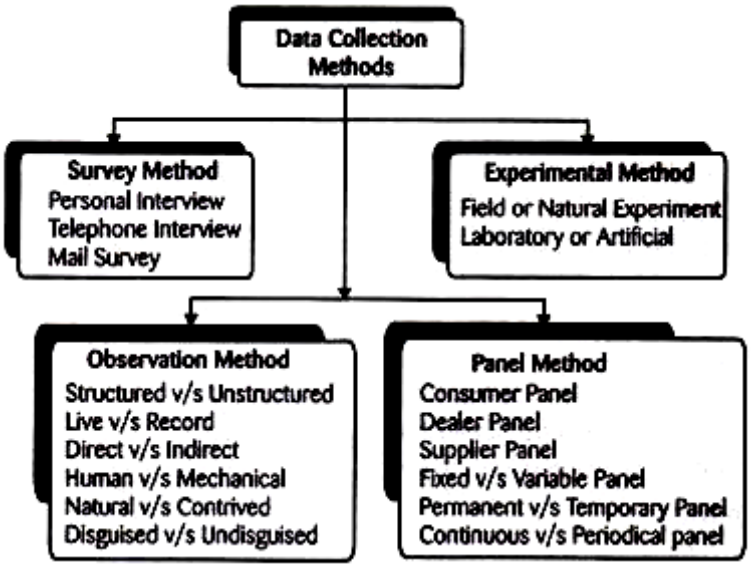


Fig No:2 Primary Data Collection Methods

Primary Data Collection Methods

1. Survey Method or Questionnaire Method:

Survey method is also said as communication method as the data are collected by communicating with the respondents, either by face-to-face oral communication or by other means like telephone, mails, etc. This is a widely used method for collecting primary data. It is fit for any kind of research problem.

Major marketing research projects, more or less, follow survey method. Because of the intensive use of questionnaire in survey method, it is also called as the questionnaire method. The unique characteristic of a survey method is that the data are collected by asking questions to the relevant respondents. Commonly used options in the survey methods include interview, telephone interview, and mail survey.

i. Interview:

Interview involves a face-to-face interaction with the respondents. Personal interview includes collection of data by personally contacting the respondents. Here face- to-face communication and free feedback are possible. It is a very effective and flexible method for conducting survey.

Interview is conducted using questionnaire, containing different types of questions. Using probe questions like what, why, when, how much, where, with whom, etc., more information can be elicited from the respondents. Picture, chart, cartoons, products, and other similar devices are used to get more clear and precise information regarding their interest, attitudes, and opinions. Interviews may include personal interview, focus group interview, primary interview, and in-depth interview.

In personal interview, at a time, only one interviewee is interviewed while focus group interview includes interviewing more respondents at a time. Primary interview is conducted to collect the primary (elementary or brief) information. In contrast, the in-depth interview consists of the detailed discussion with the respondents. Success of interview depends on ability, training, experience, and competency of interviewer.

ii. Telephonic Interview:

Nowadays, a telephone survey can be easily conducted due to wide spread telephone facilities provided by telephone department and private companies. Up-to-date telephone directories (in hard and soft copy format) can make the task easy. However, in urban areas, it can be conducted more effectively. Here, interview is conducted by asking questions through telephone (including cell phone), and response of the respondents is recorded systematically. This is an ideal method when one wants information on the current/live activities.

For example, we can get information about the performance of the star cricketers when match is being displayed on television by asking question to viewers through telephone. Similarly, the effectiveness of advertisement can be measured by immediately contacting the respondents when advertisement is published during particular programme. It is suitable when one wants short answers for a few questions. A large number of interviews can be conducted in a short time. This survey may be structured or unstructured. But, generally the structured telephone survey is used to get information on the specific aspects within limited time

Main problems associated with telephone survey are:

a. Unwillingness,
b. No scope for further query,
c. Limited information can be collected,
d. Lack of attention or non-committed answer and misleading information,
e. Only respondents with telephone (and or cell phone) facility can be contacted; not much fit for rural areas, and
f. Limited utility due to certain practical problems in conducting such survey.

In spite of these limitations, it can be a powerful option if it is conducted carefully.

iii. Mail Survey:

In this method, data are collected by mail or letter. Well-designed printed copy of questionnaire is sent to known and unknown respondents with a request to return it back dully filled. The mail may work as a silent fieldworker. Certain gifts, rewards, or direct

benefits are associated with the mail to inspire and prompt the respondents for quick and complete information.

Sometimes, a coin, coupons, or draw tickets are sent with questionnaire. Follow-up with sweet reminders can create respondents' interest. Newspapers and magazines can also be used as medium for limited survey. Internet (putting quarries or questions on websites) and E-mail (electronic mail) are the latest computer-based devices to send and collect data on the relevant area. SMS by cell phone is also widely used for the purpose.

This method doesn't face geographical constraints. With same charge, by government postal service, national wide survey is possible. In fact, private mail service providers, like courier services, charge rates as per distance. It is, comparatively, less costly and convenient. For mail survey, questionnaire is prepared in regional language, and simple, short and direct questions are used.

Practical problems related to the mail survey are:

a. Time consuming,
b. Careless completion of questionnaire,
c. Minimum response rate,
d. Incomplete response
e. Limited information can be collected,
f. SMS (cell phone), e-mail, etc., are costly and there are a lot of related practical problems,
g. Expression or face reading is not possible, etc.

2. Observation Method:

This is another type of widely used method for primary data collection. However, it is used as a complementary to survey method. It is used to furnish, revise or complement data collected through the survey. Observation can be defined as: The act of carefully recognizing and noting facts or occurrence.

The distinguished characteristic of this method is that no questions are asked to respondents for collecting data, but their behaviour is observed minutely. Under this method,

researcher can observe, measure, or note the original behaviour of respondents, mostly consumers and dealers.

There can be two types of observations – live observation and record observation. In case of live observation, on-going (live) facts or occurrence are recognized or noted. On the other hand, the record observation involves recognizing, or noting of the records.

Observation carried out by the properly selected, trained, capable, and experienced observer can provide an objective information. A lot depends upon ability of observer. Various tools used for observing behaviour may include camera, movie camera, close-circuit camera, printed forms, etc.

Practical problems associated with observation methods are:

a. It is difficult of collect data objectively,
b. It doesn't measure the state of mind, which is more relevant for the study of intension, buying motive, or attitudes,
c. It depends heavily upon ability and experience of the observer; there is possibility of the biased outcomes, and
d. It is costly and time consuming.

Types of Observation:

There can be various types of observation.

Some popular forms have been stated briefly as under:

i. Structured v/s Unstructured Observation:

Structured observation involves a detailed plan regarding what and when to observe; why and how to observe, and where and who is to observe. Printed forms are used to record the behaviour of respondents. Every aspect related to observation is predetermined in advance. It is known as planned or structured observation. Sometimes, the observer watches and notes the behaviour without any specific scheme or plan. Here, time, methods, place, and procedures of observing behaviour and recording data are not specified in advance. Such observation may turn as unstructured observation.

ii. Lives v/s Record Observation:

In case of the live observation, on-going or live behaviour and activities are observed. The record observation consists of observing the recorded/ past behaviour of the relevant respondents.

iii. Direct v/s Indirect Observation:

Direct Observation involves observing behaviour of the respondents directly. There is no considerable physical distance between observer and respondents. Indirect observation is the distanced observation. Behaviour is observed at the distance place. Direct or indirect observation is applicable to both live as well as record observation.

iv. Natural v/s Contrived Observation:

While natural observation is conducted in the original setting or situations, the contrived observation is based on artificially created environment. Artificial situation is created, people are informed, and their behaviour is observed. The natural observation provides more reliable and original information.

v. Human v/s Mechanical Observation:

Obviously, human observation involves human being. Human organism is recognizing and noting the respondents' behaviour. On the contrary, the mechanical observation involves certain mechanical or electrical devices, such as movie camera, automatic recording close-circuit camera or robot is used to observe behaviour and activities of people.

vi. Disguised v/s Undisguised Observation:

This is a very important classification of observation. Disguised observation is one in which the targeted people do not know that they are being observed. They will behave naturally and originally. Sometimes, the respondents are informed that their behaviour will be observed at a particular time.

Thus, they know that they are being observed. It is a kind of an undisguised observation. Because they are aware, they may behave differently than regular. Depending upon situations, the suitable method of observation is used.

3. Experimental Method:

Under this method of data collection, a cause and effect (i.e., causal) relationship is established. The independent variables are manipulated to measure the effects of such manipulation on the dependent variables. For example, if marketing manager want to measure the effect of 10% price rise on sales, first, he raises price by 10% (manipulation of independent variable), and then he tries to measure the effects of the price rise on sales volume (impact on dependent variable).

However, along with manipulation of independent variables, the impact of relevant extraneous factors should also be kept in mind to estimate the exact effect of manipulation. Many times, to minimize the effect of uncontrollable factors, the experiment is conducted in the controlled environment.

Major problems associated with experimental methods for primary data collection are:

a. Impact of extraneous factors that minimizes reliability of results,
b. Experimental method is costly,
c. It is time consuming,
d. Possibility of the strange (abnormal) results than normal because of effect of experiments; people may deliberately react abnormally, etc.

Despite all these problems, the experimental method is very useful for certain marketing issues, for example, testing of new product in particular localities before it is lunched fully. It can be used to measure effectiveness of packaging and design, or measuring effect of particular promotional tool. Conducting a successful experiment for data collection needs a great deal of knowledge, experience, and ability.

Types of Experiment:

Experimental method can be conducted in two ways:

i. Field or Natural Experiment:

Such experiment is conducted in the real market situation. No attempts are made to create an artificial situation for manipulation and measurement of effects. In a natural way, the independent variables are manipulated in one or more market places to measure their

impact of dependent variables. One of the prime problems is that here the researcher has no control on the situation and, consequently, outcomes of experiment may be misleading.

ii. Laboratory or Artificial Experiment:

This experimental method differs significantly from the former one. Here, attempts are made to create artificial situations in which experiment is made. It is conducted in the controlled environment. The researcher has considerable control on the situations. The net or exact outcome may be obtained. But, it is conducted in a limited scale and it is difficult to derive general conclusions on the basis. For example, some customers and dealers are invited in a laboratory and are shown demonstration of proposed product to estimate product acceptability at particular price. There is full possibility that results may be quite imaging compared to real situation. Response during experiment and post experiment may produce contrasting results.

4. Panel Method:

Panel method is a hybrid method. All aforesaid methods are used to collect data from the panel. Panel can be defined as: The fixed and relatively permanent sample/group of respondents to obtain information continuously or intermittently (periodical) basis. In case of panel method, data are collected only from panels of response groups or respondents.

As and when information is needed, these panels are contacted. They are provided incentives; they are offered gifts or some rewards to encourage them provide relevant and accurate information willingly.

The data are more reliable and up-to-date. Such panels provide necessary information about market trends, fashion, consumer attitudes and expectations, strengths of competitors, and also make valuable suggestions to improve the company's overall performance. Panel is relatively fixed and permanent sample of respondents. However, changes in terms of size, type, and location are made to suits the company's requirements.

Types of Panel:

i. Consumer Panel:

Such panel involves only consumers. They are consulted for the required data, or they provide data periodically on any issue related to market as per the contract.

ii. Dealer Panel:

Dealer panel consists of middlemen, such as wholesalers, retailers, and agents. They can provide valuable information regarding consumers, competitors, and overall market environment.

iii. Supplier Panel:

Suppliers are those parties who supply necessary inputs like raw materials, provisions, parts, and other inputs required for production and marketing of products. This panel also includes service providers like insurance companies, transporters, bankers, and so forth.

iv. Continuous or Periodical Panel:

Continuous panel provides information on a continuous basis. They maintain live contact with a company and inform the company as and when they feel that the information is important. Periodical panel, on the other hand, provides detail at a fixed interval.

v. Permanent or Temporary Panel:

Permanent panel is standing in nature. Such panel serves for relatively a long period to time. On the other hand, the temporary panel is ad-hoc in nature. It is terminated when the time is over.

vi. Fixed or Variable Panel:

In case of a fixed panel, number and type of respondents are fixed. No changes are made in the panel. While in variable panel, number and types of respondents are subject to change.

2.5 Secondary Data Collection Methods

When the data are collected by someone else for a purpose other than the researcher's current project and has already undergone the statistical analysis is called as Secondary Data. The secondary data are readily available from the other sources and as such, there are no

specific collection methods. The researcher can obtain data from the sources both internal and external to the organization. The internal sources of secondary data are:

- Sales Report
- Financial Statements
- Customer details, like name, age, contact details, etc.
- Company information
- Reports and feedback from a dealer, retailer, and distributor
- Management information system

There are several external sources from where the secondary data can be collected. These are:

- Government censuses, like the population census, agriculture census, etc.
- Information from other government departments, like social security, tax records, etc.
- Business journals
- Social Books
- Business magazines
- Libraries
- Internet, where wide knowledge about different areas is easily available.

The secondary data can be both qualitative and quantitative. The qualitative data can be obtained through newspapers, diaries, interviews, transcripts, etc., while the quantitative data can be obtained through a survey, financial statements and statistics. One of the advantages of the secondary data is that it is easily available and hence less time is required to gather all the relevant information. Also, it is less expensive than the primary data. But however, the data might not be specific to the researcher's needs and at the same time is incomplete to reach a conclusion. Also, the authenticity of the research results might be skeptical.

ATTITUDES MEASUREMENT

Scaling Techniques for Measuring Data Gathered from Respondents The term scaling is applied to the attempts to measure the attitude objectively. Attitude is a resultant of number of external and internal factors. Depending upon the attitude to be measured, appropriate scales are designed. Scaling is a technique used for measuring qualitative responses of respondents such as those related to their feelings, perception, likes, dislikes, interests and preferences.

Most frequently used Scales

1. Nominal Scale
2. Ordinal Scale
3. Interval Scale
4. Ratio Scale
5. Self-Rating Scales
6. Graphic Rating Scale
7. Itemized Rating Scales
8. Likert Scale
9. Semantic Differential Scale
10. Staple's Scale
11. Multi-Dimensional Scaling
12. Thurston Scales
13. Guttman Scales/Scalo gram Analysis
14. The Q Sort technique

Four types of scales are generally used for Marketing Research.

Nominal Scale

This is a very simple scale. It consists of assignment of facts/choices to various alternative categories which are usually exhaustive as well mutually exclusive. These scales are just numerical and are the least restrictive of all the scales. Instances of Nominal Scale are - credit card numbers, bank account numbers, employee id numbers etc. It is simple and

widely used when relationship between two variables is to be studied. In a Nominal Scale numbers are no more than labels and are used specifically to identify different categories of responses. Following example illustrates -What is your gender? [] Male [] Female

Another example is - a survey of retail stores done on two dimensions - way of maintaining stocks and daily turnover.

How do you stock items at present?

- By product category
- At a centralized store
- Department wise
- Single warehouse

Ordinal Scale

Ordinal scales are the simplest attitude measuring scale used in Marketing Research. It is more powerful than a nominal scale in that the numbers possess the property of rank order. The ranking of certain product attributes/benefits as deemed important by the respondents is obtained through the scale.

Example 1: Rank the following attributes (1 - 5), on their importance in a microwave oven.

- Company Name
- Functions
- Price
- Comfort
- Design

The most important attribute is ranked 1 by the respondents and the least important is ranked 5. Instead of numbers, letters or symbols too can be used to rate in an ordinal scale. Such scale makes no attempt to measure the degree of favorability of different rankings.

Interval Scale

Herein the distance between the various categories unlike in Nominal, or numbers unlike in Ordinal, are equal in case of Interval Scales. The Interval Scales are also termed as

Rating Scales. An Interval Scale has an arbitrary Zero point with further numbers placed at equal intervals. A very good example of Interval Scale is a Thermometer.

Illustration 1 - How do you rate your present refrigerator for the following qualities?

Company Name	Less Known	1	2	3	4	5	Well Known
Functions	Few	1	2	3	4	5	Many
Price	Low	1	2	3	4	5	High
Design	Poor	1	2	3	4	5	Good
Overall Satisfaction	Very Dis-Satisfied	1	2	3	4	5	Very Satisfied

Such a scale permits the researcher to say that position 5 on the scale is above position 4 and also the distance from 5 to 4 is same as distance from 4 to 3. Such a scale however does not permit conclusion that position 4 is twice as strong as position 2 because no zero position has been established. The data obtained from the Interval Scale can be used to calculate the Mean scores of each attribute over all respondents. The Standard Deviation (a measure of dispersion) can also be calculated.

Ratio Scale

Ratio Scales are not widely used in Marketing Research unless a base item is made available for comparison. In the above example of Interval scale, a score of 4 in one quality does not necessarily mean that the respondent is twice more satisfied than the respondent who marks 2 on the scale. A Ratio scale has a natural zero point and further numbers are placed at equally appearing intervals. For example, scales for measuring physical quantities like - length, weight, etc.

The ratio scales are very common in physical scenarios. Quantified responses forming a ratio scale analytically are the most versatile. Rati scale possess all he characteristics of an internal scale, and the ratios of the numbers on these scales have meaningful interpretations. Data on certain demographic or descriptive attributes, if they are obtained through open-ended questions, will have ratio-scale properties. Consider the following questions:

Q 1) what is your annual income before taxes? _____ $

Q 2) How far is the Theater from your home? _____ Miles

Answers to these questions have a natural, unambiguous starting point, namely zero. Since starting point is not chosen arbitrarily, computing and interpreting ratio makes sense. For example, we can say that a respondent with an annual income of $ 40,000 earns twice as much as one with an annual income of $ 20,000.

Graphic Rating Scale

The respondents rate the objects by placing a mark at the appropriate position on a line that runs from one extreme of the criterion variable to another. Example

0 (poor quality) 1(bad quality) 5(neither good nor bad) 7(good quality)BRAND 1

This is also known as continuous rating scale. The customer can occupy any position. Here one attribute is taken ex-quality of any brand of ice-cream.

Poor good BRAND 2

This line can be vertical or horizontal and scale points may be provided. No other indication is there on the continuous scale. A range is provided. To quantify the responses to question that "indicate your overall opinion about ice-ream Brand 2 by placing a tick mark at appropriate position on the line", we measure the physical distance between the left extreme position and the response position on the line.; the greater the distance, the more favorable is the response or attitude towards the brand. Its limitation is that coding and analysis will require substantial amount of time, since we first have to measure the physical distances on the scale for each respondent.

Itemized Rating Scales

These scales are different from continuous rating scales. They have a number of brief descriptions associated with each category. They are widely used in Marketing Research. They essentially take the form of the multiple category questions. The most common are - Likert, Semantic, Staple and Multiple Dimension. Others are - Thurston and Guttman.

Likert Scale

It was developed Rensis Likert. Here the respondents are asked to indicate a degree of agreement and disagreement with each of a series of statement. Each scale item has 5 response categories ranging from strongly agree and strongly disagree.

5Strongly agree 4Agree3Indifferent 2Disagree 1Strongly disagree

Each statement is assigned a numerical score ranging from 1 to 5. It can also be scaled as -2 to +2. (-2 -1 0 1 2)

For example, quality of Mother Diary ice-cream is poor then Not Good is a negative statement and Strongly Agree with this means the quality is not good.

Each degree of agreement is given a numerical score and the respondents total score is computed by summing these scores. This total score of respondent reveals the particular opinion of a person.

Likert Scale are of ordinal type, they enable one to rank attitudes, but not to measure the difference between attitudes. They take about the same amount of efforts to create as Thurston scale and are considered more discriminating and reliable because of the larger range of responses typically given in Likert scale.

A typical Likert scale has 20 - 30 statements. While designing a good Likert Scale, first a large pool of statements relevant to the measurement of attitude has to be generated and then from the pool statements, the statements which are vague and non-discriminating have to be eliminated.Thus, Likert scale is a five-point scale ranging from 'strongly agreement 'to 'strongly disagreement'. No judging gap is involved in this method.

Semantic Differential Scale

This is a seven-point scale and the end points of the scale are associated with bipolar labels.

1Unpleasant /Submissive 2 3 4 5 6 7

Pleasant/Dominant

Suppose we want to know personality of a particular person. We have options-

Unpleasant/Submissive

Pleasant/Dominant

Bi-polar means two opposite streams. Individual can score between 1 to 7 and -3 to 3. On the basis of these responses profiles are made. We can analyze for two or three products and by joining these profiles we get profile analysis. It could take any shape depending on the number of variables.

When Semantic Differential Scale is used to develop an image profile, it provides a good basis for comparing images of two or more items. The big advantage of this scale is its simplicity, while producing results compared with those of the more complex scaling methods. The method is easy and fast to administer, but it is also sensitive to small differences in attitude, highly versatile, reliable and generally valid.

Staple's Scale

It was developed by Jan Staple. This scale has some distinctive features: -Each item has only one word/phrase indicating the dimension it represents. Each item has ten response categories. Each item has an even number of categories. The response categories have numerical labels but no verbal labels. For example, in the following items, suppose for quality of ice cream, we ask respondents to rank from +5 to -5. Select a plus number for words which best describe the ice cream accurately. Select a minus number for words you think do not describe the ice cream quality accurately. Thus, we can select any number from +5, for words we think are very accurate, to -5, for words we think are very inaccurate. This scale is usually presented vertically.

+5 +4 +3 +2 +1 High Quality

-1 -2 -3 -4 -5

This is a unipolar rating scale.

Multi-Dimensional Scaling

It consists of a group of analytical techniques which are used to study consumer attitudes related to perceptions and preferences. It is used to study-The major attributes of a given class of products perceived by the consumers in considering the product and by which they compare the different ranks. To study which brand competes most directly with each other. To find out whether the consumers would like a new brand with a combination of

characteristics not found in the market. What would be the consumer's ideal combination of product attributes? What sales and advertising messages are compatible with consumers brand perceptions? It is a computer based technique. The respondents are asked to place the various brands into different groups like similar, very similar, not similar, and so on. A goodness of fit is traded off on a large number of attributes. Then a lack of fit index is calculated by computer program. The purpose is to find a reasonably small number of dimensions which will eliminate most of the stress. After the configuration for the consumer's preference has been developed, the next step is to determine the preference with regards to the product under study. These techniques attempt to identify the product attributes that are important to consumers and to measure their relative importance.

This scaling involves an unrealistic assumption that a consumer who compares different brands would perceive the differences on the basis of only one attribute. For example, what are the attributes for joining M. Comcourse? The responses may be -to do PG, to go into teaching line, to get knowledge, appearing in the NET. There are a number of attributes, you cannot base decision on one attribute only. Therefore, when the consumers are choosing between brands, they base their decision on various attributes. In practice, the perceptions of the consumers involve different attributes and any one consumer perceives each brand as a composite of a number of different attributes. This is a shortcoming of this scale. Whenever we choose from a number of alternatives, go for multi- dimensional scaling. There are many possible uses of such scaling like in market segmentation, product life cycle, vendor evaluations and advertising media selection.

The limitation of this scale is that it is difficult to clearly define the concept of similarities and preferences. Further the distances between the items are seen as different

Thurston Scales

These are also known as equal appearing interval scales. They are used to measure the attitude towards a given concept or construct. For this purpose, a large number of statements are collected that relate to the concept or construct being measured. The judges rate these statements along an 11-category scale in which each category expresses a different degree of favorableness towards the concept. The items are then ranked according to the mean or

median ratings assigned by the judges and are used to construct questionnaire of twenty to thirty items that are chosen more or less evenly across the range of ratings.

The statements are worded in such a way so that a person can agree or disagree with them. The scale is then administered to assemble of respondents whose scores are determined by computing the mean or median value of the items agreed with. A person who disagrees with all the items has a score of zero. So, the advantage of this scale is that it is an interval measurement scale. But it is the time-consuming method and labor intensive. They are commonly used in psychology and education research.

Guttman Scales/Scalo gram Analysis

It is based on the idea that items can be arranged along a continuum in such a way that a person who agrees with an item or finds an item acceptable will also agree with or find acceptable all other items expressing a less extreme position. For example - Children should not be allowed to watch indecent programs or government should ban these programs or they are not allowed to air on the television. They all are related to one aspect. In this scale, each score represents a unique set of responses and therefore the total score of every individual is obtained. This scale takes a lot of time and effort in development. They are very commonly used in political science, anthropology, public opinion, research and psychology.

The Q Sort technique

It is used to discriminate among large number of objects quickly. It uses a rank order procedure and the objects are sorted into piles based on similarity with respect to some criteria. The number of objects to be sorted should be between 60-140 approximately. For example, here we are taking nine brands. On the basis of taste, we classify the brands into tasty, moderate and non-tasty.

We can classify on the basis of price also-Low, medium, high. Then we can attain the perception of people that whether they prefer low priced brand, high or moderate. We can classify sixty brands or pile it into three piles. So, the number of objects is to be placed in three piles-low, medium or high. Thus, the Q-sort technique is an attempt to classify subjects in terms of their similarity to attribute under study.

Different Attitude Measurement Methods used in Marketing Research

Attitudes are individual mental processes which determine both the actual and potential response of each person in a social world. An attitude is always directed toward some object and therefore, attitude is the state of mind of the individual toward a value.

(i) Area of Application of Attitude Measurement:

An increased attention is being paid to the attitude survey by the marketing researchers. They have been found to be extremely useful in the matters of various marketing problems such as response to an advertisement, price change, product quality, brand loyalty and trade mark etc.

(ii) Merits of Attitude Measurement:

- A controlled and planned marketing development needs the knowledge of attitude of consumers. In other words, the knowledge of response mechanism is so essential for successful implementation of the marketing plans.
- The attitude of consumers would aid in successful classification of 'types of consumers'. The basis of grouping is attitude of consumers towards certain product or service.
- Attitude affords predictability which is very much useful to control marketing conditions.
- The study of attitude has a practical importance. A good salesman must be well versed with attitude of consumers, and understands how different types of consumers behave.

(iii) However, Limitations of Attitude Measurement may be as under:

- The attitude is intangible and not subject to visual observations.
- The consumer attitude is a complex affair due to multiple influences. Hence, we cannot say with certainty how a person will react.
- Measuring attitude lacks proper scale. Marketing Research has no instruments device to measure attitude correctly.

(**iv)Attitude Measurement**:

Scaling techniques are used to measure different psychological aspects such as attitude, perception and preferences of the people with the help of certain pre-defined set of stimuli

and instructions. The stimuli may be certain brands of a product. Scaling procedures are nominal, ordinal, interval and ratio type as described earlier.

Attitude measure scales are constructed to include the following:

a) Paired Comparison:

This method requires the respondent to choose one of stimuli that has more of some property over the other with respect to some designated property. Example: Hero Honda motor cycle dominates all other motor cycles.

b) Ordered Category Sorting:

It requires the respondent to order stimuli w.r.t. Some designated property of interest. Example: "A" Represents a set of dozen car tyres in terms of high grip, moderate grip and low grip etc.

c) Ranking Method:

This determines the perceived order of six brands of tyres w.r.t. gripness on application of brakes. Attitudes each respondent is asked to rank the tyre brands w.r.t. gripness.

d) Rating Techniques:

Rating of different brands of motor cycles in terms of reliability, and fuel efficiency i.e., kms/litre of petrol etc.

UNIT IV

4.1 INTRODUCTION TO SAMPLING

Meaning

Research objectives are generally translated into research questions that enable the researchers to identify the information needs. Once the information needs are specified, the sources of collecting the information are sought. Some of the information may be collected through secondary sources (published material). Whereas the rest may be obtained through primary sources. The primary methods of collecting information could be the observation method, personal interview with questionnaire, and their analysis plays a vital role in finding answers to research questions. Survey respondents should be selected using the appropriate procedures, otherwise the researchers may not be able to get the right information to solve the problem under investigation. The process of selecting the right individuals, objects or events for the study is known as sampling. Sampling involves the study of a small number of individuals, objects chosen from a large group.

Sampling Concepts

Before we get into the details of various issues pertaining to sampling, it would be appropriate to discuss some of the sampling concepts.

Population:

Population refers to any group of people or object that form the subject of study in a particular survey and are similar in one or more ways. For example, the number of full-time MBA students, the population size would be 200. We may be interested in understanding their perceptions about business education. If there are 200 class IV employees would form the population of interest. If a TV manufacturing company produces 150 TVs per week and we are interested in estimation the proportion of defective TVs produced per week, all the 150 TVs would form our population. If, in an organization there are 1000 engineers, out of which 350 are mechanical engineers and we are interested in examining the proportion of mechanical engineers who intend to leave the organization within six months, all the 350 how

the patients in a hospital are looked after, then all the patients of the hospital would fall under the category of population.

Element:

An element comprises a single member of the population. Out of the 350 mechanical engineers mentioned above, each mechanical engineer would form an element of the population. In the example of MBA students whose perception about the management education is of interest to us, each of the 200 MBA students will be an element of the population. This means that there will be 200 elements of the population.

Sampling frame:

Sampling frame comprises all the elements of a population with proper identification that is available to us for selection at any stage of sampling. For example, the list of registered voters in a constituency could form a sampling frame; the telephone directory; the number of students registered with university; the attendance sheet of a particular class and the payroll of an organization are examples of sampling frames. When the population size is very large, it becomes virtually impossible to form a sampling frame. We know that there is a large number of consumers of soft drinks and, therefore, it becomes very difficult to for the sampling frame for the same.

Sample:

It is a subset of the population. It comprises only some element of the population. If out of the 350 mechanical engineers employed in an organization, 30 members would constitute the sample.

Sampling unit:

A sampling unit is a single member of the sample. If a sample of 50 students is taken from a population of 200 MBA students in a business school, then each of the 50 students is a sampling unit. Another example could be that if a sample of 50 patients is taken from a hospital to understand their perception about the services of the hospital, each of 50 patients is a sampling unit.

Sampling:

It is process of selection an adequate number of elements from the population so that the study of the sample will not only help in understanding the characteristics of t population but will also enable us to generalize the results. We will see later that there are two types of sampling designs-probability sampling design and non-probability sampling design.

Census (or complete enumeration):

An examination of each and every element of the population is called census or complete enumeration. Census is an alternative to sampling.

STEPS IN SAMPLING DESIGN

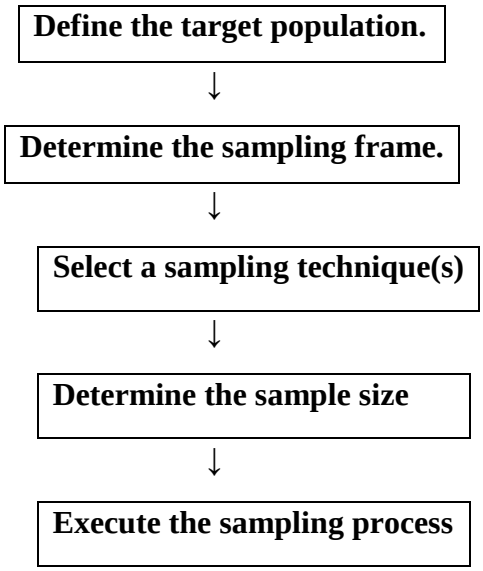
The sampling design process includes five steps that shown sequentially in figure 2.5 these steps are closely interrelated and relevant to all aspects of the management research project, from problem definition to the presentation of the results. Therefore, sample design decision should be integrated with all other decisions in a research project.

Define the target population

Sampling design begins by specifying the target population. The target population is the collection of elements or objects that possess the information sought by the researcher and about which inferences are to be made. The target population must be defined precisely. Imprecise definition of the target population will result in research that is ineffective at best and misleading at worst. Defining the target population involves translating the problem definition into a precise statement of who should and should not be included in the sample.

The target population should be defined in terms of elements. Sampling units, extent and tie. An element is the object about which of from which the information is desired. In survey research, the element, that is available for selection at some stage of t sampling process. Suppose that Revlon wanted to assess consumer response to a new line of lipsticks and wanted to sample females over 18 years of ag. It may be possible to sample females over 18 directly, in which case a sampling unit would be the same as an element. Alternatively, the sampling unit m9ght be households. In the latter case, households would be sampled and all females over 18 in each selected household would be interviewed. Here, the sampling

unit and the population element are different. Extent refers to the geographical boundaries, and the time factor is the time period under consideration. The opening duck stamps example showed an appropriate definition of a population. We use the department store project to provide another illustration.



Determine the Sampling Frame

A sampling frame is a representation of the elements of the target population. It consists of a list or set of directions for identifying the target population. Examples of a sampling frame include the telephone book, an association directory listing the firms in an industry, a mailing list purchased from a commercial organization, a city directory, or a map. If a list cannot be compiled, then at least some directions for identifying the target population should be specified, such as random digit dialing procedures in telephone surveys. In the opening duck stamp example, the sampling frame consisted of a computer program for randomly and efficiently generating telephone numbers, excluding nonworking and non-household numbers.

Select a Sampling Technique

Selecting a sampling technique involves several decisions of a broader nature. The researcher must decide whether to use a Bayesian or traditional sampling approach, to sample with or without replacement, and to use non-probability or probability sampling.

Bayesian approach

A selection method in which the elements are selected sequentially. The Bayesian approach explicitly incorporates prior information about population parameters as well as the costs and probabilities associated with making wrong decisions.

Sampling with replacement

A sampling technique in which an element can an included in the sample more than once.

Sampling without replacement

A sampling technique in which an element cannot be included in the sample more than once.

The most important decision about the choice of sampling technique is whether to use probability or nonprobability sampling. Givens it importance, the issues involved in this decision are discussed in great detail in this chapter.

If the sampling unity is different from the element, it is necessary to specify precisely how the elements within the sampling unit should be selected. In in-home personal interviews and telephone interviews, merely specifying the address or the telephone number may not be sufficient. For example, should the person answering the doorbell or the telephone be interviewed, or someone else in the household? Often, more than one person in a household may qualify. For example, both the male and female heads of household may be eligible to participate in a study examining family leisure-time activities. When a probability sampling technique is being employed, a random selection must be made from all the eligible persons in each household. A simple procedure for random selection is the next birthday method. the interviewer asks which of the eligible persons in the household has the next birthday and includes that persons in the sample, as in the opening duck stamps example.

Determine the Sample Size

Sample size refers to the number of elements to be included in the study. Determining the sample size is complex and involves several qualitative and quantitative consideration.

Important qualitative factors that should be considered in determining the simple size includes:

- the importance of the decision,
- the nature of the research,
- the number of variables,
- the nature of the analysis,
- sample sizes used in similar studies,
- incidence rates,
- completion rates, and
- Resource constraints.

In general, for more important decisions, more information is necessary and the information should be obtained more precisely. This calls for larger samples, but as the sample size increases, each unit of information is obtained at greater cost. The degree of precision may be measured in terms of the standard deviation of the mean. The degree of precision may be measured in terms of the standard deviation of the mean. The standard deviation of the mean is inversely proportional to the square root of the sample size. The larger the sample, the smaller the gain in precision by increasing the sample size by one unit.

The nature of the research also has an impact of nth sample size. For exploratory research designs, such as those using qualitative research, the sample size is typically small. For conclusive research, such as descriptive surveys, larger samples are required. Likewise, if data are being collected on a large number of variables, larger samples are required. The cumulative effects of sample error across variables are reduced in a large sample.

Execute the Sampling Process

Execution of the sampling process requires a detailed specification of how the sampling design decisions with respect to the population. Sampling frame, sampling unit, an operational definition of a household is needed. Procedures should be specified for vacant housing units and for callbacks in case no one is at home. Detailed information must be provided for all sampling design decision.

Criteria for good sample design

Whether the result obtained from a sample survey would be accurate or not depends upon the quality of the sample. The characteristics of a good sample are described below.

1. **Representativeness:** A sample must be representative of the population. Probability sampling technique yield representative sample. In measurement terms, the sample must be valid. The validity of a sample depends upon its accuracy and precision.
2. **Accuracy:** Accuracy is defined as the degree to which bias is absent from the sample. An accurate (unbiased) sample is one which exactly represents the population. It is free from any influence that causes any difference between sample value and population value (say, average).
3. **Precision:** The sample must yield precise estimate. Precision is measured by the standard error or standard deviation of the sample estimate. The smaller the standard error or estimate, the higher is the precision of the sample.
4. **Size:** A good sample must be adequate in size in order to be reliable. The sample should be of such size that the inferences drawn from the sample are accurate to the given level of confidence.

4.2 TYPES OF SAMPLE DESIGNS

Sampling design refers to the process of selecting samples from a population. There are two types of sampling designs.

1. Probability or Random sampling
2. Non-probability or Non-random sampling

Probability sampling is of following types:

1. Simple random sampling
2. Stratified random sampling
3. Systematic random sampling
4. Cluster sampling

Non-probability sampling may be classified into:

1. Convenience or accidental sampling
2. Purposive (or Judgment) sampling
3. Quota sampling
4. Snow-ball sampling

Probability vs. Non-Probability Sampling

Probability sampling is based on the theory of probability. It is also known as random sampling. It provides a known non-zero chance of selection for each population element.
Its characteristics are:

1. In probability sampling every population has a chance of being selected.
2. Such chance is a known probability. For instance, if a sampling frame is a list of 100 students of a specific course of study, in a simple random sample, each student has $1/100^{th}$ chance of being selected.
3. Probability sampling yields a representative sample, and hence the findings of the sample survey are generalizable to the population.
4. The closeness of a sample to the population can be determined by estimating sampling bias or error. Through randomization, the danger of unknown sampling bias can be minimized. Hence, probability sampling is preferable to non-probability sampling.

Probability sampling should be used when generalization is the objective of study, and a greater degree of accuracy of estimation of population parameters is required. Cost and time required for probability sampling may be large. Hence, the benefit derived from it should justify the cost.

Non-probability sampling or non-random sampling is not based on the theory of probability. This sampling does not provide a chance of selection to each population element. The only merits of this type of sampling are simplicity, convenience a d low cost.
Its merits are:

1. It does not ensure a selection chance to each population unit.
2. The selection probability is unknown.

3. A non-probability sample may not be a representative one.
4. Non-probability sampling plan does not perform inferential function, i.e., the population parameters cannot be estimated from the sample values.
5. It suffers from sampling bias which will distort results.

Therefore, non-random is not a desirable method. Yet there are some practical reasons for using it. Those reasons are:

1. When there is no other feasible alternative due to non-availability of a list of population, non-availability of some population elements for collection of data, etc.;
2. When the study does not aim at generalizing the findings to the population, but simply at feeling the range of conditions, or nature of the phenomenon;
3. When the cost required for probability sampling may be too large, and the benefit expected from it is not commensurate with such costs; and
4. When probability sampling requires more time, but the time constraints and the time limit for completing the study do not permit it.

PROBABILITY SAMPLING METHODS

Random Sampling Procedures

The importance of randomness in sampling needs no emphasis. It is a means for securing a representative sample. How can a random sample be drawn? The layman tends to think that random sampling means picking out units "at random", i.e., in a haphazard or hit-and-miss way. Experience shows that the human being is an extremely poor instrument for the conduct of a random selection. To ensure true randomness the method of selection must be independent of human judgement. There are three basic procedures.

1. The lottery method: This is the simplest and most familiar procedure of random sampling. If a sample of 10 students is to be drawn out of a list of 50 students in a section, take 50 equal size chips or slips of paper; number them from 1 to 50 each bearing only one number. Roll each slip. Put the rolled slips in a global container and thoroughly shuffle or mix them. Take 10 chips from the container one after another. Each time before drawing a

chip, mix the chips in the container thoroughly. The units bearing the numbers of chips drawn constitute the random sample.

In the above sampling procedure, there are two alternatives. After a number is selected by draw, it may be replaced and consequently it has a chance of being selected again. Such a method is known as sampling with replacement. This is usually referred to as unrestricted random sampling. Alternatively, the selected number is set aside, and so in the subsequent draws, it does not get chance of being selected again. This type of sampling is known as sampling without replacement. This is a form of restricted sampling.

Sampling with replacement guarantees each element an equal and independent chance of being selected in each draw. However, an element previously drawn and replaced in the vessel has a chance of being drawn again. But the common procedure is not to count it again as an item of the sample. For, it is absurd to ask a respondent to fill in a questionnaire twice.

Lottery method is useful for drawing a small sample from a small population. But it would be time consuming and tedious if the population is very large.

(4) The sampling error in this sampling is greater than that in order probability samples of the same size, because it is less precise than other methods.

(5) The size of the sample required to ensure its representativeness is usually larger under this type of sampling than under other random sampling techniques.

(6) A simple random design may be expensive in time and money.

These problems have led to the development of alternative superior random sampling designs like stratified random sampling, systematic sampling, etc.

Stratified Random Sampling

This is an improved type of random or probability sampling. In this method, the population is sub-divided into homogeneous groups or strata, and from each stratum, random sample is drawn. For example, university students may be dividend on the basis of discipline, and each discipline group may again be divided into juniors and seniors; and the employees of a business undertaking may be divided into managers and non-managers and each of those two groups may be sub-divided into salary-grade-wise strata.

Accordingly stratified random sampling may be classified into (a) Proportionate stratified sampling and (b) Disproportionate stratified sampling.

Proportionate Stratified Sampling

This sampling involves drawing a sample from each stratum in proportion to the latter's share in the total population. For example, if the final year MBA students of the Management Faculty of a university consist of the following specialization groups:

Specialization stream	**No.of students**	**Proportion of each stream**
Production	40	0.4
Finance	20	0.2
Marketing	30	0.3
Rural Development	10	0.1
	100	1.0

The researcher wants to draw an overall sample of 30. Then the strata sample sizes would be:

Strata	**Sample size**
Production	30 × 0.4 = 12
Finance	30 × 0.2 = 6
Marketing	30 × 0.3 = 9
Rural Development	30 × 0.1 = 3
	30

Thus, proportionate sampling gives proper representation to each stratum and its statistical efficiency is generally higher. This method is, therefore, very popular.

Disproportionate Stratified Random Sampling

This method does not give proportionate representation to strata. It necessarily involves giving overrepresentation to some strata and under representation to others. There may be several disproportionate schemes. All strata may be given equal weight, even though their shares in the total population vary. Alternatively, some substrata may be given greater weight and others lesser weight. When is such disproportionate weighing preferable?

The desirability of disproportionate sampling is usually determined by three factors, viz., (a) the sizes of strata, (b) internal variances among strata, and (c) sampling costs.

The guideline suggested by Cochran is:

In a given stratum, take a larger sample if

(a) the stratum is larger,

(b) the stratum is more variable internally, and

(c) Sampling is cheaper in the stratum.

If the elements of a stratum are more mixed or variable, then it would be sensible to take a larger sample from it in order to make it representative of the stratum. Similarly, if the cost per sampling unit is expected to be greater in some strata than in others, one could increase the cost effectiveness by taking a less proportionate sample in the costlier strata.

Usage: This method of disproportionate sampling is not widely used. However, it is appropriate to use it under the following circumstances:

(1) When the population contains some small but important sub-groups.

(2) When certain sub-groups are quite heterogeneous, while others are homogeneous; and

(3) When it is expected that there will be appreciable differences in the response rates of the sub-groups in the population. But the above differences should be several-fold to make disproportionate sampling worthwhile.

Disproportionate sampling cannot be used for population with unknown proportions of characteristics, because correct sizes of strata samples cannot be determined.

Systematic Sampling or Fixed Interval Method

Meaning and process: This method of sampling is an alternative to random sampling. It consists of taking every k^{th} item in the population after a random start with an item from 1 to k. For example, suppose it is desired to select a sample of 20 students, from a list of 300 students, divide the population total of 300 by 20, the quotient is 15. (If there is any fraction in the quotient ignore the fraction and take the integer or whole number). Select a number at random between 1 and 15, using lottery method or a table of random numbers.

Suppose the selected number is 9. Then the students numbered 9, 24 (9+15), 39 (24+15), 54 (39+15), 69, 84… are selected as the sample.

As the interval between sample units is fixed, this method is also known as fixed interval method.

Applications: Systematic selection can be applied to various populations such as students in a class, houses in a street, telephone directory, customers of a bank, assembly line output in a factory, members of an association, and so on.

Cluster Sampling

Where the population elements are scattered over a wider area and a list of population elements is not readily available, the use of simple or stratified random sampling method would be too expensive and time-consuming. In such cases cluster sampling is usually adopted.

Meaning: cluster sampling means random selection of sampling units consisting of population elements. Each such sampling unit is a cluster of population elements. Then from each selected sampling unit, a sample of population elements is drawn by either simple random selection or stratified random selection.

Suppose a researcher wants to select a random sample of 1,000 households out of 40,000 estimated households in a city for a survey. A direct sample of individual households would be difficult to select, because a list of households does not exist and would be too costly to prepare. Instead, he can select a random sample of a few blocks/wards. The number of blocks to be selected depends upon the average number of estimated households per block. Suppose the average number of households per block is 200, then 5 blocks comprise the sample. Since the number of households per block varies, the actual sample size depends on the block which happen to be selected. Alternatively, he can draw a sample of more blocks and from each sample blocks a certain number of households may be selected by systematic sampling. Some illustrations of clusters are:

Population	Elements	Cluster or Sampling units
1. City	Households	Blocks
2. City	Individuals	Households
3. Affiliating University	Students	Affiliated collages
4. Rural areas	Households	Villages
5. Industrial areas	Industrial unit	Industrial estates

Features: What makes a desirable cluster depends on the survey's situation and resources. The individual elements are determined by the survey objectives. For example, for an opinion poll, the individual person is a population element, but for a socio-economic survey of households or a consumer behavior survey, a household may be population element or unit of study. The cluster may be an institution or a geographical area or any other appropriate group depending on the nature of survey.

The number of elements in a cluster is called the cluster size. The clusters in most populations are of unequal size, e.g., dwellings in blocks, persons in household, employees in sections, farm households in villages, etc. Clusters of equal size are often the result of planned conditions such as manufacturing, e.g., matches in match boxes, soap cakes in cases. They rarely exist in nature or society.

Cluster sampling vs. stratified sampling: How does cluster sampling compare with stratified sampling? There are certain differences between them.

Cluster sampling process: The process of cluster sampling involves the following steps:

Cluster Sampling	Stratified Sampling
1. The sampling unit is a cluster or a group consisting of population elements.	The population elements itself is the sampling unit.
2. The population is divided into many clusters or sub-groups, each with a few elements.	The population is divided into a few sub-groups or strata, each with many elements.
3. Clustering is done on the basis of geographical areas or administrative divisions. (district/taluka) farm size etc.,	Stratification is done on the basis of variables under study, e.g., educational status, product line, of organizational unit. (e.g., department/sections)

4. We try to secure heterogeneity with sub-groups and homogeneity between sub-groups.	We aim at securing homogeneity within sub-groups and heterogeneity between sub-groups.
5. We make a random selection of sub-groups or clusters.	We make a random selection of elements from each sub-group.
6. The resulting sample may give a lower degree of representativeness for a given sample size.	It yields a higher degree of representative sample for the same sample size.
7. The sampling error may be great.	
8. The cost per element is lower.	The sampling error will be less. The cost per elements is higher.

1. **Identify clusters:** What can be appropriate clusters for a population? This depends on the nature of the study and the distribution of the population relating to it. The appropriate clusters may be area units (e.g., districts, talukas, villages, blocks of a city) or organizations/organizational units (e.g., schools, colleges, factories, sections in a school or departments in a factory).
2. **Examine the nature of clusters:** How homogeneous are the cluster? Clusters should not be homogeneous in internal characteristics. A sample drawn from such clusters cannot fully represent the overall population. Hence clusters should be constructed in a way as to increase intra-cluster variance. For example, contiguous villages/city blocks that contain different income/social groups may be combined into one cluster

Should the clusters be of equal or unequal size? "The theory of clustering is that the means of sample clusters are unbiased estimates of the population mean. This is generally true when clusters are equal. But natural clusters often vary. The effects of unequal size may be reduced by 1) combining small clusters and splitting large clusters or 2) stratifying clusters by size and selecting clusters from each stratum.

3. **Determine the number of stages:** Shall we use single-stage or multistage clusters? This depends primarily on the geographical area of the study, the scale of the study, there size of the population and the consideration of costs. Depending on these factors, the following alternatives are possible:

   (a) Single-stage sampling: Select clusters on a random basis and study all elements in each of the sample clusters.

   (b) Two-stage sampling: Select clusters and then select element from each selected cluster.

   (c) Multi-stage sampling: Extent the above method to more stages.

Area Sampling:

This is an important form of cluster sampling. In larger field surveys, clusters consisting of specific geographical areas like districts, talukas, villages or blocks in a city are randomly drawn. As the geographical areas are selected as sampling units in such cases, their sampling is called area sampling. It is not a separate method of sampling, but forms part of cluster sampling. It is not a separate method of sampling, but forms part of cluster sampling.

In a country like India where a state (previously known as a province) is divided into districts, districts into talukas and talukas into towns and villages, areas sampling is done on the basis of these administrative units in multi-stages.

Illustration: where they are covered by a study is a city, to draw a random sample of households, the following procedure may be adopted:

(1) Take a map of the concerned city and lay over it a transparent sheet with a grid system of lines

(2) The grid system divides the city into squares of equal size, say 100 areas.

(3) Leave the squares occupied by non-residential business and public buildings, parks etc., - say 30 squares.

(4) Number the remaining squares in a serial order 1,2,3,4, 5,.. 70 in a serpentine manner.

(5) Estimate the average number of households in each square on the basis of house counts in a few squares. Say the average number of households is 80.

(6) If the required sample of households is, say 640, determine the number of squares to be selected by dividing this total by 80, i.e., 8 squares.

(7) Select eight squares out of 80 on a simple random basis using a table of random numbers; or by adopting systematic random sampling method, i.e., every 10^{th} (80/8=10) square with a random start.

(8) Study all households in each of the sample eight squares. The total sample would be 8 × 80 =640 or a little less or more.

Where different socio-economic class of households are found to be concentrated in specific areas of the city, it is desirable to stratify the areas on an identifiable basis, then

- ❖ Draw a random sample of proportionate number of areas from each stratum.
- ❖ Prepare a list of households in each of the selected areas.
- ❖ Select randomly a proportionate number of households in each of these lists.

Alternatively divide each of the selected area into smaller area of almost equal size called segments and select randomly a proportionate number of segments in each sample area and survey all households in each of the selected segments.

Area sampling invariably involves multi-stage sampling and sub-sampling.

Multi-Stage Sampling

In this method, sampling is carried out in two or more stages. The population is regarded as being composed of a number of first stag sampling units. Each of them is made up of a number of second stage units and so forth. That is, at each stage, a sampling unit is a cluster of the sampling units of the subsequent stage. First, a sample of the first stage sampling units is drawn. The procedure continues down to the final sampling units or population elements. Appropriate random sampling method is adopted at each stage.

Usage: multi-stage sampling is appropriate where the population is scattered over a wider geographical area and no frame or list is available for sampling. It is also useful when a survey has to be made within a limited time and cost budget.

Advantages: The crucial advantages of multi-stage sampling are:

1. It results in concentration of fieldwork in compact small areas and consequently in a saving of time, labor and money.
2. It is more convenient, efficient and flexible than single-stage sampling.
3. It obviates the necessity of having a sampling frame covering the entire population.

Disadvantages: The major disadvantage of the multi-stage sampling is that the procedure of estimating sampling error and cost advantages is complicated. It is difficult for a non-satisfaction follow this estimation procedure.

Sub-Sampling:

Sub-sampling is a part of a multi-stage sampling process. In multi-stage sampling, the sampling in second and subsequent stage frames are called sub-sampling. Suppose that from a population of 40,000 households in 800 streets of a city, we want to select a sample of about 400 households. We can select a sample of 400 individual households (elements) or a sample of 8 streets (cluster). The sample of 400 elements would be scattered over the city, but the cluster sample would be confined to 8 streets. Clustering reduces survey costs, but increases the sampling error. Sub-sampling balances these two conflicting effects of clustering. In the above case, first a sample of say 80 streets may be drawn and from each of the selected street a 10% sub sample of households may be drawn. In each of the above stages, an appropriate probability sampling-simple random/stratified random sampling /systematic random sampling-may be adopted.

NON-PROBABILITY SAMPLING METHODS

Introduction

As explained earlier, non-probability sampling does not adopt the theory of probability and it does not give a representative sample of the population. The primary methods of non-probability sampling are:

- ❖ Convenience sampling (or Accidental sampling)
- ❖ Purposive (or Judgment) sampling
- ❖ Quota sampling
- ❖ Snow-ball sampling

Convenience or Accidental Sampling

This is non-probability sampling. It means selecting sample units in a just 'hit and miss' fashion, e.g., interviewing people whom we happen to meet. This sampling also means selecting whatever sampling units are conveniently available, e.g., a teacher may select students in his class.

This method is also known as accidental sampling because t respondents whom the researcher meets accidently are included in the sample.

Usefulness: Though convenience sampling has no status, it may be used for simple purpose such as testing ideas or gaining ideas or rough impression about a subject of interest. It lays a groundwork for a subsequent probability sampling. Sometimes it may have to be necessarily used. For example, when a population cannot be defined or a list of population is not available, there is no other alternative than to use convenient sampling.

Advantages:

1. Convenience sampling is the cheapest and simplest.
2. It does not require a list of population.
3. It does not require any statistical expertise.

Disadvantage:

1. Convenience sampling is highly biased, because of the researcher's subjectivity, and so it does not yield a representative sample.
2. It is the least reliable sampling method. There is no way of estimation the representativeness of the sample.
3. The findings cannot be generalized.

Purposive or Judgement Sampling

This method means deliberate selection of sample units that conform to some pre-determined criteria. This is also known as Judgement sampling. This involves selection of cases which we judge as the most appropriate ones for the given study. It is based on the judgement of the researcher or some expert. It does not aim at securing a cross section of a population.

T chance that a particular case be selected for the sample depends on the subjective judgement of the researcher. For example, a researcher may deliberately choose industrial undertakings in which quality circles are believed to be functioning successfully and undertaking in which quality circles are believed to be a total failure.

Application: The method is appropriate when what is important is the typicality and specific relevance of the sampling unit to the study and not their overall representativeness to the population.

Advantage: The advantages of purposive or judgement sampling are:

1. It is less costly and more convenient.
2. It guarantees inclusion of relevant elements in the sample. Probability sampling plans cannot give such guarantee.

Disadvantage: the demerits of judgment sampling are:

1. This does not ensure the representativeness of sample.
2. This is less efficient for generalizing when compared with random sampling.
3. This method requires more prior extensive information about the population one studies. Without such information, it is not possible to adjudge the suitability of the sample items to be selected.
4. This method does not lend itself for using inferential statistics, because, this sampling does not satisfy the underlying assumption of randomness.

Quota Sampling

This is a form of convenient sampling involving selection of quota groups of accessible sampling units by traits such as sex, age, social class, etc., when the population is known to consist of various categories by sex, age, religion, social class etc., in specific proportions, each investigator may give an assignment of quota groups specified by the per-determined trait in specific proportions. He can then select accessible persons, belonging to those quota groups in the area assigned to him.

"Quota Sampling is therefore a method of stratified sampling in which selection within strata is non-random. It is this Non-random element that constitutes its greatest weakness".

Quotas are stratified by such variables as sex, age, social class and religion. It is easy to classify accessible respondents under sex, age and religion, but it is very difficult to classify then into social categories, since social class usually involves a combination of factors such as occupation income and caste and the interviewer's subjective judgement and bias play some role in the social class classification of respondents.

A model of assignment given to an interviewer is shown below:

Assignment of Quota

Gender		**Age**		**Social Class**	
Male	11	20-40	5	Higher	3
Female	09	41-50	8	Middle	10
		51-60	4	Lower	7
		61 & above	3		
Total	20	Total	20	Total	20

Application: Quota sampling is used in studies like marketing surveys, opinion polls and leadership surveys which do not aim at precision, but to get quickly some crude results.

Merits: The major advantages of quota sampling are:

1. It is considerably less costly than probability sampling.
2. It is takes less time.
3. There is no need for a list of population. Thus, quota sampling is a suitable method of sampling a population for which no suitable frame is available.
4. Field work can easily be organized. Strict supervision need not be required.

Shortcoming: The method of quota sampling suffers from certain major shortcomings.

1. It may not yield a precise representative sample, and it is impossible to estimate sampling error. The findings, therefore, are not generalizable to any significant extent.

2. Interviewers may tent to choose the most accessible person; they may ignore slums or areas difficult to reach. Thus, they may fail to secure a representative sample within their quota groups.
3. Strict control of field work is difficult.
4. It difficult or sampling on more than three variable dimensions. This is because the number of categories to be selected is a multiplication of the number of values in each variable. For instances, if we want sample proportion at number of persons by sex, social status and age and these variables consist of two, tree and three categories respectively, we have to select $2 \times 3 \times 3 = 18$ categories of respondents.
5. The quota of sampling is subject to a higher degree of classification error, because the investigators are likely to base their classification of respondents' social status and economic status mostly on their impression about them.

Snowball Sampling

This is the colorful name for a technique of building up a list or a sample of a special population by using an initial setoff its members as information. For example, if a researcher wants to study the problem faced by Indians through some source like Indian embassy. Then he can ask each one of the to supply names of other Indians known to them, and continue this procedure until he gets an exhaustive list from which he can draw a sample or make a census survey.

This sampling technique may also be used in socio-metric studies. For example, the members of a social group may be asked to name the persons with whom they have social contacts, each one of the persons so named may also be asked to do so, and so on. The researcher may thus get a constellation of associates and analyses it.

Advantages: The advantages of snowball sampling are:

1. It is very useful in studying social groups, informal group in a formal organization, and diffusion of information among professionals of various kinds.
2. It is useful for smaller populations for which no frames are readily available.

Disadvantages:

1. The major disadvantages of snowball sampling are that it does not allow the use of probability statistical methods. Elements included are dependent on the subjective choice of the original selected respondents.
2. It is difficult to apply this method when the population is large.
3. It does not ensure the inclusion of all elements in the list.

UNIT V

5.1 DATA COLLECTION AND THE FIELD FORCE

Methods of designing data collection forms, particularly questionnaires, and methods of selecting samples from which to collect data have been discussed. Ways of coping with the most common problems that endanger accurate results have been described. But no matter how carefully a sample is drawn or a questionnaire designed, the data collected will not be accurate unless field force executes its job properly. As it is usually performed, fieldwork is one of the major sources of error in the typical research project – especially in questionnaire studies.

In telephone and personal interviews, an interviewer typically selects the person to interview, asks questions, and records the answers. Errors occur at each step. Electronic and computer developments are helping organize and mechanize some aspects of the process, thus reducing errors but perhaps adding new ones. The increased concern with privacy in modern society and the growing volume of telephone and mail intrusions are causing an increase in the number of respondents who refuse to cooperate, thus adding another potential source of error.

In addition to the above there are many less understood sources of error. To be able to appraise the validity and reliability of data collected through interviewing it is necessary to know the procedures used to collect data in the field. This article describes the procedures and examines how one can best cope with the problems encountered.

Fieldwork Procedure:

Research directors have two major alternatives for getting their fieldwork done – they can develop their own organizations or they can contract with a field work agency to do the job. In either case it is a difficult and costly step in the research process. Field work involves the selection, training, supervision and evaluation of individuals who collect data in the field. Data collection may be by interview or observation; but since the problems are greater in the interview process, the following discussion is primarily in terms of interviewing by telephone and in person. Mail surveys do not have these problems.

Most fieldwork organizations now have a central location from which they can do telephone interviews nationwide, and they can maintain a full-time staff of interviewers who are well trained and experienced. This set up may be combined with “store” space in a shopping centre where personal interviews are conducted and were full time staff is available for that purpose. These interviewers are able to handle many field work assignments and, with such centralization the data collection process can be loosely monitored.

Telephone Interviewing:

When telephone interviewing is computer assisted, the paper questionnaire is replaced with a video screen. The questionnaire is entered into the computer in such a way that the questions come on the screen in proper sequence. If the appropriate next question is determined by the answer to the last one, the computer can be programmed to ensure that this happens. Interviewers read the questions and either type in the answers or use “light pens” to mark the answers on the video screen. This procedure has the advantage of controlling the questionnaire and having the data entered in the computer directly so that at any time the results can be summarized quickly.

When a project is ready for data collection, interviewers are assembled for training at the telephone interviewing site. Training in this case may involve instruction on using the computer as well as on the project itself. A supervisor can observe the work of individual interviewers on a master screen that shows what is on a given interviewer’s screen while what is being said comes over an audio monitor.

Tabulation

Tabulation is the process of summarizing raw data and displaying it in compact form for further analysis. Therefore, preparing tables is a very important step. Tabulation may be by hand, mechanical, or electronic. The choice is made largely on the basis of the size and type of study, alternative costs, time pressures, and the availability of computers, and computer programs. If the number of questionnaires is small and their length short, hand tabulation is quite satisfactory.

A table may be divided into: (i) Frequency tables, (ii) Response tables, (iii) Contingency tables, (iv)Univariate tables, (v) Bi-variate tables, (vi) Statistical tables and (vii) Time series tables.

Generally, a research table has the following parts: (a) table number, (b) title of the table, (c) caption, (d) stub (row heading), (e) body, (f) headnote, (g) footnote.

As a general rule, the following steps are necessary in the preparation of a table:

(i) **Title of table:** The table should be first given a brief, simple and clear title which may express the basis of classification

(ii) Columns and rows: Each table should be prepared in an adequate number of columns and rows.

(iii) Captions and stubs: The columns and rows should be given simple and clear captions and stubs.

(iv) Ruling: columns and rows should be divided by means of thin or thick rulings.

(v) Arrangement of items: Comparable figures should be arranged side by side.

(vi) Deviations: These should be arranged in the column near the original data so that their presence may be easily noted.

(vii) Size of columns: This should be according to the requirement.

(viii) Arrangements of items: This should be according to the problem.

(ix) Special emphasis: This can be done by writing important detain bold or special letters.

(x) Unit of measurement: The unit should be noted below the lines.

(xi) Approximation: This should also be noted below the title**.**

(xii) Footnotes: These may be given below the table.

(xiii) Total: totals of each column and grand total should be in one line.

(xiv) Source: source of data must be given. For primary data, write primary data.

It is always necessary to present fact in a tabular for if they can be presented more simply in the body of the text. Tabular presentation enables the reader to follow it more quickly than textual presentation. A table should not merely repeat information covered in the text. The same information should not, of course, be presented in tabular form and graphical form.

Smaller and simpler tables may be presented in the text, while the large and complex tables may be placed at the end of the chapter or report.

Diagrams

Diagrams are charts and graphs used to present data. These facilitate in catching the attention of the reader. They help in presenting the data more effectively. Creative presentation of the data is possible. Interpretation can be effectively done.

5.3 ANALYSIS TECHNIQUES

TESTS OF SIGNIFICANCE

An important aspect of the sampling theory is to study the tests of significance, which will enable us to decide, on the basis of the results of the samples, whether

- the deviation between the observed sample statistic and the hypothetical parameter value or
- The deviation between two samples statistics is significant or might be attributed due to chance or the fluctuations of the sampling.

If n is large, all the distributions like, Binomial, Poisson, Chi-square, t distribution, F distribution can be approximated by a normal curve.

Hypothesis

A hypothesis is some statement about a population parameter. The hypothesis is tested on the basis of the outcome of a random sample.

Null Hypothesis

In any testing of hypothesis problem, we are faced with a pair of hypothesis such that one and only one of them is always true. One of this pair is called null hypothesis, and the other one is called alternative hypothesis.

The Null hypothesis is represented as H_0 and the alternative hypothesis is represented by H_1,

If the population mean is represented by μ.

$H_0: \mu < 50; H_1, \mu > 50$

End of the testing if we conclude that H_0 is to be rejected, then H_1 should be accepted.

Type -1 and Type - II Errors

In testing the hypothesis if we wrongly reject H_0, when in reality H_0 is true, the error is called a Type I error. Similarly, if we wrongly accept H_0 when H_0 is false, the error is called a Type II error.

We should not commit both the errors and should be reduced to the minimum they can be completely eliminated when the full population is examined. The probability of Type I error would be kept down to lower limits.

The Significance Level

In testing of hypothesis, Type I error is assumed to be more serious than Type II error and so the probability of Type I error needs to be explicitly controlled. This is done through the significance level of which the test is conducted. The significance level sets a limit to the probability of Type I errors and test procedures are designed so as to get the lowest probability of Type II error subject to the significance level. The probability of Type I error is denoted by a and probability of Type II error is denoted by p. Most of the test are conducted at $\alpha = 0.1$, $\alpha = 0.05$, $\alpha = 0.01$, by convection as well as by convenience. Generally, we use to test at 5% level.

Hypothesis Testing Procedure

Step 1: State the null and the alternative hypothesis.

Step 2: Choose the test statistic.

Step 3: Specify a level of significance of a.

Step 4: Define the critical region in terms of the test statistic.

Step 5: Compare the observed value of the test statistic with the cut-off value to accept or reject the null hypothesis.

Level of Significance and Critical Region

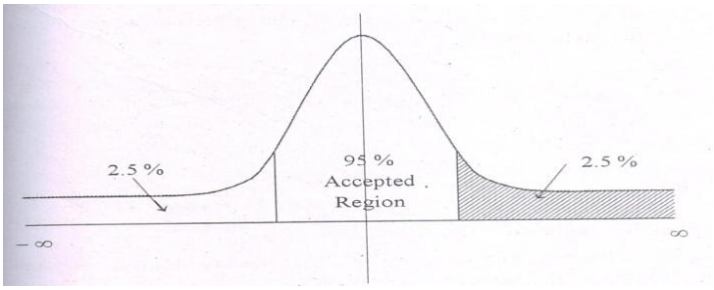


Fig No:4 Normal Curve

In testing a hypothesis, the maximum probability with which we are willing to risk a Type I error is called the level of significance of the test. Generally, we take either 5% or 1% level of significance that is there are about 5 cases in 100 that we would reject the hypothesis when it should be accepted. That is, we are about 95% confident that we have made that the right decision similarly for 1% level of significance.

From the above fig. the test statistic ***Z = t - E (t) / S .E of t***of a sample statistic lies between -1.96 and 1.96, we are 95% confident that the hypothesis is true.

(i.e) P[-1.96 $\leq$ Z $\leq$ 1.96] = 0.95

If for a random sample the test statistic Z lies outside the range -1.96 to 1.96 i.e., if | Z | > 1.96, we say that event will happen with probability of only 0.05. If the given hypothesis were true. In this case we say that Z-score differed significantly from the value expected under the hypothesis and hence the hypothesis us to be rejected at, 5% level of significance. The total shaded are 0.5 represents the probability of our H_Q being wrong in rejecting the hypothesis. 0.05 is the probability of making Type -1 error. Thus if | Z | > 1.96 the hypothesis is rejected at a 5% level significance.

(i., e.)|Z| > 1.96 constitutes critical region or region of rejection of the hypothesis or the region of significance. Thus, the critical region is the area under the sampling distribution in which the test statistic value has to fall for the null hypothesis to be rejected. The set of Z scores inside the range -1.96 to 1.96 is called the region of the acceptance of the hypothesis.

Decision Rule

1. Reject the null hypothesis at 5% level of significance if the test statistic
   | Z | > 1.96.

Accept the null hypothesis at 5% level of significance if $|Z| \leq 1.96$.

2. Reject the null hypothesis at 1% level of significance if $|Z| > 2.58$.

   Accept the null hypothesis at 1% level of significance of $|Z| \leq 2{,}58$.

One - Tailed and Two - Tailed Test

In testing whether the population mean $\mu = \mu_0$, we have $H_0 : \mu = \mu_0$ against the alternative hypothesis H_1 given by

$\mathbf{H_1} : \mu > \mu_0$ (right-tailed) or $\mu < \mu_0$ (left-tailed).

In the right-tailed test $\mathbf{H_1} : \mu > \mu_0$, the critical region $Z > Z_\alpha$ lies entirely in the right tail of the sampling distribution of sample mean x with area equal to the level of significance α. Similarly, in the left-tailed $H_1 : \mu < \mu_0$, the critical region $[Z < -Z_\alpha]$ lies entirely in the left of the sampling distribution of x with area equal to the level of significance α.

If the alternative hypothesis H_1 in a test be two-tailed (both right and left tailed).

Right-tailed test Left-tailed test;

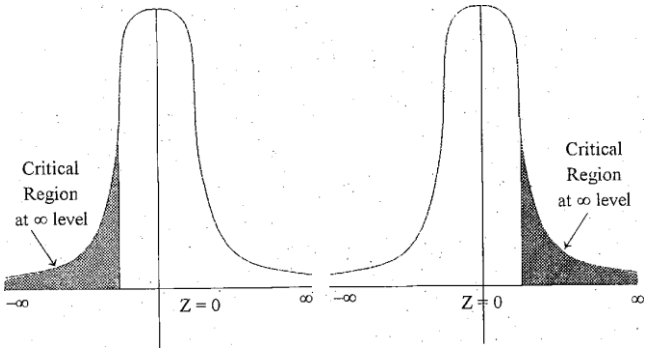


Fig No:5 Right & Left tailed test

(i.e) $H_1 : \mu \neq \mu_0$ ($\mu > \mu_0$ or $\mu < \mu_0$) then the test is called two-tailed test and in such a case the critical region lies in both right and left tailed of the sampling distribution of the test statistic, with, total area equal to the level of the significance. We apply two-tailed or one-tailed according as H_1 is two-tailed or one-tailed.

Critical Values of Z

Level of the significance (a)	**1%**	**5%**	**10%**
Critical values of two-tailed tests	$\|Z_\alpha\| = 2.58$,	$\|Z_\alpha\| = \mathbf{1.96}$	$\|Z_\alpha\| = 1.645$
Critical values of right-tailed tests	$Z_\alpha = 2.33$	$Z_\alpha = 1.645$	$Z_\alpha = 1.28$
Critical values of left-tailed tests	$Z_\alpha = -2.33$	$Z_\alpha = -1.645$	$Z_\alpha = -1.28$

ASSUMPTIONS ABOUT PARAMETRIC AND NONPARAMETRIC TESTS

Parametric (distribution) tests refer to statistical analysis tests that are generally appropriate to use when the data being examined is interval or ratio and is based on a large population sample and/or produces an identifiable Gaussian function or bell-shaped curve indicating a normality of distribution.

Non-parametric (distribution free) tests refer to statistical analyses tests which are less powerful than parametric tests but generally appropriate to use when the data being examined is ordinal or nominal and is based on a small population sample or does not have a clear Gaussian function.

If you understand those definitions then you understand the difference between parametric and non-parametric. If parametric assumptions are met you use a parametric test. If they're not met you use a non-parametric test. If assumptions are partially met, then it's a judgement call. In general, try and avoid non-parametric when possible (because it's less powerful).

Parametric Assumptions

Listed below are the most frequently encountered assumptions for parametric tests. Statistical procedures are available for testing these assumptions. The Kolmogorov-Smirnov Test is used to determine how likely it is that a sample came from a population that is normally distributed. The Levene test is used to test the assumption of equal variances. If we violate test assumptions, the statistic chosen cannot be applied. In this circumstance, we have two options: 1) we can use a data transformation or 2) we can choose a nonparametric statistic. If data transformations are selected, the transformation must correct the violated assumption. If successful, the transformation is applied and the parametric statistic is used for data analysis.

1. Interval or ratio scale of measurement (approximately interval)
2. Random sampling from a defined population

3. **Samples are independent/dependent (varies by statistic)**
4. **Characteristic is normally distributed in the population**
5. **Population variances are equal (if two or more groups/variables in the design)**

Non - Parametric Assumptions

A nonparametric test is a hypothesis test that does not require the population's distribution to be characterized by certain parameters. For example, many hypothesis tests rely on the assumption that the population follows a normal distribution with parameters μ and σ. nonparametric tests do not have this assumption, so they are useful when your data are strongly non-normal and resistant to transformation.

However, nonparametric tests are not completely free of assumptions about your data. For instance, nonparametric tests require the data to be an independent random sample.

	Parametric	Non-parametric
Distribution	Normal/Gaussian	Any
Assumed variance	Homogeneous	Any
Type of data	Ratio or Interval	Ordinal or Nominal
Data set relationships	Independent	Any
Measure of central tendency	Mean	Median
Correlation test	Pearson	Spearman
Independent measures, 2 groups	Independent-measures t-test	Mann-Whitney test
Independent measures, >2 groups	One-way, independent-measures ANOVA	Kruskal-Wallis test
Repeated measures, 2 conditions	Matched-pair t-test	Wilcoxon test
Repeated measures, >2 conditions	One-way, repeated measures ANOVA	Friedman's test

Fig No:6 Parametric and non-parametric tests

CHI SQUARE TEST

Chi square test is applied in statistics to test the goodness of fit to verify the distribution of observed data with assumed theoretical distribution. Therefore, it is a measure to study the divergence of actual and expected frequencies. It has great use in statistics, especially in sampling studies, where we expect a doubted coincidence between actual and expected frequencies, and the extent to which the difference can be ignored, because of fluctuations in sampling. If there is no difference between the actual and expected frequencies, χ^2 is zero. Thus, the Chi square test describes the discrepancy between theory and observation.

Characteristics of χ^2 test

- Test is based on events of frequencies, - where as in theoretical distribution, the test is based on mean and standard deviation.
- To draw inferences, this test is applied, specially testing the hypothesis but not useful for estimation.
- The test can be used between the entire set of observed and expected frequencies.
- For every increase in the number of degree of freedom, a new χ^2 distribution is formed.
- It is a general-purpose test and as such is highly useful in research.

Assumptions

1. All the observations must be independent.
2. All the events must be mutually exclusive.
3. There must be large observations.
4. For comparison purposes, the data must be in original units.

Degree of Freedom

When we compare the computed value of χ^2 with the table value the degree of freedom is evident. The degree of freedom means the number of classes to which values can be assigned at will, without violating restrictions. For e.g., we choose any four numbers, whose total is 50. Here we have a choice to select any three numbers, say 10, 15, 20 and the fourth number is 5, [50 - (10 + 15 + 20)]. Thus, our choice of freedom is reduced by one, on the condition

that the total be 50. Therefore, the restriction placed on the freedom is one and degree of freedom is three. As the restrictions increase, the freedom is reduced. Thus,

V –n - K

V : (nu) = Degree of freedom

K: Number of independent constraints

n: Number of frequency classes.

For a contingency table, 2><2, table, the degree of freedom is

V = (C-l) (r-l)

=: (2-1) (2-1)

= 1.

Uses

χ2 test of goodness of fit. Through the test we can find out the deviations between the observed values and expected values. Here we are not concerned with the parameters but concerned with the form of distribution. Karl pearson has developed a method to test the difference between the theoretical value (hypothesis) and the observed value. The test is done by comparing the computed value with the table value of χ^2 for the desired degree of freedom. A Greek letter χ^2 is used to describe the magnitude of difference between the fact and theory.

The χ^2may be defined as

$$\chi 2 = \sum \left\{ \frac{(O-E)^2}{E} \right\}$$

O = observed frequencies

E = Expected frequencies.

Steps

- A hypothesis is established along with the significance level.
- Compute deviations between observed value and expected value (O-E).
- Square the deviations calculated $(O-E)^2$.
- Divide the $(O-E)^2$ by its expected frequency.
- Add all the values obtained in step 4.
- Find the value of χ^2, from χ^2table at certain level of significance, usually 5% level.

If the calculated value of $\chi^2$is greater than the tabled value of χ^2, at certain level of significance, we reject the hypothesis. If the computed value of χ^2value is zero then, the observed value and expected values completely coincide. If the computed value of χ^2 is less than the table value, at a certain degree of level of significance, it is said to be non-significant. This implies that the discrepancy, between the observed and expected frequencies in simple sampling.

χ^2as a test of independence

χ^2 test can be used to find out whether one or more attributes are associated or not. For example, coaching class and successful candidate, marriage and failure, etc.; we can find out whether they are related or independent we take a hypothesis that the attributes are independent. If the calculated value of $x^2$is less than the tabled value at a certain level of significance, the hypothesis is correct and vice versa.

$$\chi 2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

$$\text{Expected value} = \frac{\text{Row Total (R.T) x Column Total (C.T)}}{\text{Grand Total (G.T)}}$$

Example: A certain drug was administered to 500 people out of a total of 800 included in the sample to test its efficiency against typhoid. The result is given below.

	Typhoid	**No. Typhoid**	**Total**
Drug	200	300	500
No Drug	280	20	300
Total	480	320	800

On the basis of these data, can it be concluded that the drug is effective in preventing typhoid (Given for V = 1, χ^2 0.05 = 3.84).

Solution:

Let the hypothesis be "The drug is not effective in preventing typhoid".

"The table of expected frequencies are:

480 X 500 ---------- =300 800	320 X 500 ---------- = 200 800	500
480 X 300 ---------- = 180 800	320 X 300 ---------- = 120 800	300
480	320	800

N.B alternatively, after finding out the first value, the remaining can be obtained in the following manner.

O	E	(O-E)	$(O-E)^2$	$(O-E)^2 E$
200	300	-100	10000	33.33
280	180	+ 100	10000	55.56
300	200	+100	10000	50.00
20	120	-100	10000	83.33
800	800	$\chi 2 = \sum \frac{(O_i - E_i)^2}{E_i}$ = 222.22		

V= (r-l) (C-l.)

= (2-1) (2-1)

= 1 x 1

= 1.

df=l, $\chi^2_{0.05}$ = 3.84.

Calculated value of χ^2 = 222.22, Table value of χ^2= 3.84 (from table) the calculated value of $\chi^2$is much greater than the table value. Therefore, the hypothesis the drug is not effective is rejected. Hence, we conclude that the drug is effective in preventing typhoid:

'T' TEST

A t-test is any statistical hypothesis test in which the test statistic follows a Student's t-distribution under the null hypothesis. It can be used to determine if two sets of data are significantly different from each other.

A t-test is most commonly applied when the test statistic would follow a normal distribution if the value of a scaling term in the test statistic were known. When the scaling term is unknown and is replaced by an estimate based on the data, the test statistics (under certain conditions) follow a Student's t distribution.

Types of t-tests

A t-test is a hypothesis test of the mean of one or two normally distributed populations. Several types of t-tests exist for different situations, but they all use a test statistic that follows a t-distribution under the null hypothesis:

Test	**Purpose**	**Example**
1sample t-test	Tests whether the mean of a single population is equal to a target value	Is the mean height of female college students greater than 5.5 feet?
2 sample t-test	Tests whether the difference between the means of two independent populations is equal to a target value	Does the mean height of female college students significantly differ from the mean height of male college students?
paired t-test	Tests whether the mean of the differences between dependent or paired observations is equal to a target value	If you measure the weight of male college students before and after each subject takes a weight-loss pill, is the mean weight loss significant enough to conclude that the pill works?

STUDENT'S 't' TEST FOR SINGLE MEAN

Suppose we want to test

- If a random sample x_i of size n has been drawn from a normal population with a specified mean μ_0.

- If the sample mean differs significantly from the hypothetical value μ_0 of the population mean.

$$t = \frac{\bar{x} - \mu}{\frac{S}{\sqrt{n}}} \; (or) \; t = \frac{\bar{x} - \mu}{\frac{S.D}{\sqrt{n-1}}}$$

Where

$\bar{x}$ → Sample mean

μ →Population mean

S → Standard deviation

n → Number of observation

n -1 → is degree of freedom

Example 1: **A machinist is making engine parts with axle diameter of 0.700 inch. A random sample of 10 parts shows a mean diameter of 0.742 inch with S.D of 0.040 inch. Compute the statistic you would use to test whether the work is meeting the specification.**

Solution

Null Hypothesis H_0: $\mu = 0.700$

Alternative Hypothesis H_1:

$\mu \neq 0.700$

$n = 10$

$\bar{x} = 0.742$

$S.D = 0.040$

$$t = \frac{\bar{x} - \mu}{\frac{S.D}{\sqrt{n-1}}}$$

$$= \frac{0.742 - 0.700}{\frac{0.040}{\sqrt{10-1}}}$$

$$= \frac{0.042}{\frac{0.04}{\sqrt{9}}}$$

$$= \frac{0.042x3}{0.040}$$

$$= 3.15$$

Table value of t at 5% with degree of freedom 9.

$t_{0.05} = 2.26$

Result:

Calculated value > Table value => Reject H_0.

' 3.15 > 2.26 => Reject H_0.

STUDENT'S 't' TEST FOR DIFFERENCE OF MEANS

To test the significant difference between two means $\overline{x_1}$ and $\overline{x_2}$ of samples of size $\overline{n_1}$ and $\overline{n_2}$ use the statistic.

$$t = \frac{\overline{x_1} - \overline{x_2}}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

where

$$S^2 = \frac{\sum\left(x_1 - \overline{x_1}\right)^2 + \sum\left(x_2 - \overline{x_2}\right)^2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

OR

$$S^2 = \frac{1}{n_1 + n_1 - 2}\left(n_1 s_1^2 + n_2 s_2^2\right)$$

S_1; S_2 sample standard deviation

Degree of freedom d.f = $n_1 + n_2 - 2$

Example: Samples of two types of electric light bulbs were tested for length of life and following data were obtained.

	Type I	**Type II**
Sample Number	**$n_1 = 8$**	**$n_2 = 7$**

Sample Means $\overline{x_1}$ **= 124hrs** $\overline{x_1}$ **= 1036 hrs**

Sample S.D S_1 **= 36 hours** S_2 **= 40hrs.**

Is the difference in the means sufficient to warrant that type I superior to type II regarding length of life.

Null Hypothesis H_0**:**

$\mu_1=\mu_2$

There is no significant difference between two types.

$$S=\sqrt{\frac{n_1 s_1^2+n_1 s_1^2}{n_1+n_2-2}}$$

$$S=\sqrt{\frac{8x36^2+7x40^2}{8+7-2}}$$

$$=\sqrt{\frac{21568}{13}}$$

S = 40.73

$$t=\frac{\overline{x_1}-\overline{x_2}}{s\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}$$

$$t=\frac{1234-1036}{40.73\sqrt{\frac{1}{8}+\frac{1}{7}}}$$

$$=\frac{198}{21.079}$$

t = 9.39

Degree of freedom = n_1+n_2-2

= 8+7-2

= 13 at 5% level

=1.77

Result

Calculated value > Table value => Reject H_0.

9.39 > 1.77 => Reject H_0

SMALL SAMPLES - F TEST

G.W. Snedecor has discovered a continuous probability distributing called Snedecor's F distributing. Here F is named after R. A Fishes who has contributed a lot to the development of Mathematical statistics.

$$F = \frac{S_1^2}{S_2^2}$$

Where

$$S_1^2 = \frac{n_1}{n_1 - 1} S_1^2$$

(or)

$$S_1^2 = \frac{\Sigma(x - \bar{x})^2}{n_1}$$

$$S_2^2 = \frac{n_2}{n_2 - 1} S_2^2$$

(or)

$$S_2^2 = \frac{\Sigma(y - \bar{y})^2}{n_2}$$

Example 1: From the following data test if the difference between the varieties is significant at 5% level of significance.

Sum of squares of deviations from the mean	**84.4**	**102.6**
Size	**8**	**10**
Sample	**A**	**B**

Solution:

H_0 : $\sigma_1^2 = \sigma_2^2$ (The samples are drawn from the populates with equal variances)

H_1 : $\sigma_1^2 \neq \sigma_2^2$ (The samples are drawn from the populates with unequal variances)

Variance of the sample A is

$$S_1^2 = \frac{\sum\left(x-\bar{x}\right)^2}{n_1}$$

$$S_1^2 = \frac{84.4}{8}$$

Variance of the sample B is

$$S_2^2 = \frac{\sum\left(y-\bar{y}\right)^2}{n_2}$$

$$S_2^2 = \frac{102.6}{10}$$

The estimated variances of the population from which the samples A and B are drawn are given by

$$S_1^2 = \frac{n_1 S_1^2}{n_1 - 1}$$

$$S_1^2 = \frac{8}{7} X \frac{84.4}{8}$$

$$S_1^2 = 12.06$$

$$S_2^2 = \frac{n_2 S_2^2}{n_2 - 1}$$

$$S_1^2 = \frac{10}{9} X \frac{102.6}{10}$$

$$S_1^2 = 11.4$$

Hence $S_1^2 > S_2^2$

To carry out the test we use the F-statistic given by

$$F = \frac{S_1^2}{S_2^2}$$

$$F = \frac{12.06}{11.4}$$

F= 1.058

d.f = (n_1-l , n_2-l) = (7,9)

Table value of F(7, 9) at 5% level = 3.29.

Conclusion:

H_0 is accepted since the calculated value of F < the table value of F.

Hence the population variances are equal.

TEST OF SIGNIFICANCE FOR PROPORTIONS USING NORMAL DISTRIBUTION

Test for a Single Proportion

Suppose a large sample of size n it's taken from a normal population to test the Significance difference between a sample population Q and the population proportion P we use statistic. '

$$Z = \frac{P - P}{\sqrt{\frac{PQ}{n}}}$$

PROBLEMS UNDER PROPORTIONS AND DIFFERENCES

Example: 1 In a sample of1,000 people in Maharashtra, 540 are rice eaters and the rest are wheat eaters. Can we assume that both rice and wheat are equally popular in this state at 1% level of significance?

Solution:

Null Hypothesis H_0:

Both rice and wheat eaters are equally popular.

n = 1000, x = 540

$$p = \frac{x}{n} = \frac{540}{1000} = 0.54$$

$$p = 0.5$$

We know that,

P + Q = 1

Q = 1 - P

$= 1 - 0.5$

Q = ½

$$Z = \frac{P - P}{\sqrt{\frac{PQ}{n}}} = \frac{0.54 - 0.50}{\sqrt{\frac{(0.5)(0.5)}{1000}}}$$

$$\frac{0.040}{0.0138} = 2.532$$

Z = 2.532

Table value = n degree of freedom at 1%. = 2.58

Conclusion:

Calculated value < Table value

2.532 < 2.58.

We accept H_0. We may conclude that rice and wheat eaters are equally popular in Maharashtra State.

ANALYSIS OF VARIANCE [ANOVA]

It is a technique used to test equality of means when more than one populations are considered.

In **Z**-test and t-test we consider only the equality of two population means.

If there are more than two populations, for testing the equality of their means the analysis of variance method is applied.

This technique introduced by R.A. Fisher was originally used in agricultural experiment in which different types of fertilizers were applied to plots of land, different types of feeding methods to animals and so on. This technique is widely used in different fields.

For example:

To study the pattern of average sales by using different sales techniques; the types of drugs manufactured by different companies to cure a particular disease.

A central point here is that although the ANOVA is literally a technique that *analysis variances*. It provides us with a test for the significance of the difference among means.

Before discussing the procedures used in ANOVA. We consider the general underlying principle.

If the null hypothesis that three population means (μ_1, μ_2, μ_3) are equal in true then both, the variation among the sample means. $\left(\overline{X_1}, \overline{X_2}, \overline{X_3}\right)$ And the variation within these groups use chance errors of the sampling process. The first of these types of variations is referred to as variation between samples. The second type is referred to as variation within samples.

"Between Sample Variation" is a variation of the sample means $\overline{X_1}, \overline{X_2}$ and X_3 around their general mean $\overline{X}$.

"Within Sample Variation" is a variation of the individual observations within each sample from their respective means $\overline{X_1}, \overline{X_2}$ and X_3

Under the null hypothesis that the population means are equal, between sample variation and within sample variation would be expected not to differ significantly from one another after adjustment for degrees of freedom, since they both reflect the same type of chance sampling errors. On the other hand, if the null hypothesis is false and the population means are different then between sample variation should significantly exceed the within sample variation.

Hence a comparison of "between sample variation" and "within sample variation" yields information concerning difference among the sample means.

The ANOVA with different classification, before that we state the assumptions made in this technique.

- Samples are independently drawn from the populations.
- The populations are normally distributed.
- The variances of all the populations are equal.

Types of ANOVA

- One-way classification
- Two-way classification
- Three-way classification

ANOVA '

It is a statistical technique specially designed to test whether the means of more than two quantitative populations are equal. It consists of classifying and cross classifying statistical results and test whether the means of a specified classification differ significantly.

One-Way Classification

The observations are classified according to one factor. This is exhibited column-wise.

Model

$$Y_i=\mu+\alpha_1+e_1$$

Y_i → random variable

μ → General mean effect

α_1 → Treatment

e_1 → error

Null Hypothesis H_0:

There is no significant difference in the means of the sample.

$\mu_1=\mu_2 \ldots. =\mu_n$

Alternative Hypothesis H_1:

There is some significant difference in the means of the sample,

$\mu_1\neq\mu_2 \ldots.\neq\mu_n$

Procedures:

A set of observations classified in one direction.

	X_1	X_2	……	X_C
	X_{11}	X_{21}	……	X_{C1}
	X_{12}	X_{22}	……	X_{C2}
	.	.	.	.
	.	.	.	.
	.	.	.	.
	X_{1r}	X_{2r}	……	X_{Cr}
Mean	$\overline{X}_1$	$\overline{X}_2$	……	$\overline{X}_C$

$$\overline{\overline{X}} = \frac{\overline{X_1} + \overline{X_2} + ... + \overline{X}_C}{C}$$

Correction factor = $\frac{G^2}{n}$

G → Grand Total

n → number of observation

Treatment [column] sum of square

$$\mathbf{CSS} = \sum_j \left(\overline{X}_j - \overline{\overline{X}}\right)^2$$

Error Sum of Square

$$\text{ESS} = \sum_j \sum_i \left(X_{ij} - \overline{X}_J\right)^2$$

Total Sum of Square

$$\text{TSS} = \sum \sum \left(\overline{X}_{ij} - \overline{\overline{X}}\right)^2$$

TSS = CSS + ESS

If each of these sum of squares is divided by the corresponding number of degrees of freedom, we get mean sum of squares.

ANOVA Table

Source of variation	**Degrees of freedom**	**Sum of square**	**Mean sum of square**	**F-ratio**	**F-table**
Column	C - l	**C.S.S**	$\frac{C.S.S}{C-1} \rightarrow (1)$	$\frac{(1)}{(2)} (or) \rightarrow$	F(C-l , n-C)
Error	n - C	**E.S.S**	$\frac{E.S.S}{n-c} \rightarrow (2)$	$\frac{(2)}{(1)} \rightarrow$	F(n-C, C-l)
Total	n - 1	**T.S.S**			F(n-C, C-l)

$$\text{F-ratio} = \frac{\text{Largest estimation of variance}}{\text{Smallest estimation of variance}}$$

Short-Cut Method

Step 1 : find n, the total number of observations

Step 2: find G the total of all observations.

Step 3 : find, $\frac{G^2}{n}$ the correction factor (C.F)

Step 4 : Calculate the total sum of square

$$\text{TSS} = \sum Y_{ij}^2 - C.F$$

Step 5 : Calculate the column sum of square

$$\text{CSS} = \sum \frac{C_{ij}^2}{r_i} - C.F$$

Step 6: Prepare the **ANOVA** table to calculate.

F – ratio

Null Hypothesis H_0: Population means are equal. $\mu_1=\mu_2=\mu_3$

Alternative Hypothesis H_1: Population means

are not equal

$\mu_1 \neq \mu_2 \neq \mu_3$

TYPE I

Example: 1 Set up ANOVA table for the following per hectare yield for these varieties.

Variety of Wheat

A1	A2	A3
6	5	5
7	5	4
3	3	3
8	7	4

Also work out F-ratio and test whether there is a significant difference among the means of the wheat.

Null Hypothesis H_0:

There is no significant difference between the means of the sample.

$\mu_1=\mu_2=\mu_3$

Alternative Hypothesis H_1:

There is a significant difference between the means of the sample.

$\mu_1\neq\mu_2\neq\mu_3$

Correction Factor :[C.F]

$$= \frac{G^2}{n}$$
$$= \frac{3600}{12}$$
$$= 300$$

Total Sum of Square (TSS)

$$\text{TSS} = \sum Y_{ij}^2 - C.F$$
$$= 36+25+25+49+25+16+9+9+9+64+49+16-300$$
$$= 332-300$$
$$= 32$$

Column Sum of Square (CSS)

$$\text{CSS} = \sum \frac{C_{ij}^2}{r_i} - C.F$$
$$= \frac{576+400+256}{4} - 300$$
$$= \frac{1232}{4} - 300$$
$$= = 8$$

Error Sum of Square (ESS)

= TSS – CSS

=32-8

=24

ANOVA Table

Source of variation	Degrees of freedom	Sum of square	Mean sum of square	F-ratio	F-table
CSS	**2**	**8**	**8/2=4**		
ESS	**9**	**24**	**24/9=2.67**	**4/2.67 =1.50**	**F(2,9)=4.26**
TSS	**11**	**32**			

Result :

Calculated value < Tabulated value

$1.50 < 4.26$

Accept the H_0.

Conclusion :

There is no significant difference between the means of the sample.

ANOVA (Two-Way Classification)

The observations are classified according totwo factor. This is exhibited column and row wise.

Model

$$Y_{ij} = \mu + \alpha_i + \beta_j + C_{ij}$$

Y_{ij}→ random variable

μ → General mean effect

α_i→ Treatment (Column)

e_i→ error

β_j→ row wise

e_{ij}→ error

Null Hypothesis H_0 :

There is no significant difference between columns and rows.

Alternative Hypothesis H_1 :

There is a significant difference between columns and rows.

Error Sum of Square

= Total **S.S** - (Column **S.S** +Row **S.S)**

Row Sum of Square (RSS)

$$\frac{\sum r_{ij}^2}{C_i} - C.F$$

Procedure :

Step 1 : find n, the total number of observations

Step 2: find G the total of all observations.

Step 3 : find, $\frac{G^2}{n}$ --- the correction factor (C.F)

Step 4 : Calculate the total sum of square

$$\text{TSS} = \sum Y_{ij}^2 - C.F$$

Step 5 : Calculate the column sum of square

$$\text{CSS} = \sum \frac{C_{ij}^2}{r_i} - C.F$$

Step 6: Calculate the Row sum of square

$$\text{RSS} = \sum \frac{r_{ij}^2}{r_i} - C.F$$

Step 7; Calculate the Error sum of square

ESS = TSS-(CSS + RSS)

Prepare the ANOVA Table

Source of variation	**Degrees of freedom**	**Sum of square**	**Mean sum of square**	**F-ratio**	**F-table**
Column	C - l	**C.S.S**	$\frac{C.S.S}{C-1} \rightarrow (1)$	$\frac{(1)}{(3)} \rightarrow (a)$	F(C-l,(C-1) (r-C))
Row	r - 1	**R.S.S**	$\frac{R.S.S}{r-1} \rightarrow (2)$		F(r-l,(C-1) (r-1))
Error	(C - 1) (r - 1)	**E.S.S**	$\frac{E.S.S}{(C-I)(r-1)} \rightarrow$	$\frac{(2)}{(3)} \rightarrow (b)$	
Total	n - 1	**T.S.S**			

Result:

If calculated value < Tabulated value

accept the H_0.

$$\text{F-ratio} = \frac{\text{Largest estimation of variance}}{\text{Smallest estimation of variance}}$$

Between Row

If Calculated value < Tabulated value

11.24 < 19.35

Accept the H_Q.

Conclusion:

There is a significant difference between Columns and Rows.

THREE WAY ANOVA

The three-way ANOVA is used to determine if there is an interaction effect between three independent variables on a continuous dependent variable (i.e., if a three-way interaction exists). As such, it extends the two-way ANOVA, which is used to determine if such an interaction exists between just two independent variables (i.e., rather than three independent variables).

5.4 RESEARCH REPORT PRESENTATIONS

REPORT WRITING AND ITS SIGNIFICANCE

Research report is considered a major component of the research study for the research task remains incomplete till the report has been presented and/or written. As a matter of fact, even the most brilliant hypothesis, highly well designed and conducted research study, and the most striking generalizations and findings are of little value unless they are effectively communicated to others. The purpose of research is not well served unless the findings are made known to others. Research results must invariably enter the general store of knowledge. All this explains the significance of writing research report. There are people who do not consider writing of report as an integral part of the research process. But the

general opinion is in favor of treating the presentation of research results or the writing of report as part and parcel of the research project. Writing of report is the last step in a research study and requires a set of skills somewhat different from those called for in respect of the earlier stages of research. This task should be accomplished by the researcher with utmost care; he may seek the assistance and guidance of experts for the purpose.

STEPS IN WRITING REPORT

Research reports are the product of slow, painstaking, accurate inductive work. The usual steps involved in writing report are: (a) logical analysis of the subject-matter; (b) preparation of the final outline; (c) preparation of the rough draft; (d) rewriting and polishing; (c) preparation of the final bibliography; and (f) writing the final draft. Though all these steps are self-explanatory, yet a brief mention of each one of these will be appropriate for better understanding.

Logical analysis of the subject matter: It is the first step which is primarily concerned with the development of a subject. There are two ways in which to develop a subject (a) logically and (b) chronologically. The logical development is made on the basis of mental connections and associations between the one thing and another by means of analysis. Logical treatment often consists in developing the material from the simple possible to the most complex structures. Chronological development is based on a connection or sequence in time or occurrence. The directions for doing or making something usually follow the chronological order.

Preparation of the final outline: It is the next step in writing the research report "Outlines are the framework upon which long written works are constructed. They are an aid to the logical organization of the material and a reminder of the points to be stressed in the report."

Preparation of the rough draft: This follows the logical analysis of the subject and the preparation of the final outline. Such a step is of utmost importance for the researcher now sits to write down what he has done in the context of his research study. He will write down the procedure adopted by him in collecting the material for his study along with various limitations faced by him, the technique of analysis adopted by him, the broad findings and

generalizations and the various suggestions he wants to offer regarding the problem concerned.

Rewriting and polishing of the rough draft: This step happens to be most difficult part of all formal writing. Usually this step requires more time than the writing of the rough draft. The careful revision makes the difference between a mediocre and a good piece of writing. While rewriting and polishing, one should check the report for weaknesses in logical development or presentation. The researcher should also "see whether or not the material, as it is presented, has unity and cohesion; does the report stand upright and firm and exhibit a definite pattern, like a marble arch? Or does it resemble an old wall of moldering cement and loose brick."4 In addition the researcher should give due attention to the fact that in his rough draft he has been consistent or not. He should check the mechanics of writing—grammar, spelling and usage.

Preparation of the final bibliography: Next in order comes the task of the preparation of the final bibliography. The bibliography, which is generally appended to the research report, is a list of books in some way pertinent to the research which has been done. It should contain all those works which the researcher has consulted. The bibliography should be arranged alphabetically and may be divided into two parts; the first part may contain the names of books and pamphlets, and the second part may contain the names of magazine and newspaper articles. Generally, this pattern of bibliography is considered convenient and satisfactory from the point of view of reader, though it is not the only way of presenting bibliography. The entries in bibliography should be made adopting the following order:

For books and pamphlets, the order may be as under:

1. Name of author, last name first.
2. Title, underlined to indicate italics.
3. Place, publisher, and date of publication.
4. Number of volumes.

Example

Kothari, C.R., Quantitative Techniques, New Delhi, Vikas Publishing House Pvt. Ltd., 1978.

For magazines and newspapers, the order may be as under:

1. Name of the author, last name first.

2. Title of article, in quotation marks.

3. Name of periodical, underlined to indicate italics.

4. The volume or volume and number.

5. The date of the issue.

6. The pagination.

Example

Robert V. Roosa, "Coping with Short-term International Money Flows", The Banker, London, September, 1971, p. 995.

The above examples are just the samples for bibliography entries and may be used, but one should also remember that they are not the only acceptable forms. The only thing important is that, whatever method one selects, it must remain consistent.

Writing the final draft: This constitutes the last step. The final draft should be written in a concise and objective style and in simple language, avoiding vague expressions such as "it seems", "there may be", and the like ones. While writing the final draft, the researcher must avoid abstract terminology and technical jargon. Illustrations and examples based on common experiences must be incorporated in the final draft as they happen to be most effective in communicating the research findings to others. A research report should not be dull, but must enthuse people and maintain interest and must show originality. It must be remembered that every report should be an attempt to solve some intellectual problem and must contribute to the solution of a problem and must add to the knowledge of both the researcher and the reader.

LAYOUT OF REPORT

Anybody, who is reading the research report, must necessarily be conveyed enough about the study so that he can place it in its general scientific context, judge the adequacy of its methods and thus form an opinion of how seriously the findings are to be taken. For this purpose, there is the need of proper layout of the report. The layout of the report means as to what the research report should contain. A comprehensive layout of the research report should comprise (A) preliminary pages; (B) the main text; and (C) the end matter. Let us deal with them separately.

(A) Preliminary Pages

In its preliminary pages, the report should carry a title and date, followed by acknowledgements in the form of 'Preface' or 'Foreword'. Then there should be a table of contents followed by list of tables and illustrations so that the decision-maker or anybody interested in reading the report can easily locate the required information in the report.

(B) Main Text

The main text provides the complete outline of the research report along with all details. Title of the research study is repeated at the top of the first page of the main text and then follows the other details on pages numbered consecutively, beginning with the second page. Each main section of the report should begin on a new page. The main text of the report should have the following sections: (i) Introduction; (ii) Statement of findings and recommendations; (iii) The results; (iv) The implications drawn from the results; and (v) The summary.

(i) Introduction: The purpose of introduction is to introduce the research project to the readers. It should contain a clear statement of the objectives of research i.e., enough background should be given to make clear to the reader why the problem was considered worth investigating. A brief summary of other relevant research may also be stated so that the present study can be seen in that context. The hypotheses of study, if any, and the definitions of the major concepts employed in the study should be explicitly stated in the introduction of the report.

The methodology adopted in conducting the study must be fully explained. The scientific reader would like to know in detail about such thing: How was the study carried out? What was its basic design? If the study was an experimental one, then what were the experimental manipulations? If the data were collected by means of questionnaires or interviews, then exactly what questions were asked (The questionnaire or interview schedule is usually given in an appendix)? If measurements were based on observation, then what instructions were given to the observers? Regarding the sample used in the study the reader should be told: Who were the subjects? How many were there? How were they selected? All these questions are crucial for estimating the probable limits of generalizability of the

findings. The statistical analysis adopted must also be clearly stated. In addition to all this, the scope of the study should be stated and the boundary lines be demarcated. The various limitations, under which the research project was completed, must also be narrated.

(ii) Statement of findings and recommendations: After introduction, the research report must contain a statement of findings and recommendations in non-technical language so that it can be easily understood by all concerned. If the findings happen to be extensive, at this point they should be put in the summarized form.

(iii) Results: A detailed presentation of the findings of the study, with supporting data in the form of tables and charts together with a validation of results, is the next step in writing the main text of the report. This generally comprises the main body of the report, extending over several chapters. The result section of the report should contain statistical summaries and reductions of the data rather than the raw data. All the results should be presented in logical sequence and split into readily identifiable sections. All relevant results must find a place in the report. But how one is to decide about what is relevant is the basic question. Quite often guidance comes primarily from the research problem and from the hypotheses, if any, with which the study was concerned. But ultimately the researcher must rely on his own judgement in deciding the outline of his report. "Nevertheless, it is still necessary that he states clearly the problem with which he was concerned, the procedure by which he worked on the problem, the conclusions at which he arrived, and the bases for his conclusions."

(iv) Implications of the results: Toward the end of the main text, the researcher should again put down the results of his research clearly and precisely. He should, state the implications that flow from the results of the study, for the general reader is interested in the implications for understanding the human behavior. Such implications may have three aspects as stated below:

(a) A statement of the inferences drawn from the present study which may be expected to apply in similar circumstances.

(b) The conditions of the present study which may limit the extent of legitimate generalizations of the inferences drawn from the study.

(c) The relevant questions that still remain unanswered or new questions raised by the study along with suggestions for the kind of research that would provide answers for them.

It is considered a good practice to finish the report with a short conclusion which summarizes and recapitulates the main points of the study. The conclusion drawn from the study should be clearly related to the hypotheses that were stated in the introductory section. At the same time, a forecast of the probable future of the subject and an indication of the kind of research which needs to be done in that particular field is useful and desirable.

(v) Summary: It has become customary to conclude the research report with a very brief summary, resting in brief the research problem, the methodology, the major findings and the major conclusions drawn from the research results.

(C) End Matter

At the end of the report, appendices should be enlisted in respect of all technical data such as questionnaires, sample information, mathematical derivations and the like ones. Bibliography of sources consulted should also be given. Index (an alphabetical listing of names, places and topics along with the numbers of the pages in a book or report on which they are mentioned or discussed) should invariably be given at the end of the report. The value of index lies in the fact that it works as a guide to the reader for the contents in the report.

MECHANICS OF WRITING A RESEARCH REPORT

There are very definite and set rules which should be followed in the actual preparation of the research report or paper. Once the techniques are finally decided, they should be scrupulously adhered to, and no deviation permitted. The criteria of format should be decided as soon as the materials for the research paper have been assembled. The following points deserve mention so far as the mechanics of writing a report are concerned:

1. **Size and physical design**: The manuscript should be written on unruled paper 81/ $2^{//} \times 11^{//}$ in size. If it is to be written by hand, then black or blue-black ink should be used. A margin of at least one and one-half inches should be allowed at the left hand and of at

least half an inch at the right hand of the paper. There should also be one-inch margins, top and bottom. The paper should be neat and legible. If the manuscript is to be typed, then all typing should be double spaced on one side of the page only except for the insertion of the long quotations.

2. **Procedure**: Various steps in writing the report should be strictly adhered (All such steps have already been explained earlier in this chapter).
3. **Layout**: Keeping in view the objective and nature of the problem, the layout of the report should be thought of and decided and accordingly adopted (The layout of the research report and various types of reports have been described in this chapter earlier which should be taken as a guide for report-writing in case of a particular problem).
4. **Treatment of quotations**: Quotations should be placed in quotation marks and double spaced, forming an immediate part of the text. But if a quotation is of a considerable length (more than four or five type written lines) then it should be single-spaced and indented at least half an inch to the right of the normal text margin.
5. **The footnotes**: Regarding footnotes one should keep in view the followings:
   a) The footnotes serve two purposes viz., the identification of materials used in quotations in the report and the notice of materials not immediately necessary to the body of the research text but still of supplemental value. In other words, footnotes are meant for cross references, citation of authorities and sources, acknowledgement and elucidation or explanation of a point of view. It should always be kept in view that footnote is not an end nor a means of the display of scholarship. The modern tendency is to make the minimum use of footnotes for scholarship does not need to be displayed.
   b) Footnotes are placed at the bottom of the page on which the reference or quotation which they identify or supplement ends. Footnotes are customarily separated from the textual material by a space of half an inch and a line about one and a half inches long.
   c) Footnotes should be numbered consecutively, usually beginning with 1 in each chapter separately. The number should be put slightly above the line, say at the end of a quotation. At the foot of the page, again, the footnote number should be indented and typed a little above the line. Thus, consecutive numbers must be used to correlate

the reference in the text with its corresponding note at the bottom of the page, except in case of statistical tables and other numerical material, where symbols such as the asterisk (*) or the like one may be used to prevent confusion.

d) Footnotes are always typed in single space though they are divided from one another by double space.

6. Documentation style: Regarding documentation, the first footnote reference to any given work should be complete in its documentation, giving all the essential facts about the edition used. Such documentary footnotes follow a general sequence. The common order may be described as under:

(i) Regarding the single-volume reference

1. Author's name in normal order (and not beginning with the last name as in a bibliography) followed by a comma;
2. Title of work, underlined to indicate italics;
3. Place and date of publication;
4. Pagination references (The page number).

Example

John Gessner, Masters of the Drama, New York: Dover Publications, Inc. 1954, p. 315.

(ii) Regarding multivolumed reference

1. Author's name in the normal order;
2. Title of work, underlined to indicate italics;
3. Place and date of publication;
4. Number of volume;
5. Pagination references (The page number).

(iii) Regarding works arranged alphabetically

For works arranged alphabetically such as encyclopedias and dictionaries, no pagination reference is usually needed. In such cases the order is illustrated as under:

Example 1

"Salamanca," Encyclopedia Britannica, 14th Edition.

Example 2

"Mary Wollstonecraft Godwin," Dictionary of national biography.

But if there should be a detailed reference to a long encyclopedia article, volume and pagination reference may be found necessary.

(iv) Regarding periodicals reference

1. Name of the author in normal order;
2. Title of article, in quotation marks;
3. Name of periodical, underlined to indicate italics;
4. Volume number;
5. Date of issuance;
6. Pagination.

(v) Regarding anthologies and collections reference

Quotations from anthologies or collections of literary works must be acknowledged not only by author, but also by the name of the collector.

(vi) Regarding second-hand quotations reference

In such cases the documentation should be handled as follows:

1. Original author and title;
2. "quoted or cited in,";
3. Second author and work.

Example

J.F. Jones, Life in Polynesia, p. 16, quoted in History of the Pacific Ocean area, by R.B. Abel, p. 191.

(vii) Case of multiple authorship

If there are more than two authors or editors, then in the documentation the name of only the first is given and the multiple authorship is indicated by "et al." or "and others". Subsequent references to the same work need not be so detailed as stated above. If the work is cited again without any other work intervening, it may be indicated as ibid, followed by a comma and the page number. A single page should be referred to as p., but more than one page be referred to as pp. If there are several pages referred to at a stretch, the practice is to use often the page number, for example, pp. 190ff, which means page number 190 and the following pages; but only for page 190 and the following page '190f'. Roman numerical is generally used to indicate the number of the volume of a book. Op. cit. (opera citato, in the

work cited) or Loc. cit. (loco citato, in the place cited) are two of the very convenient abbreviations used in the footnotes. Op. cit. or Loc. cit. after the writer's name would suggest that the reference is to work by the writer which has been cited in detail in an earlier footnote but intervened by some other references.

7. Punctuation and abbreviations in footnotes: The first item after the number in the footnote is the author's name, given in the normal signature order. This is followed by a comma. After the comma, the title of the book is given: the article (such as "A", "An", "The" etc.) is omitted and only the first word and proper nouns and adjectives are capitalized. The title is followed by a comma. Information concerning the edition is given next. This entry is followed by a comma. The place of publication is then stated; it may be mentioned in an abbreviated form, if the place happens to be a famous one such as Lond. for London, N.Y. for New York, N.D. for New Delhi and so on. This entry is followed by a comma. Then the name of the publisher is mentioned and this entry is closed by a comma. It is followed by the date of publication if the date is given on the title page. If the date appears in the copyright notice on the reverse side of the title page or elsewhere in the volume, the comma should be omitted and the date enclosed in square brackets [c 1978], [1978]. The entry is followed by a comma. Then follow the volume and page references and are separated by a comma if both are given. A period closes the complete documentary reference. But one should remember that the documentation regarding acknowledgements from magazine articles and periodical literature follow a different form as stated earlier while explaining the entries in the bibliography.

Certain English and Latin abbreviations are quite often used in bibliographies and footnotes to eliminate tedious repetition. The following is a partial list of the most common abbreviations frequently used in report-writing (the researcher should learn to recognize them as well as he should learn to use them):

anon., anonymous

ante., before

art., article

aug., augmented

bk., book

bull.,	bulletin
cf.,	compare
ch.,	chapter
col.,	column
diss.,	dissertation
ed.,	editor, edition, edited.
ed. cit.,	edition cited
e.g.,	exempli gratia: for example
eng.,	enlarged
et.al.,	and others

8. Use of statistics, charts and graphs: A judicious use of statistics in research reports is often considered a virtue for it contributes a great deal towards the clarification and simplification of the material and research results. One may well remember that a good picture is often worth more than a thousand words. Statistics are usually presented in the form of tables, charts, bars and line graphs and pictograms. Such presentation should be self-explanatory and complete in itself. It should be suitable and appropriate looking to the problem at hand. Finally, statistical presentation should be neat and attractive.

9. The final draft: Revising and rewriting the rough draft of the report should be done with great care before writing the final draft. For the purpose, the researcher should put to himself questions like: Are the sentences written in the report clear? Are they grammatically correct? Do they say what is meant'? Do the various points incorporated in the report fit together logically? "Having at least one colleague read the report just before the final revision is extremely helpful. Sentences that seem crystal-clear to the writer may prove quite confusing to other people; a connection that had seemed self-evident may strike others as a non-sequitur. A friendly critic, by pointing out passages that seem unclear or illogical, and perhaps suggesting ways of remedying the difficulties, can be an invaluable aid in achieving the goal of adequate communication."

10. Bibliography: Bibliography should be prepared and appended to the research report as discussed earlier.

11. Preparation of the index: At the end of the report, an index should invariably be given, the value of which lies in the fact that it acts as a good guide, to the reader. Index may be prepared both as subject index and as author index. The former gives the names of the subject-topics or concepts along with the number of pages on which they have appeared or discussed in the report, whereas the latter gives the similar information regarding the names of authors. The index should always be arranged alphabetically. Some people prefer to prepare only one index common for names of authors, subject-topics, concepts and the like ones.

PRECAUTIONS FOR WRITING RESEARCH REPORTS

Research report is a channel of communicating the research findings to the readers of the report. A good research report is one which does this task efficiently and effectively. As such it must be prepared keeping the following precautions in view:

1. While determining the length of the report (since research reports vary greatly in length), one should keep in view the fact that it should be long enough to cover the subject but short enough to maintain interest. In fact, report-writing should not be a means to learning more and more about less and less.
2. A research report should not, if this can be avoided, be dull; it should be such as to sustain reader's interest.
3. Abstract terminology and technical jargon should be avoided in a research report. The report should be able to convey the matter as simply as possible. This, in other words, means that report should be written in an objective style in simple language, avoiding expressions such as "it seems," "there may be" and the like.
4. Readers are often interested in acquiring a quick knowledge of the main findings and as such the report must provide a ready availability of the findings. For this purpose, charts, graphs and the statistical tables may be used for the various results in the main report in addition to the summary of important findings.
5. The layout of the report should be well thought out and must be appropriate and in accordance with the objective of the research problem.
6. The reports should be free from grammatical mistakes and must be prepared strictly in accordance with the techniques of composition of report-writing such as the use of

quotations, footnotes, documentation, proper punctuation and use of abbreviations in footnotes and the like.

7. The report must present the logical analysis of the subject matter. It must reflect a structure wherein the different pieces of analysis relating to the research problem fit well.
8. A research report should show originality and should necessarily be an attempt to solve some intellectual problem. It must contribute to the solution of a problem and must add to the store of knowledge.
9. Towards the end, the report must also state the policy implications relating to the problem under consideration. It is usually considered desirable if the report makes a forecast of the probable future of the subject concerned and indicates the kinds of research still needs to be done in that particular field.
10. Appendices should be enlisted in respect of all the technical data in the report.
11. Bibliography of sources consulted is a must for a good report and must necessarily be given. Index is also considered an essential part of a good report and as such must be prepared and appended at the end.
12. Report must be attractive in appearance, neat and clean, whether typed or printed.
13. Calculated confidence limits must be mentioned and the various constraints experienced in conducting the research study may also be stated in the report.
14. Objective of the study, the nature of the problem, the methods employed and the analysis techniques adopted must all be clearly stated in the beginning of the report in the form of introduction.

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