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RESEARCH METHODOLOGY

UNIT-I: INTRODUCTION

Meaning and significance of research - Types of research - Research Process**:** Problem identification and definition – Criteria for good research- Hypothesis: Null Hypothesis Vs Alternative Hypothesis, Hypothesis formulation – Various types of variables.

Introduction

In the modern complex world, every society today is faced with serious social, economic & political problems. These problems need systematic, intelligent and Practical solutions. Problem solving is technical process. It requires the accumulation of new knowledge. Research provides the means for accumulating knowledge & wisdom. In other words, research is a systematic effort of gathering analysis & interpretation of problems confronted by humanity. It is a thinking process and scientific method of studying a problem and finding solution. It is an in-depth analysis based on reflective thinking.

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 specially 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, organising 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 Encyclopaedia of Social Sciences define research as "the manipulation of things, concepts or symbols for the purpose of generalising to extend, correct or

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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 generalisation 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, analysing the facts and reaching certain conclusions either in the form of solutions(s) towards the concerned problem or in certain generalisations for some theoretical formulation.

Definitions

Research in common parlance refers to a search for knowledge. One can also define research as a scientific and systematic search for pertinent information on a specific topic. Research is an academic activity and the term should be used in a technical sense.

a) –William Emory defines Research as "any organised enquiry designed and carried out to provide information for solving a problem"

b) The new Oxford English Dictionary defines research is "the scientific investigation into and study of material, sources etc in order to establish facts and the reach new conclusions".

c) Redman and Mory defines, research as "a systematised effort to gain new knowledge''.

d) "A careful investigation or inquiry specially through search for new facts in any branch of knowledge" Advanced Leaner's Dictionary.

Characteristics of Research

The above definitions reveal the following characteristics of Research

1. Research is a systematic and critical investigation into a phenomenon.

2. It is not mere compilation of facts.

3. It adopts scientific method.

4. It is objective & Logical

5. It is based on empirical evidence.

6. Research is directed towards finding answers to questions & solutions to problems.

7. Its emphasis the generalisation theories and principles.

Objectives of Research

The objectives of Research can be grouped under the following heads

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1. To gain familiarity with a phenomenon or to achieve new insights to it.

2. To portray accurately the characteristics of a particular individual situation or a group.

3. To determine the frequency with which something occurs or with which it is associated with something else.

4. To test a hypothesis of a causal relationship between variables.

Significance of Research

Research inculcates scientific and inductive thinking and it promotes the development of logical habits of thinking and organisation. The role of research in several fields of applied economics, whether related to business or to the economy as a whole, has greatly increased in modern times. The increasingly complex nature of business and government has focused attention on the use of research in solving operational problems. Research, as an aid to economic policy, has gained added importance, both for government and business.

- Research provides the basis for nearly all government policies in our economic system.
- Research has its special significance in solving various operational and planning problems of business and industry
- Research is equally important for social scientists in studying social relationships and in seeking answers to various social problems.

keeping in view the following points:

(a) To those students who are to write a master's or Ph.D. thesis, research may mean a careerism or a way to attain a high position in the social structure;

(b) To professionals in research methodology, research may mean a source of livelihood;

(c) To philosophers and thinkers, research may mean the outlet for new ideas and insights;

(d) To literary men and women, research may mean the development of new styles and creative work;

(e) To analysts and intellectuals, research may mean the generalisations of new theories.

Thus, research is the fountain of knowledge for the sake of knowledge and an important source of providing guidelines for solving different business, governmental and social problems. It is a sort of formal training which enables one to understand the new developments in one's field in a better way.

RESEARCH METHODS/TYPES OF RESEARCH

The basic types of research are as follows:

Descriptive: *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.

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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.

Analytical research: In *analytical research*, on the other hand, the researcher has to use facts or information already available, and analyse these to make a critical evaluation of the material.

Basic research or *Fundamental:*

This research is conducted largely for the enhancement of knowledge and is research which does not have immediate commercial potential. The research is done for human welfare, animal welfare, and plant kingdom welfare. It is called basic, pure, fundamental research. The main motivation here is to expand man's knowledge, not to create or invent something. According to Travers, "Basic Research is designed to add to an organized body of scientific knowledge and does not necessarily produce results of immediate practical value." Such research is time and cost intensive (Example: An experimental research that may not be or will be helpful in human progress). It is used to solve a problem by adding to the field of application of discipline.

Applied Research

Applied research is designed to solve practical problems of the modern world, rather than to acquire knowledge for knowledge's sake. The goal of applied research is to improve the human condition. It focuses on analysis and solving social and real-life problems. This research is generally conducted on a large-scale basis and is expensive. As such, it is often conducted with the support of some financing agency like the national government, public corporation, world bank, UNICEF, UGC, Etc. According to Hunt, "applied research is an investigation for ways of using scientific knowledge to solve practical problems" for example: - improve agriculture crop production, treat or cure a specific disease, improve the energy efficiency of homes, offices, how can communication among workers in large companies be improved. This type of research can also be called Action Research.

Quantitative Research

This research is based on numeric figures or numbers. Quantitative research aim to measure the quantity or amount and compares it with past records and tries to project for future period. In social sciences, "quantitative research refers to the systematic empirical investigation of quantitative properties and phenomena and their relationships". The objective of quantitative research is to develop and employ mathematical models, theories or hypothesis pertaining to phenomena.

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The process of measurement is central to quantitative research because it provides fundamental connection between empirical observation and mathematical expression of quantitative relationships. Statistics is the most widely used branch of mathematics in quantitative research. Statistical methods are used extensively with in fields such as economics and commerce.

In sum, the research using the normative approach conducts why may be called quantitative research as the inferences from it are largely based on quantitative data. Moreover, objectivity is the primary guard so that the research may be replicated by others, if necessary. Quantitative can also be called Analytical Research.

Qualitative Research

Qualitative research presents a non-quantitative type of analysis. Qualitative research is collecting, analysing and interpreting data by observing what people do and say. Qualitative research refers to the meanings, definitions, characteristics, symbols, metaphors, and description of things. Qualitative research is much more subjective and uses very different methods of collecting information, mainly individual, in-depth interviews and focus groups.

The nature of this type of research is exploratory and open ended. Small number of people are interviewed in depth and or a relatively small number of focus groups are conducted. Qualitative research can be further classified in the following type.

I. Phenomenology: -a form of research in which the researcher attempts to understand how one or more individuals experience a phenomenon. Eg:-we might interview 20 victims of Bhopal tragedy.

II. Ethnography: - this type of research focuses on describing the culture of a group of people. A culture is the shared attributes, values, norms, practices, language, and material things of a group of people. Eg:-the researcher might decide to go and live with the tribal in Andaman island and study the culture and the educational practices.

III. Case study: -is a form of qualitative research that is focused on providing a detailed account of one or more cases. Eg:-we may study a classroom that was given a new curriculum for technology use.

IV. Grounded theory: - it is an inductive type of research, based or grounded in the observations of data from which it was developed; it uses a variety of data sources, including quantitative data, review of records, interviews, observation and surveys

V. Historical research: -it allows one to discuss past and present events in the context of the present condition, and allows one to reflect and provide possible answers to current issues and problems. Eg: -the lending pattern of business in the 19th century.

Conceptual Research: 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.

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Empirical Research:

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 first-hand, 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 characterised 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.

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 of 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.

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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.

RESEARCH PROCESS

Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps. the following order concerning various steps provides a useful procedural guideline regarding the research process:

(1) formulating the research problem;

(2) extensive literature survey;

(3) developing the hypothesis;

(4) preparing the research design;

(5) determining sample design;

(6) collecting the data;

(7) execution of the project;

(8) analysis of data;

(9) hypothesis testing;

(10) generalisations and interpretation, and

(11) preparation of the report or presentation of the results, i.e., formal write-up of conclusions reached.

A brief description of the above stated steps will be helpful.

Figure 1 ***RESEARCH PROCESS IN FLOW CHART***

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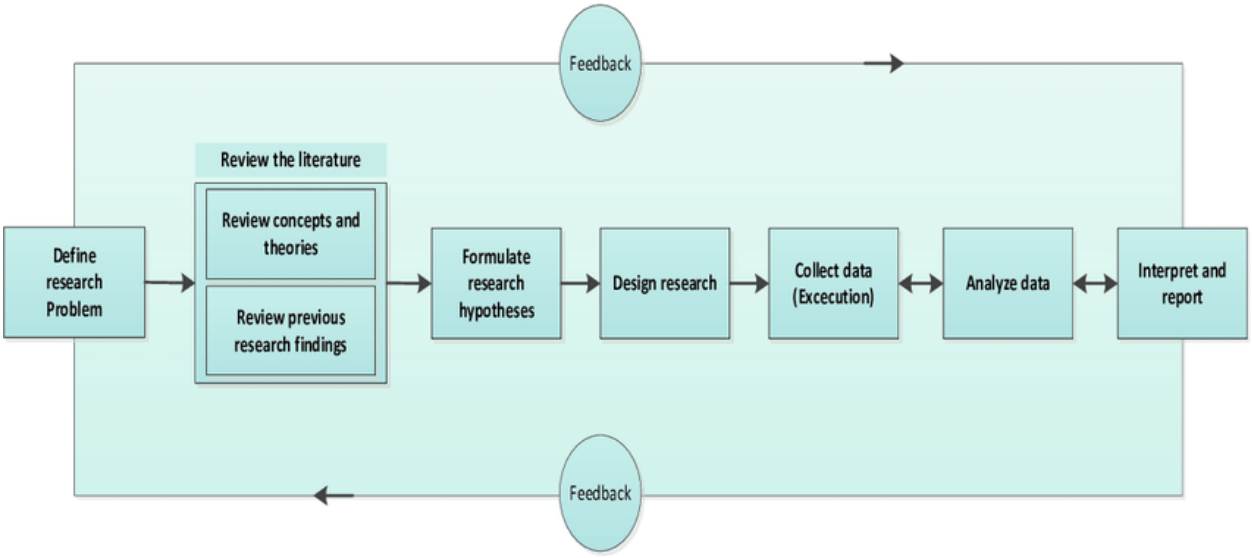

Formulating the research problem:

There are two types of research problems, viz., those which relate to states of nature and those which relate to relationships between variables. At the very outset the researcher must single out the problem he wants to study, i.e., he must decide the general area of interest or aspect of a subject-matter that he would like to inquire into. Initially the problem may be stated in a broad general way and then the ambiguities, if any, relating to the problem be resolved. Then, the feasibility of a particular solution has to be considered before a working formulation of the problem can be set up. The formulation of a general topic into a specific research problem, thus, constitutes the first step in a scientific enquiry. Essentially two steps are involved in formulating the research problem, viz., understanding the problem thoroughly, and rephrasing the same into meaningful terms from an analytical point of view.

The best way of understanding the problem is to discuss it with one's own colleagues or with those having some expertise in the matter. In an academic institution the researcher can seek the help from a guide who is usually an experienced man and has several research problems in mind. Often, the guide puts forth the problem in general terms and it is up to the researcher to narrow it down and phrase the problem in operational terms. In private business units or in governmental organisations, the problem is usually earmarked by the administrative agencies with whom the researcher can discuss as to how the problem originally came about and what considerations are involved in its possible solutions.

The researcher must at the same time examine all available literature to get himself acquainted with the selected problem. He may review two types of literature—the conceptual literature concerning the concepts and theories, and the empirical literature consisting of studies made earlier which are similar to the one proposed. The basic outcome of this review will be the knowledge as to what data and other materials are available for operational purposes which will enable the researcher to specify his own research problem in a meaningful context. After this the researcher

rephrases the problem into analytical or operational terms i.e., to put the problem in as specific terms as possible. This task of formulating, or defining, a research problem is a step of greatest importance in the entire research process. The problem to be investigated must be defined unambiguously for that will help discriminating relevant data from irrelevant ones. Care must, however, be taken to verify the objectivity and validity of the background facts concerning the problem.

2. Extensive literature survey: Once the problem is formulated, a brief summary of it should be written down. It is compulsory for a research worker writing a thesis for a Ph.D. degree to write a synopsis of the topic and submit it to the necessary Committee or the Research Board for approval. At this juncture the researcher should undertake extensive literature survey connected with the problem. For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place to go to. Academic journals, conference proceedings, government reports, books etc., must be tapped depending on the nature of the problem. In this process, it should be remembered that one source will lead to another. The earlier studies, if any, which are similar to the study in hand should be carefully studied. A good library will be a great help to the researcher at this stage.

3. Development of working hypotheses: After extensive literature survey, researcher should state in clear terms the working hypothesis or hypotheses. Working hypothesis is tentative assumption made in order to draw out and test its logical or empirical consequences. As such the manner in which research hypotheses are developed is particularly important since they provide the focal point for research. They also affect the manner in which tests must be conducted in the analysis of data and indirectly the quality of data which is required for the analysis. In most types of research, the development of working hypothesis plays an important role. Hypothesis should be very specific and limited to the piece of research in hand because it has to be tested. The role of the hypothesis is to guide the researcher by delimiting the area of research and to keep him on the right track. It sharpens his thinking and focuses attention on the more important facets of the problem. It also indicates the type of data required and the type of methods of data analysis to be used.

4. Preparing the research design: The research problem having been formulated in clear cut terms, the researcher will be required to prepare a research design, i.e., he will have to state the conceptual structure within which research would be conducted. The preparation of such a design facilitates research to be as efficient as possible yielding maximal information. In other words, the function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money. But how all these can be achieved depends mainly on the research purpose. Research purposes may be grouped into four categories, viz., (i) Exploration, (ii) Description, (iii) Diagnosis, and (iv) Experimentation. A flexible research design which provides opportunity for considering many different aspects of a problem is considered appropriate if the purpose of the research study is that of exploration. But when the purpose happens to be an accurate description of a situation or of an association between variables, the suitable design will be one that minimises bias and maximises the reliability of the data collected and analysed.

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The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following:

(i) the means of obtaining the information;

(ii) the availability and skills of the researcher and his staff (if any);

(iii) explanation of the way in which selected means of obtaining information will be organised

and the reasoning leading to the selection;

(iv) the time available for research; and

(v) the cost factor relating to research, i.e., the finance available for the purpose.

5. Determining sample design: All the items under consideration in any field of inquiry constitute a 'universe' or 'population'. A complete enumeration of all the items in the 'population' is known as a census inquiry. It can be presumed that in such an inquiry when all the items are covered no element of chance is left and highest accuracy is obtained. But in practice this may not be true. Even the slightest element of bias in such an inquiry will get larger and larger as the number of observations increases. Moreover, there is no way of checking the element of bias or its extent except through a resurvey or use of sample checks. Besides, this type of inquiry involves a great deal of time, money and energy. Not only this, census inquiry is not possible in practice under many circumstances. For instance, blood testing is done only on sample basis. Hence, quite often we select only a few items from the universe for our study purposes. The items so selected constitute what is technically called a sample.

The researcher must decide the way of selecting a sample or what is popularly known as the sample design. In other words, a sample design is a definite plan determined before any data are actually collected for obtaining a sample from a given population.

6. Collecting the data: In dealing with any real-life problem it is often found that data at hand are inadequate, and hence, it becomes necessary to collect data that are appropriate. There are several ways of collecting the appropriate data which differ considerably in context of money costs, time and other resources at the disposal of the researcher.

Primary data can be collected either through experiment or through survey. If the researcher conducts an experiment, he observes some quantitative measurements, or the data, with the help of which he examines the truth contained in his hypothesis. But in the case of a survey, data can be collected by any one or more of the following ways:

Primary Data Collection: Primary data may be from the following.

1. Experiment
2. Questionnaire
3. Observation

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4. Interview

Secondary data collection: it has the following categories:

1. Review of literature
2. Official and non-official reports
3. Library approach

7. Execution of the project: Execution of the project is a very important step in the research process. If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable. The researcher should see that the project is executed in a systematic manner and in time. If the survey is to be conducted by means of structured questionnaires, data can be readily machine-processed. In such a situation, questions as well as the possible answers may be coded. If the data are to be collected through interviewers, arrangements should be made for proper selection and training of the interviewers. The training may be given with the help of instruction manuals which explain clearly the job of the interviewers at each step. Occasional field checks should be made to ensure that the interviewers are doing their assigned job sincerely and efficiently.

A careful watch should be kept for unanticipated factors in order to keep the survey as much realistic as possible. This, in other words, means that steps should be taken to ensure that the survey is under statistical control so that the collected information is in accordance with the pre-defined standard of accuracy.

8. Analysis of data: After the data have been collected, the researcher turns to the task of analysing them. The analysis of data requires a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences. The unwieldy data should necessarily be condensed into a few manageable groups and tables for further analysis. Thus, researcher should classify the raw data into some purposeful and usable categories. *Coding* operation is usually done at this stage through which the categories of data are transformed into symbols that may be tabulated and counted. *Editing* is the procedure that improves the quality of the data for coding. With coding the stage is ready for tabulation. *Tabulation* is a part of the technical procedure wherein the classified data are put in the form of tables. The mechanical devices can be made use of at this juncture. A great deal of data, especially in large inquiries, is tabulated by computers. Computers not only save time but also make it possible to study large number of variables affecting a problem simultaneously.

Analysis work after tabulation is generally based on the computation of various percentages, coefficients, etc., by applying various well-defined statistical formulae. In the process of analysis, relationships or differences supporting or conflicting with original or new hypotheses should be subjected to tests of significance to determine with what validity data can be said to indicate any conclusion(s).

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9. Hypothesis-testing: After analysing the data as stated above, the researcher is in a position to test the hypotheses, if any, he had formulated earlier. Do the facts support the hypotheses or they? happen to be contrary? This is the usual question which should be answered while testing hypotheses. Various tests, such as Chi square test, *t*-test, *F*-test, have been developed by statisticians for the purpose. The hypotheses may be tested through the use of one or more of such tests, depending upon the nature and object of research inquiry. Hypothesis-testing will result in either accepting the hypothesis or in rejecting it. If the researcher had no hypotheses to start with, generalisations established on the basis of data may be stated as hypotheses to be tested by subsequent researches in times to come.

10. Generalisations and interpretation: If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalisation, i.e., to build a theory. As a matter of fact, the real value of research lies in its ability to arrive at certain generalisations. If the researcher had no hypothesis to start with, he might seek to explain his findings on the basis of some theory. It is known as interpretation. The process of interpretation may quite often trigger off new questions which in turn may lead to further researches.

11. Preparation of the report or the thesis: Finally, the researcher has to prepare the report of

what has been done by him.

PROBLEM IDENTIFICATION AND DEFINITION

In research process, the first and foremost step happens to be that of selecting and properly defining a research problem. A research problem, in general, refers to some difficulty which a researcher experiences in the context of either a theoretical or practical situation and wants to obtain a solution for the same.

state the components1 of a research problem as under:

(i) There must be an individual or a group which has some difficulty or the problem.

(ii) There must be some objective(s) to be attained at. If one wants nothing, one cannot have

a problem.

(iii) There must be alternative means (or the courses of action) for obtaining the objective(s) one wishes to attain. This means that there must be *at least two means* available to a researcher for if he has no choice of means, he cannot have a problem.

(iv) There must remain some doubt in the mind of a researcher with regard to the selection of alternatives. This means that research must answer the question concerning the relative efficiency of the possible alternatives.

(v) There must be some environment(s) to which the difficulty pertains.

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Thus, a research problem is one which requires a researcher to find out the best solution for the given problem, i.e., to find out by which course of action the objective can be attained optimally in the context of a given environment.

The purpose of a problem statement is to:

1. **Introduce the reader to the importance of the topic being studied**. The reader is oriented to the significance of the study and the research questions or hypotheses to follow.
2. **Places the problem into a particular context** that defines the parameters of what is to be investigated.
3. **Provides the framework for reporting the results** and indicates what is probably necessary to conduct the study and explain how the findings will present this information.

Types and Content

There are four general conceptualizations of a research problem in the social sciences:

1. **Casuist Research Problem --** this type of problem relates to the determination of right and wrong in questions of conduct or conscience by analyzing moral dilemmas through the application of general rules and the careful distinction of special cases.
2. **Difference Research Problem --** typically asks the question, "Is there a difference between two or more groups or treatments?" This type of problem statement is used when the researcher compares or contrasts two or more phenomena.
3. **Descriptive Research Problem --** typically asks the question, "what is...?" with the underlying purpose to describe a situation, state, or existence of a specific phenomenon.
4. **Relational Research Problem --** suggests a relationship of some sort between two or more variables to be investigated. The underlying purpose is to investigate qualities/characteristics that are connected in some way.

Sources of Problems for Investigation

Identifying a problem to study can be challenging, not because there is a lack of issues that could be investigated, but due to pursuing a goal of formulating a socially relevant and researchable problem statement that is unique and does not simply duplicate the work of others. To facilitate how you might select a problem from which to build a research study, consider these three broad sources of inspiration:

Deductions from Theory

This relates to deductions made from social philosophy or generalizations embodied in life in society that the researcher is familiar with. These deductions from human behavior are then fitted within an empirical frame of reference through research. From a theory, the research can formulate a research problem or hypothesis stating the expected findings in certain empirical situations. The research asks the question: "What relationship between variables will be observed if theory aptly

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summarizes the state of affairs?" One can then design and carry out a systematic investigation to assess whether empirical data confirm or reject the hypothesis and hence the theory.

Interdisciplinary Perspectives

Identifying a problem that forms the basis for a research study can come from academic movements and scholarship originating in disciplines outside of your primary area of study. A review of pertinent literature should include examining research from related disciplines, which can expose you to new avenues of exploration and analysis. An interdisciplinary approach to selecting a research problem offers an opportunity to construct a more comprehensive understanding of a very complex issue than any single discipline might provide.

Interviewing Practitioners

The identification of research problems about particular topics can arise from formal or informal discussions with practitioners who provide insight into new directions for future research and how to make research findings increasingly relevant to practice. Discussions with experts in the field, such as, teachers, social workers, health care providers, etc., offers the chance to identify practical, "real world" problems that may be understudied or ignored within academic circles. This approach also provides some practical knowledge which may help in the process of designing and conducting your study.

Personal Experience

Your everyday experiences can give rise to worthwhile problems for investigation. Think critically about your own experiences and/or frustrations with an issue facing society, your community, or in your neighbourhood. This can be derived, for example, from deliberate observations of certain relationships for which there is no clear explanation or witnessing an event that appears harmful to a person or group or that is out of the ordinary.

Relevant Literature

The selection of a research problem can often be derived from an extensive and thorough review of pertinent research associated with your overall area of interest. This may reveal where gaps remain in our understanding of a topic. Research may be conducted to: 1) fill such gaps in knowledge; 2) evaluate if the methodologies employed in prior studies can be adapted to solve other problems; or, 3) determine if a similar study could be conducted in a different subject area or applied to different study sample [i.e., different groups of people]. Also, authors frequently conclude their studies by noting implications for further research; this can also be a valuable source of problems to investigate.

Technique Involved in Defining A Problem

The technique for the purpose involves the undertaking of the following steps generally one after the other: (i) statement of the problem in a general way; (ii) understanding the nature of the

problem; (iii) surveying the available literature (iv) developing the ideas through discussions; and (v) rephrasing the research problem into a working proposition.

(i) Statement of the problem in a general way: First of all, the problem should be stated in a broad general way, keeping in view either some practical concern or some scientific or intellectual interest. For this purpose, the researcher must immerse himself thoroughly in the subject matter concerning which he wishes to pose a problem. In case of social research, it is considered advisable to do some field observation and as such the researcher may undertake some sort of preliminary survey or what is often called *pilot survey*. Then the researcher can himself state the problem or he can seek the guidance of the guide or the subject expert in accomplishing this task. Often, the guide puts forth the problem in general terms, and it is then up to the researcher to narrow it down and phrase the problem in operational terms.

(ii) Understanding the nature of the problem: The next step in defining the problem is to understand its origin and nature clearly. The best way of understanding the problem is to discuss it with those who first raised it in order to find out how the problem originally came about and with what objectives in view. If the researcher has stated the problem himself, he should consider once again all those points that induced him to make a general statement concerning the problem. For a better understanding of the nature of the problem involved, he can enter into discussion with those who have a good knowledge of the problem concerned or similar other problems. The researcher should also keep in view the environment within which the problem is to be studied and understood.

(iii) Surveying the available literature: All available literature concerning the problem at hand must necessarily be surveyed and examined before a definition of the research problem is given. This means that the researcher must be well-conversant with relevant theories in the field, reports and records as also all other relevant literature. He must devote sufficient time in reviewing of research already undertaken on related problems. This is done to find out what data and other materials, if any, are available for operational purposes. "Knowing what data are available often serves to narrow the problem itself as well as the technique that might be used. This would also help a researcher to know if there are certain gaps in the theories, or whether the existing theories applicable to the problem under study are inconsistent with each other, or whether the findings of the different studies do not follow a pattern consistent with the theoretical expectations and so on. All this will enable a researcher to take new strides in the field for furtherance of knowledge i.e., he can move up starting from the existing premise. Studies on related problems are useful for indicating the type of difficulties that may be encountered in the present study as also the possible analytical shortcomings. At times such studies may also suggest useful and even new lines of approach to the present problem.

(iv) Developing the ideas through discussions: Discussion concerning a problem often produces useful information. Various new ideas can be developed through such an exercise. Hence, a researcher must discuss his problem with his colleagues and others who have enough experience in the same area or in working on similar problems. This is quite often known as an *experience*

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survey. People with rich experience are in a position to enlighten the researcher on different aspects of his proposed study and their advice and comments are usually invaluable to the researcher. They help him sharpen his focus of attention on specific aspects within the field.

(v) Rephrasing the research problem: Finally, the researcher must sit to rephrase the research problem into a working proposition. Once the nature of the problem has been clearly understood, the environment (within which the problem has got to be studied) has been defined, discussions over the problem have taken place and the available literature has been surveyed and examined, rephrasing the problem into analytical or operational terms is not a difficult task. Through rephrasing, the researcher puts the research problem in as specific terms as possible so that it may become operationally viable and may help in the development of working hypotheses

CRITERIA FOR GOOD RESEARCH

1. The purpose of the research should be clearly defined and common concepts be used.

2. The research procedure used should be described in sufficient detail to permit another researcher to repeat the research for further advancement, keeping the continuity of what has already been attained.

3. The procedural design of the research should be carefully planned to yield results that are

as objective as possible.

4. The researcher should report with complete frankness, flaws in procedural design and estimate their effects upon the findings.

5. The analysis of data should be sufficiently adequate to reveal its significance and the methods of analysis used should be appropriate. The validity and reliability of the data should be checked carefully.

6. Conclusions should be confined to those justified by the data of the research and limited to those for which the data provide an adequate basis.

7. Greater confidence in research is warranted if the researcher is experienced, has a good reputation in research and is a person of integrity.

In other words, we can state the qualities of a good research12 as under:

1. *Good research is systematic:* It means that research is structured with specified steps to be taken in a specified sequence in accordance with the well-defined set of rules. Systematic characteristic of the research does not rule out creative thinking but it certainly does reject the use of guessing and intuition in arriving at conclusions.

2**. *Good research is logical:*** This implies that research is guided by the rules of logical reasoning and the logical process of induction and deduction are of great value in carrying out research. Induction is the process of reasoning from a part to the whole whereas deduction is the process of

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reasoning from some premise to a conclusion which follows from that very premise. In fact, logical reasoning makes research more meaningful in the context of decision making.

3. *Good research is empirical:* It implies that research is related basically to one or more aspects of a real situation and deals with concrete data that provides a basis for external validity to research results.

4. *Good research is replicable:* This characteristic allows research results to be verified by replicating the study and thereby building a sound basis for decisions.

HYPOTHESIS

Introduction

Hypothesis is usually considered as the principal instrument in research. Its main function is to suggest new experiments and observations. In fact, many experiments are carried out with the deliberate object of testing hypotheses. Decision-makers often face situations wherein they are interested in testing hypotheses on the basis of available information and then take decisions on the basis of such testing.

Meaning of Hypothesis

Ordinarily, when one talks about hypothesis, one simply means a mere assumption or some supposition to be proved or disproved. But for a researcher hypothesis is a formal question that he intends to resolve. Thus, a hypothesis may be defined as a proposition or a set of propositions set forth as an explanation for the occurrence of some specified group of phenomena either asserted merely as a provisional conjecture to guide some investigation or accepted as highly probable in the light of established facts.

Definitions

- Hypothesis is considered as an intelligent guess or prediction, that gives directional to the researcher to answer the research question.
- Hypothesis or Hypotheses are defined as the formal statement of the tentative or expected prediction or explanation of the relationship between two or more variables in a specified population
- A hypothesis is a formal tentative statement of the expected relationship between two or more variables under study.
- A hypothesis helps to translate the research problem and objective into a clear explanation or prediction of the expected results or outcomes of the study.

Characteristics of hypothesis:

Hypothesis must possess the following characteristics:

(i) Hypothesis should be clear and precise. If the hypothesis is not clear and precise, the inferences drawn on its basis cannot be taken as reliable.

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(ii) Hypothesis should be capable of being tested.

(iii) Hypothesis should state relationship between variables, if it happens to be a relational hypothesis.

(iv) Hypothesis should be limited in scope and must be specific. A researcher must remember that narrower hypotheses are generally more testable and he should develop such hypotheses.

(v) Hypothesis should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned. But one must remember that simplicity of hypothesis has nothing to do with its significance.

(vi) Hypothesis should be consistent with most known facts i.e.; it must be consistent with a substantial body of established facts. In other words, it should be one which judge accept as being the most likely.

(vii) Hypothesis should be amenable to testing within a reasonable time. One should not use even an excellent hypothesis, if the same cannot be tested in reasonable time for one cannot spend a life-time collecting data to test it.

(viii) Hypothesis must explain the facts that gave rise to the need for explanation. This means that by using the hypothesis plus other known and accepted generalizations, one should be able to deduce the original problem condition. Thus, hypothesis must actually explain what it claims to explain; it should have empirical reference.

Functions and Importance of Hypothesis

- It provides clarity to the research problem and research objectives.
- It describes, explains or predicts the expected results or outcome of the research.
- It indicates the type of research design.
- It directs the research study process.
- It identifies the population of the research study that is to be investigated or examined.
- It facilitates data collection, data analysis and data interpretation
- It enables an investigator to start his research work.
- It may lead to formulations of another hypothesis.
- It leads to interpret results drawing conclusions related to original purpose.

TYPES OF HYPOTHESIS

- Simple hypothesis
- Complex hypothesis
- Empirical hypothesis
- Null hypothesis
- Alternative hypothesis
- Logical hypothesis
- Statistical hypothesis

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Simple Hypothesis

Simple hypothesis is that one in which there exits relationship between two variables one is called independent variable or cause and the other is dependent variable or effect.

Complex Hypothesis

Complex hypothesis is that one in which as relationship among variables exists. In this type dependent and independent variable are more than two.

Ex. Smoking and other drugs leads to cancer, tension, chest infections etc.

The higher ration of unemployment poverty illiteracy leads to crimes like dacoit etc.

Empirical Hypothesis

Empirical which means it is based on evidence. In scientific method the word "empirical" refers to the use of working hypothesis that can be tested using observation and experiment. Empirical data is produced by experiment and observation.

Question Form of Hypothesis

It Is the simplest form of empirical hypothesis. In simple case of investigation and research are adequately implemented by resuming a question.

Ex. how is the ability of 9th class students in learning moral values?

Null Hypothesis

Null the hypothesis that there is no significant difference between specified populations, any observed difference being due to sampling or experimental error. • It is denoted by H0

Alternate Hypothesis

The alternative hypothesis, denoted by H1 or Ha,. Is the hypothesis that sample observations are influenced by some non-random cause.

Statistical Hypothesis

A hypothesis which can be verified statistically called statistical hypothesis. The statement would be logical or illogical but if statistic verifies it, it will be statistical hypothesis.

Directional Hypothesis

Directional Hypothesis predicts the direction of the relationship between the independent and dependent variable. Example- High quality of nursing education will lead to high quality of nursing practice skills. Girls ability of learning moral science is better than boys.

Non-Directional Hypothesis

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Non -directional Hypothesis predicts the relationship between the independent variable and the dependent variable but does not specific the directional of the relationship.

Casual Hypothesis

Causal Hypothesis predicts a cause and effects relationship or interaction between the independent variable and dependent variable. This hypothesis predicts the effect of the independent variable on the dependent variable

Associative Hypothesis

Associative Hypothesis predicts an associative relationship between the independent variable and the dependent variable. When there is a change in any one of the variables, changes also occur in the other variable.

PROCEDURE FOR HYPOTHESIS TESTING

To test a hypothesis means to tell (on the basis of the data the researcher has collected) whether or not the hypothesis seems to be valid. In hypothesis testing the main question is: whether to accept the null hypothesis or not to accept the null hypothesis? Procedure for hypothesis testing refers to all those steps that we undertake for making a choice between the two actions i.e., rejection and acceptance of a null hypothesis. The various steps involved in hypothesis testing are stated below:

(i) *Making a formal statement:*

The step consists in making a formal statement of the null hypothesis (*H*0) and also of the alternative hypothesis (*Ha*). This means that hypotheses should be clearly stated, considering the nature of the research problem**.** The formulation of hypotheses is an important step which must be accomplished with due care in accordance with the object and nature of the problem under consideration. It also indicates whether we should use a one-tailed test or a two-tailed test. If *Ha* is of the type greater than (or of the type lesser than), we use a one-tailed test, but when *Ha* is of the type "whether greater or smaller" then we use a two-tailed test.

(ii) *Selecting a significance level:*

The hypotheses are tested on a pre-determined level of significance and as such the same should be specified. Generally, in practice, either 5% level or 1% level is adopted for the purpose. The factors that affect the level of significance are: (a) the magnitude of the difference between sample means; (b) the size of the samples; (c) the variability of measurements within samples; and (d) whether the hypothesis is directional or non-directional (A directional hypothesis is one which predicts the direction of the difference between, say, means). In brief, the level of significance must be adequate in the context of the purpose and nature of enquiry.

(iii) *Deciding the distribution to use:*

After deciding the level of significance, the next step in hypothesis testing is to determine the appropriate sampling distribution. The choice generally remains between normal distribution and

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the *t*-distribution. The rules for selecting the correct distribution are similar to those which we have stated earlier in the context of estimation.

(iv) ***Selecting a random sample and computing an appropriate value:***

Another step is to select a random sample(s) and compute an appropriate value from the sample data concerning the test statistic utilizing the relevant distribution. In other words, draw a sample to furnish empirical data.

(v) ***Calculation of the probability:*** One has then to calculate the probability that the sample result would diverge as widely as it has from expectations, if the null hypothesis were in fact true.

(vi) ***Comparing the probability:*** Yet another step consists in comparing the probability thus calculated with the specified value for the significance level. If the calculated probability is equal to or smaller than a value in case of one-tailed test (and a /2 in case of two-tailed test), then reject the null hypothesis (i.e., accept the alternative hypothesis), but if the calculated probability is greater, then accept the null hypothesis. In case we reject *H*0, we run a risk of (at most the level of significance) committing an error of Type I, but if we accept *H*0, then we run some risk (the size of which cannot be specified as long as the *H*0 happens to be vague rather than specific) of committing an error of Type II.

Type I and Type II Errors

In the context of testing of hypotheses, there are basically two types of errors we can make. We may reject H0 when H0 is true and we may accept H0 when in fact H0 is not true. The former is known as Type I error and the latter as Type II error. In other words, Type I error means rejection of hypothesis which should have been accepted and Type II error means accepting the hypothesis which should have been rejected. Type I error is denoted by a (alpha) known as error, also called the level of significance of test; and Type II error is denoted by b (beta) known as b error. In a tabular form the said two errors can be presented as follows:

Figure 2 Type I and Type II Errors

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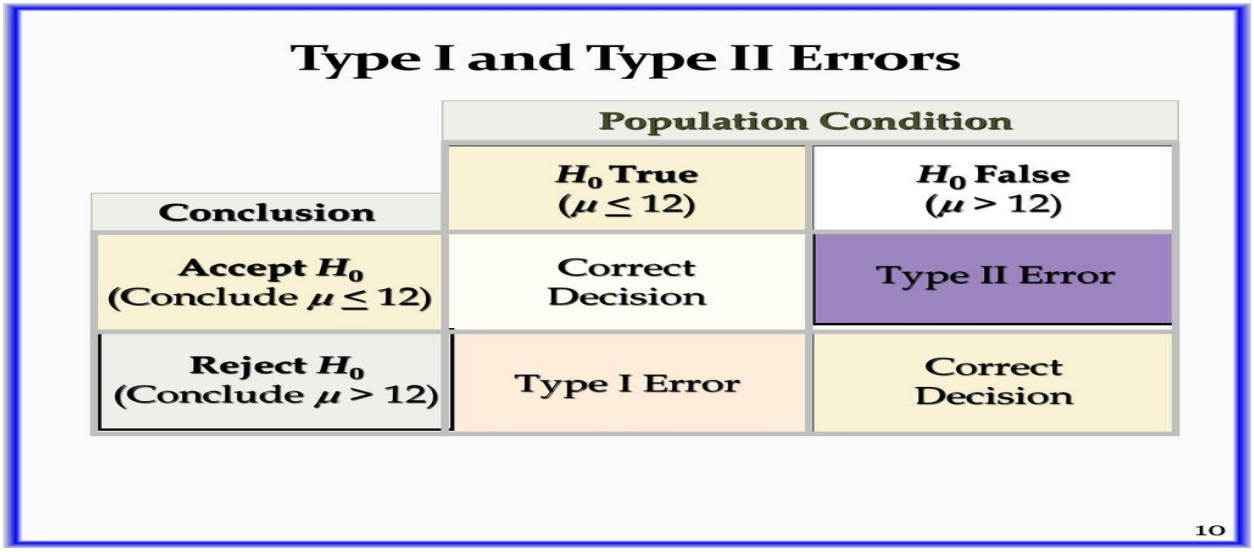

The probability of Type I error is usually determined in advance and is understood as the level of significance of testing the hypothesis. If type I error is fixed at 5 per cent, it means that there are about 5 chances in 100 that we will reject *H*0 when *H*0 is true. We can control Type I error just by fixing it at a lower level. For instance, if we fix it at 1 per cent, we will say that the maximum probability of committing Type I error would only be 0.01. But with a fixed sample size, *n*, when we try to reduce Type I error, the probability of committing Type II error increases. Both types of errors cannot be reduced simultaneously.

There is a trade-off between two types of errors which means that the probability of making one type of error can only be reduced if we are willing to increase the probability of making the other type of error. To deal with this trade-off in business situations, decision-makers decide the appropriate level of Type I error by examining the costs or penalties attached to both types of errors. If Type I error involves the time and trouble of reworking a batch of chemicals that should have been accepted, whereas Type II error means taking a chance that an entire group of users of this chemical compound will be poisoned, then in such a situation one should prefer a Type I error to a Type II error. As a result, one must set very high level for Type I error in one's testing technique of a given hypothesis.2 Hence, in the testing of hypothesis, one must make all possible effort to strike an adequate balance between Type I and Type II errors.

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UNIT-II: RESEARCH DESIGN AND SAMPLING METHODOLOGY

Meaning of and need for research design – Various types of research Design - Nature of sampling. Probability and Non-Probability sampling methods - Steps in sample design - Sample size determination and approaches.

Research Design

A Research Design is the logical and systematic planning in directing the research. The design research from translating a general scientific model into varied research problem. But in practices in most of the basis it is just a plan of study. The research design can either be formal or informal.

Definition

1. "It constitutes the blue print for the collection, measurement and analysis of data" - Philips Bernard S

2. It "provides a systematic plan of procedure for the researcher to follow" -Best John N

3. "The design research from controlling general scientific model into varied research procedure"- P.V. Young

4. "A research design is "the programme that guides the investigator in the process of collecting, analysis and interpreting observations". – David and Shava

A research design addresser itself to certain key issues such as:

a) What is the problem under study?

b) What is the major research question?

c) What is the area of the study?

d) How many people will be study?

e) How this people will be selected?

f) What methods and techniques will be used to collect data from them?

Features of Research Design

a) It is a plan that specifies the objectives of study and the hypothesis to be tested.

b) It is an outline that specifies the sources and types of information relevant to the research question.

c) It is a blueprint specifying the methods to be adopted for gathering and analysis of data.

d) It is a scheme defining the procedure involved in a research process.

Features of a good Design

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A good design has the following features.

1. Flexibility
2. Efficiency
3. Appropriate
4. Economical
5. Minimum error
6. Maximum reliability
7. Smallest experimental error
8. Maximum information

Why a Research Design?

A Research without a pre-drawn plan is like an ocean voyage without mariner's campus

1. Research Design is needed because it helps in the smooth sailing of Research operations.
2. The Research Design helps in providing direction our study.
3. It prevents welter in a study.
4. The use of Research Design prevents blind search.
5. A Research Design fixes clear cut boundary to a research.
6. It makes the research systematic
7. It help us to meet unexpected events.

Contents of a Research Design

Usually a Research Design consist of the following details

1. What is the study about?
2. Why is the study being made?
3. Where will the study be carried out?
4. What type of data is required?
5. Where can the required data be found?
6. What period of time will the studied include?
7. What will be the sample design?

8. What technique of data collection will be used?

9. How will the data we analyse?

10. In what style the report will be prepared?

By way of conclusion it can be said that research design must contain at least:

a) Statement of a problem

b) Procedure and techniques

c) Sampling frame

d) Processing and analysis of data.

Need and Importance of good Research design

The Importance of good Research design is needed because it facilitates the smooth sailing of the various research operations, thereby making research as efficient as possible yielding maximal information with minimal expenditure of effort, time and money. Just as for better, economical and attractive construction of a house, we need a blueprint (or what is commonly called the map of the house) well thought out and prepared by an expert architect, similarly we need a research design or a plan in advance of data collection and analysis for our research project. Research design stands for advance planning of the methods to be adopted for collecting the relevant data and the techniques to be used in their analysis, keeping in view the objective of the research and the availability of staff, time and money. Preparation of the research design should be done with great care as any error in it may upset the entire project. Research design, in fact, has a great bearing on the reliability of the results arrived at and as such constitutes the firm foundation of the entire edifice of the research work.

Even then the need for a well thought out research design is at times not realised by many. The importance which this problem deserves is not given to it. As a result, many researches do not serve the purpose for which they are undertaken. In fact, they may even give misleading conclusions. Thoughtlessness in designing the research project may result in rendering the research exercise futile. It is, therefore, imperative that an efficient and appropriate design must be prepared before starting research operations. The design helps the researcher to organize his ideas in a form whereby it will be possible for him to look for flaws and inadequacies. Such a design can even be given to others for their comments and critical evaluation. In the absence of such a course of action, it will be difficult for the critic to provide a comprehensive review of the proposed study.

Various types of research Design

Different research designs can be conveniently described if we categorize them as:

(1) research design in case of exploratory research studies;

(2) research design in case of descriptive and diagnostic research studies, and

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(3) research design in case of hypothesis-testing research studies.

1. Research design in case of exploratory research studies:

Exploratory research studies are also termed as formulative research studies. The main purpose of such studies is that of formulating a problem for more precise investigation or of developing the working hypotheses from an operational point of view. The major emphasis in such studies is on the discovery of ideas and insights. As such the research design appropriate for such studies must be flexible enough to provide opportunity for considering different aspects of a problem under study. Inbuilt flexibility in research design is needed because the research problem, broadly defined initially, is transformed into one with more precise meaning in exploratory studies, which fact may necessitate changes in the research procedure for gathering relevant data.

Generally, the following three methods in the context of research design for such studies are talked about:

(a) the survey of concerning literature;

(b) the experience survey and

(c) the analysis of 'insight-stimulating' examples.

The survey of concerning literature happens to be the most simple and fruitful method of formulating precisely the research problem or developing hypothesis. Hypotheses stated by earlier workers may be reviewed and their usefulness be evaluated as a basis for further research. It may also be considered whether the already stated hypotheses suggest new hypothesis. In this way the researcher should review and build upon the work already done by others, but in cases where hypotheses have not yet been formulated, his task is to review the available material for deriving the relevant hypotheses from it. Besides, the bibliographical survey of studies, already made in one's area of interest may as well as made by the researcher for precisely formulating the problem. He should also make an attempt to apply concepts and theories developed in different research contexts to the area in which he is himself working. Sometimes the works of creative writers also provide a fertile ground for hypothesis formulation and as such may be looked into by the researcher.

Experience survey means the survey of people who have had practical experience with the problem to be studied. The object of such a survey is to obtain insight into the relationships between variables and new ideas relating to the research problem. For such a survey people who are competent and can contribute new ideas may be carefully selected as respondents to ensure a representation of different types of experience. The respondents so selected may then be interviewed by the investigator. The researcher must prepare an interview schedule for the systematic questioning of informants. But the interview must ensure flexibility in the sense that the respondents should be allowed to raise issues and questions which the investigator has not previously considered. Generally, the experience collecting interview is likely to be long and may last for few hours. Hence, it is often considered desirable to send a copy of the questions to be

discussed to the respondents well in advance. This will also give an opportunity to the respondents for doing some advance thinking over the various issues involved so that, at the time of interview, they may be able to contribute effectively. Thus, an experience survey may enable the researcher to define the problem more concisely and help in the formulation of the research hypothesis. This survey may as well provide information about the practical possibilities for doing different types of research.

Analysis of 'insight-stimulating' examples is also a fruitful method for suggesting hypotheses for research. It is particularly suitable in areas where there is little experience to serve as a guide. This method consists of the intensive study of selected instances of the phenomenon in which one is interested. For this purpose, the existing records, if any, may be examined, the unstructured interviewing may take place, or some other approach may be adopted. Attitude of the investigator, the intensity of the study and the ability of the researcher to draw together diverse information into a unified interpretation are the main features which make this method an appropriate procedure for evoking insights.

Research design in case of descriptive and diagnostic research studies: Descriptive research studies are those studies which are concerned with describing the characteristics of a particular individual, or of a group, whereas diagnostic research studies determine the frequency with which something occurs or its association with something else. The studies concerning whether certain variables are associated are examples of diagnostic research studies. As against this, studies concerned with specific predictions, with narration of facts and characteristics concerning individual, group or situation are all examples of descriptive research studies. Most of the social research comes under this category.

From the point of view of the research design, the descriptive as well as diagnostic studies share common requirements and as such, we may group together these two types of research studies. In descriptive as well as in diagnostic studies, the researcher must be able to define clearly, what he wants to measure and must find adequate methods for measuring it along with a clear-cut definition of 'population' he wants to study. Since the aim is to obtain complete and accurate information in the said studies, the procedure to be used must be carefully planned. The research design must make enough provision for protection against bias and must maximise reliability, with due concern for the economical completion of the research study. The design in such studies must be rigid and not flexible and must focus attention on the following:

(a) Formulating the objective of the study (what the study is about and why is it being made?)

(b) Designing the methods of data collection (what techniques of gathering data will be adopted?)

(c) Selecting the sample (how much material will be needed?)

(d) Collecting the data (where can the required data be found and with what time period should the data be related?)

(e) Processing and analysing the data.

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(f) Reporting the findings.

Research design in case of hypothesis-testing research studies: Hypothesis-testing research studies (generally known as experimental studies) are those where the researcher tests the hypotheses of causal relationships between variables. Such studies require procedures that will not only reduce bias and increase reliability, but will permit drawing inferences about causality. Usually experiments meet this requirement. Hence, when we talk of research design in such studies, we often mean the design of experiments.

BASIC PRINCIPLES OF EXPERIMENTAL DESIGNS

Three basic principle of experimental designs-

(1) The principle of replication

(2) The principle of randomization

(3) Principle of local control.

The principle of replication-the experiment should be repeated more than once. The statistical accuracy of the experiments is increased. For example, if an experiment requiring a two -way analysis, it will then require a three-way analysis of variance since replication itself may be a source of variation in the data.

The principle of randomization-design or plan the experiment that the variations caused by extraneous factors. For example, if we grow one variety of rice, in the first half of the parts of a field and the other variety is grown in the other half, when it is possible that the soil fertility may be different in first half in comparison to the other half. If this is so, our results would not be realistic.in such a situation, we may assign the variety of rice to be grown in different parts of the fields on the basis of some random sampling technique then we may apply randomization principle and protect ourselves against the effects of the extraneous factors. The principle of randomization has a better estimate of the experimental error.

The principle of local control-plan the experiment for performing a two-way analysis of variance. For example, first divide the field into several homogeneous parts, known as blocks. Then each block is divided into parts equal to the number of treatments. Then the treatments are randomly assigned to these parts of a block. The principle of local control can eliminate the variability due to extraneous factors from the experimental error.

IMPORTANT EXPERIMENTAL DESIGNS

(A)Informal experimental designs.

(1) Before and after without control design.

(2) After only with control design.

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(3) Before and after with control design.

(B)Formal experimental designs.

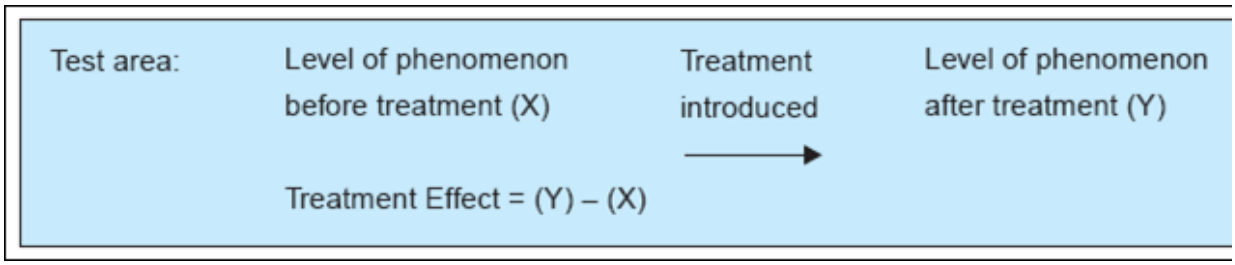
(1) Completely randomized design (C.R. Design).

(2) Randomized block design (R.B. Design).

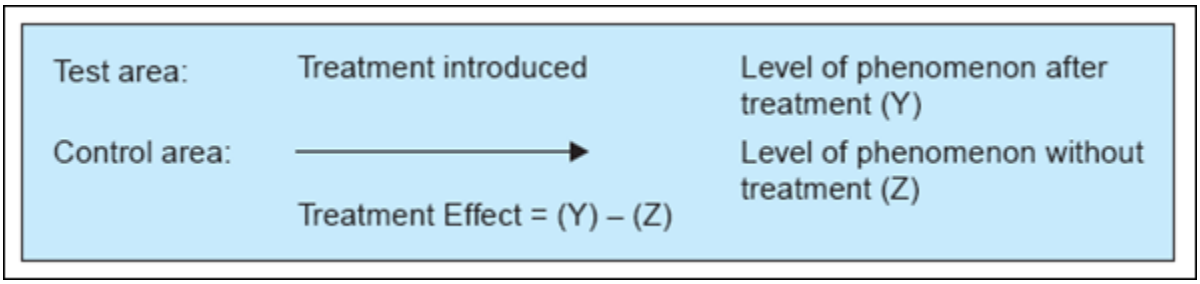
(3) Latin square design (L.S. Design).

(4) Factorial design).

1.Before-and-after without control design-A single test group or area is selected and the dependent variable is measured. The treatment is then introduced and then the dependent variable is measured again. the effect of the treatment: the level of the phenomenon after the treatment-the level of the phenomenon before the treatment.



2.After-only with control design-Two groups or areas (test area and control area) are selected and the treatment is introduced into the test area only.



3.Before-and-after with control design-

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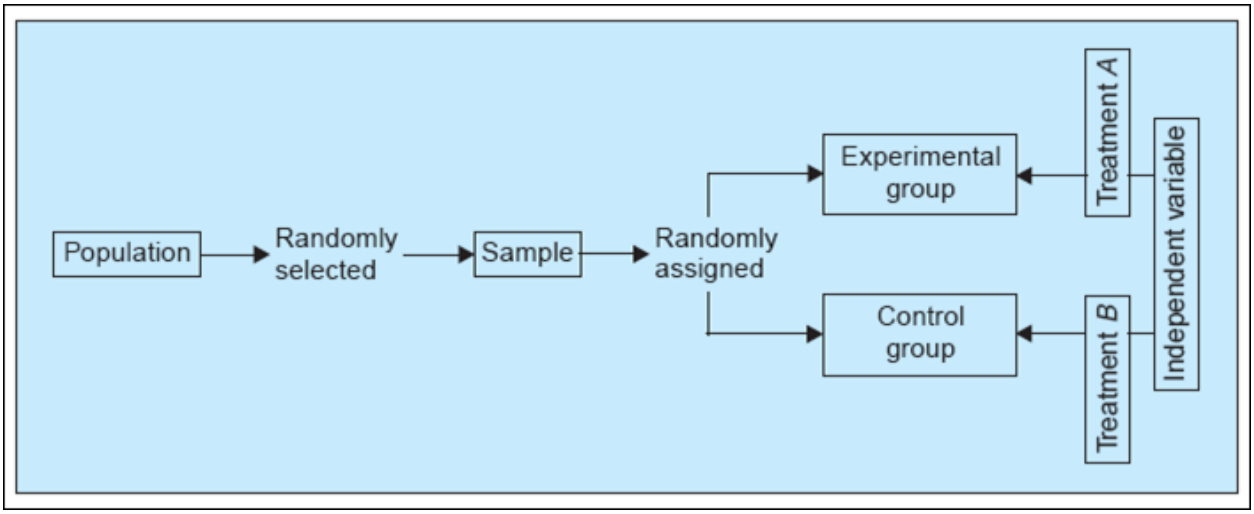
	Time Period I		Time Period II
Test area:	Level of phenomenon before treatment (X)	Treatment introduced →	Level of phenomenon after treatment (Y)
Control area:	Level of phenomenon without treatment (A)		Level of phenomenon without treatment (Z)

Treatment Effect = (Y – X) – (Z – A)

4.Completely randomized design (C.R.Design)

(a)Two-group simple randomized design



5.Randomized block design(R.B.Design)

	Very low I.Q.	Low I.Q.	Average I.Q.	High I.Q.	Very high I.Q.
	Student A	Student B	Student C	Student D	Student E
Form 1	82	67	57	71	73
Form 2	90	68	54	70	81
Form 3	86	73	51	69	84
Form 4	93	77	60	65	71

6.Latin square design (L.S.Design)

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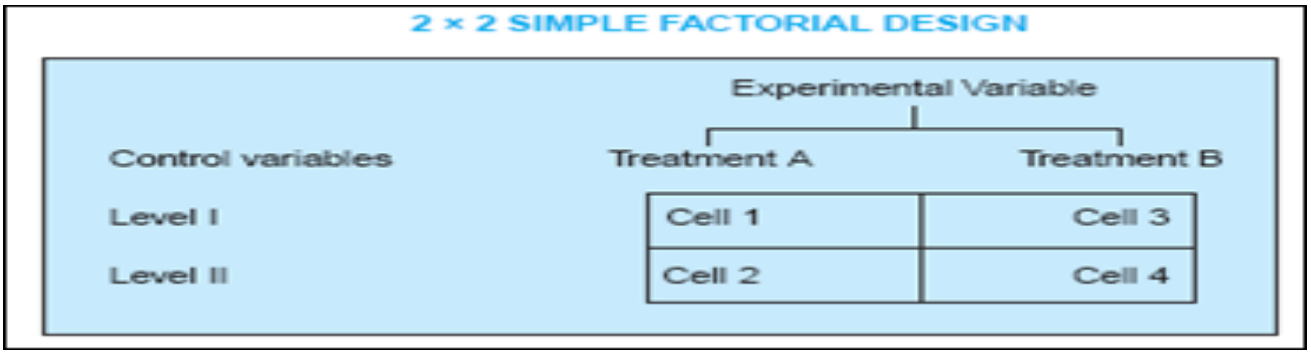
An experiment design very frequently used in agricultural research

Seeds differences	FERTILITY LEVEL I	II	III	IV	V
X_1	A	B	C	D	E
X_2	B	C	D	E	A
X_3	C	D	E	A	B
X_4	D	E	A	B	C
X_5	E	A	B	C	D

7.Factorial designs-Where the effects of varying more than one factor are to be determined. This is important in several economic and social phenomena. factorial designs can be two types:

(a) simple factorial designs

(b) complex factorial designs.



Factorial designs are used mainly because of the two advantages-

(1) provide equivalent accuracy.

(2) permit various other comparisons of interest.

SAMPLING DESIGN

CENSUS AND SAMPLE SURVEY

All items in any field of inquiry constitute a 'Universe' or 'Population.' A complete enumeration of all items in the 'population' is known as a census inquiry. It can be presumed that in such an inquiry, when all items are covered, no element of chance is left and highest accuracy is obtained. But in practice this may not be true.

Besides, this type of inquiry involves a great deal of time, money and energy. Therefore, when the field of inquiry is large, this method becomes difficult to adopt because of the resources involved.

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At times, this method is practically beyond the reach of ordinary researchers. Perhaps, government is the only institution which can get the complete enumeration carried out. Even the government adopts this in very rare cases such as population census conducted once in a decade. Further, many a time it is not possible to examine every item in the population, and sometimes it is possible to obtain sufficiently accurate results by studying only a part of total population. In such cases there is no utility of census surveys.

However, it needs to be emphasised that when the universe is a small one, it is no use resorting to a sample survey. When field studies are undertaken in practical life, considerations of time and cost almost invariably lead to a selection of respondents i.e., selection of only a few items. The respondents selected should be as representative of the total population as possible in order to produce a miniature cross-section. The selected respondents constitute what is technically called a 'sample' and the selection process is called 'sampling technique.' The survey so conducted is known as 'sample survey'.

IMPLICATIONS OF A SAMPLE DESIGN

A sample design is a definite plan for obtaining a sample from a given population. It refers to the technique or the procedure the researcher would adopt in selecting items for the sample. Sample design may as well lay down the number of items to be included in the sample i.e., the size of the sample. Sample design is determined before data are collected. There are many sample designs from which a researcher can choose. Some designs are relatively more precise and easier to apply than others. Researcher must select/prepare a sample design which should be reliable and appropriate for his research study.

Needs of sampling in Research Methodology

Sampling is used in practice for a variety of reasons such as:

1. Sampling can save time and money. A sample study is usually less expensive than a census study and produces results at a relatively faster speed.
2. Sampling may enable more accurate measurements for a sample study is generally conducted by trained and experienced investigators.
3. Sampling remains the only way when population contains infinitely many members.
4. Sampling remains the only choice when a test involves the destruction of the item under study.
5. Sampling usually enables to estimate the sampling errors and, thus, assists in obtaining information concerning some characteristic of the population.

STEPS IN SAMPLE DESIGN

While developing a sampling design, the researcher must pay attention to the following points:

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(i) **Type of universe:** The first step in developing any sample design is to clearly define the set of objects, technically called the Universe, to be studied. The universe can be finite or infinite. In finite universe the number of items is certain, but in case of an infinite universe the number of items is infinite, i.e., we cannot have any idea about the total number of items. The population of a city, the number of workers in a factory and the like are examples of finite universes, whereas the number of stars in the sky, listeners of a specific radio programme, throwing of a dice etc. are examples of infinite universes.

(ii) **Sampling unit:** A decision has to be taken concerning a sampling unit before selecting sample. Sampling unit may be a geographical one such as state, district, village, etc., or a construction unit such as house, flat, etc., or it may be a social unit such as family, club, school, etc., or it may be an individual. The researcher will have to decide one or more of such units that he has to select for his study.

(iii) **Source list:** It is also known as 'sampling frame' from which sample is to be drawn. It contains the names of all items of a universe (in case of finite universe only). If source list is not available, researcher has to prepare it. Such a list should be comprehensive, correct, reliable and appropriate. It is extremely important for the source list to be as representative of the population as possible.

(iv) **Size of sample:** This refers to the number of items to be selected from the universe to constitute a sample. This a major problem before a researcher. The size of sample should neither be excessively large, nor too small. It should be optimum. An optimum sample is one which fulfils the requirements of efficiency, representativeness, reliability and flexibility.

(v) **Parameters of interest:** In determining the sample design, one must consider the question of the specific population parameters which are of interest. For instance, we may be interested in estimating the proportion of persons with some characteristic in the population, or we may be interested in knowing some average or the other measure concerning the population. There may also be important sub-groups in the population about whom we would like to make estimates. All this has a strong impact upon the sample design we would accept.

(vi) **Budgetary constraint:** Cost considerations, from practical point of view, have a major impact upon decisions relating to not only the size of the sample but also to the type of sample. This fact can even lead to the use of a non-probability sample.

(vii) **Sampling procedure:** Finally, the researcher must decide the type of sample he will use i.e., he must decide about the technique to be used in selecting the items for the sample. In fact, this technique or procedure stands for the sample design itself. There are several sample designs (explained in the pages that follow) out of which the researcher must choose one for his study. Obviously, he must select that design which, for a given sample size and for a given cost, has a smaller sampling error.

Characteristics of A Good Sample Design:

The following are the characteristic features of a good sample design:

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a. The sample design should yield a truly representative sample;

b. The sample design should be such that it results in small sampling error;

c. The sample design should be viable in the context of budgetary constraints of the research study;

d. The sample design should be such that the systematic bias can be controlled; and

e. The sample must be such that the results of the sample study would be applicable, in general, to the universe at a reasonable level of confidence.

CRITERIA OF SELECTING A SAMPLING PROCEDURE

In this context one must remember that two costs are involved in a sampling analysis viz., the cost of collecting the data and the cost of an incorrect inference resulting from the data. Researcher must keep in view the two causes of incorrect inferences viz., systematic bias and sampling error. A *systematic bias* result from errors in the sampling procedures, and it cannot be reduced or eliminated by increasing the sample size. At best the causes responsible for these errors can be detected and corrected. Usually a systematic bias is the result of one or more of the following factors:

1. Inappropriate sampling frame: If the sampling frame is inappropriate i.e., a biased representation of the universe, it will result in a systematic bias.

2. Defective measuring device: If the measuring device is constantly in error, it will result in systematic bias. In survey work, systematic bias can result if the questionnaire or the interviewer is biased. Similarly, if the physical measuring device is defective there will be systematic bias in the data collected through such a measuring device.

3. Non-respondents: If we are unable to sample all the individuals initially included in the sample, there may arise a systematic bias. The reason is that in such a situation the likelihood of establishing contact or receiving a response from an individual is often correlated with the measure of what is to be estimated.

4. Indeterminacy principle: Sometimes we find that individuals act differently when kept under observation than what they do when kept in non-observed situations. For instance, if workers are aware that somebody is observing them in course of a work study on the basis of which the average length of time to complete a task will be determined and accordingly the quota will be set for piece work, they generally tend to work slowly in comparison to the speed with which they work if kept unobserved. Thus, the indeterminacy principle may also be a cause of a systematic bias.

5. Natural bias in the reporting of data: Natural bias of respondents in the reporting of data is often the cause of a systematic bias in many inquiries. There is usually a downward bias in the income data collected by government taxation department, whereas we find an upward bias in the income data collected by some social organisation. People in general understate their incomes if asked about it for tax purposes, but they overstate the same if asked for social status or their

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affluence. Generally, in psychological surveys, people tend to give what they think is the 'correct' answer rather than revealing their true feelings.

DIFFERENT TYPES OF SAMPLE DESIGNS

There are different types of sample designs based on two factors viz., the representation basis and the element selection technique. On the representation basis, the sample may be probability sampling or it may be non-probability sampling. Probability sampling is based on the concept of random selection, whereas non-probability sampling is 'non-random' sampling. On element selection basis, the sample may be either unrestricted or restricted. When each sample element is drawn individually from the population at large, then the sample so drawn is known as 'unrestricted sample', whereas all other forms of sampling are covered under the term 'restricted sampling'. The following chart exhibits the sample designs as explained above.

Thus, sample designs are basically of two types viz., non-probability sampling and probability sampling. We take up these two designs separately.

Figure 3 ***Chart Showing Basic Sampling Designs***

Element selection technique	Representation basis: Probability sampling	Representation basis: Non-probability sampling
Unrestricted sampling	Simple random sampling	Haphazard sampling or convenience sampling
Restricted sampling	Complex random sampling (such as cluster sampling, systematic sampling, stratified sampling etc.)	Purposive sampling (such as quota sampling, judgement sampling)

Non-probability sampling: Non-probability sampling is that sampling procedure which does not afford any basis for estimating the probability that each item in the population has of being included in the sample. Non-probability sampling is also known by different names such as deliberate sampling, purposive sampling and judgement sampling. In this type of sampling, items for the sample are selected deliberately by the researcher; his choice concerning the items remains supreme. In other words, under non-probability sampling the organisers of the inquiry purposively choose the particular units of the universe for constituting a sample on the basis that the small mass that they so select out of a huge one will be typical or representative of the whole. For instance, if economic conditions of people living in a state are to be studied, a few towns and villages may be purposively selected for intensive study on the principle that they can be representative of the entire state. Thus, the judgement of the organisers of the study plays an important part in this sampling design.

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Probability sampling: Probability sampling is also known as 'random sampling' or 'chance sampling'. Under this sampling design, every item of the universe has an equal chance of inclusion in the sample. It is, so to say, a lottery method in which individual units are picked up from the whole group not deliberately but by some mechanical process. Here it is blind chance alone that determines whether one item or the other is selected. The results obtained from probability or random sampling can be assured in terms of probability i.e., we can measure the errors of estimation or the significance of results obtained from a random sample, and this fact brings out the superiority of random sampling design over the deliberate sampling design. Random sampling ensures the law of Statistical Regularity which states that if on an average the sample chosen is a random one, the sample will have the same composition and characteristics as the universe. This is the reason why random sampling is considered as the best technique of selecting a representative sample.

In such a design, personal element has a great chance of entering into the selection of the sample. The investigator may select a sample which shall yield results favourable to his point of view and if that happens, the entire inquiry may get vitiated. Thus, there is always the danger of bias entering into this type of sampling technique. But in the investigators are impartial, work without bias and have the necessary experience so as to take sound judgement, the results obtained from an analysis of deliberately selected sample may be tolerably reliable. However, in such a sampling, there is no assurance that every element has some specifiable chance of being included. Sampling error in this type of sampling cannot be estimated and the element of bias, great or small, is always there. As such this sampling design in rarely adopted in large inquires of importance. However, in small inquiries and researches by individuals, this design may be adopted because of the relative advantage of time and money inherent in this method of sampling. *Quota sampling* is also an example of non-probability sampling. Under quota sampling the interviewers are simply given quotas to be filled from the different strata, with some restrictions on how they are to be filled. In other words, the actual selection of the items for the sample is left to the interviewer's discretion. This type of sampling is very convenient and is relatively inexpensive. But the samples so selected certainly do not possess the characteristic of random samples. Quota samples are essentially judgement samples and inferences drawn on their basis are not amenable to statistical treatment in a formal way.

Purposive or Judgmental Sample

A purposive or judgmental sample is one that is selected based on the knowledge of a population and the purpose of the study. For example, when sociologists at the University of San Francisco wanted to study the long-term emotional and psychological effects of choosing to terminate a pregnancy, they created a sample that exclusively included women who had had abortions. In this case, the researchers used a purposive sample because those being interviewed fit a specific purpose or description that was necessary to conduct the research.

Snowball Sample

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A snowball sample is appropriate to use in research when the members of a population are difficult to locate, such as homeless individuals, migrant workers, or undocumented immigrants. A snowball sample is one in which the researcher collects data on the few members of the target population he or she can locate, then asks those individuals to provide information needed to locate other members of that population whom they know.

For example, if a researcher wishes to interview undocumented immigrants from Mexico, she might interview a few undocumented individuals that she knows or can locate, and would then rely on those subjects to help locate more undocumented individuals. This process continues until the researcher has all the interviews she needs, or until all contacts have been exhausted.

This is a technique that is useful when studying a sensitive topic that people might not openly talk about, or if talking about the issues under investigation could jeopardize their safety. A recommendation from a friend or acquaintance that the researcher can be trusted works to grow the sample size.

Quota Sample

A quota sample is one in which units are selected into a sample on the basis of pre-specified characteristics so that the total sample has the same distribution of characteristics assumed to exist in the population being studied.

For example, if you are a researcher conducting a national quota sample, you might need to know what proportion of the population is male and what proportion is female, as well as what proportions of members of each gender fall into different age categories, race or ethnic categories, and educational categories, among others. The researcher would then collect a sample with the same proportions as the national population.

Probability Sampling Techniques

Probability sampling is a technique wherein the samples are gathered in a process that gives all the individuals in the population equal chance of being selected. Many consider this to be the more methodologically rigorous approach to sampling because it eliminates social biases that could shape the research sample. Ultimately, though, the sampling technique you choose should be the one that best allows you to respond to your particular research question.

Simple Random Sample

The simple random sample is the basic sampling method assumed in statistical methods and computations. To collect a simple random sample, each unit of the target population is assigned a number. A set of random numbers is then generated and the units having those numbers are included in the sample.

For example, let's say you have a population of 1,000 people and you wish to choose a simple random sample of 50 people. First, each person is numbered 1 through 1,000. Then, you generate

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a list of 50 random numbers--typically with a computer program--and the individuals assigned those numbers are the ones you include in the sample.

When studying people, this technique is best used with a homogenous population--one that does not differ much by age, race, education level, or class--because, with a heterogeneous population, one runs the risk of creating a biased sample if demographic differences are not taken into account.

Systematic Sample

In a systematic sample, the elements of the population are put into a list and then every *n*th element in the list is chosen systematically for inclusion in the sample.

For example, if the population of study contained 2,000 students at a high school and the researcher wanted a sample of 100 students, the students would be put into list form and then every 20th student would be selected for inclusion in the sample. To ensure against any possible human bias in this method, the researcher should select the first individual at random. This is technically called a systematic sample with a random start.

Stratified Sample

A stratified sample is a sampling technique in which the researcher divides the entire target population into different subgroups or strata, and then randomly selects the final subjects proportionally from the different strata. This type of sampling is used when the researcher wants to highlight specific subgroups within the population.

For example, to obtain a stratified sample of university students, the researcher would first organize the population by college class and then select appropriate numbers of freshmen, sophomores, juniors, and seniors. This would ensure that the researcher has adequate amounts of subjects from each class in the final sample.

Cluster Sample

Cluster sampling may be used when it is either impossible or impractical to compile an exhaustive list of the elements that make up the target population. Usually, however, the population elements are already grouped into subpopulations and lists of those subpopulations already exist or can be created.

For example, let's say the target population in a study was church members in the United States. There is no list of all church members in the country. The researcher could, however, create a list of churches in the United States, choose a sample of churches, and then obtain lists of members from those churches.

Area sampling

If clusters happen to be some geographic subdivisions, in that case cluster sampling is better known as area sampling. In other words, cluster designs, where the primary sampling unit represents a

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cluster of units based on geographic area, are distinguished as area sampling. The plus and minus points of cluster sampling are also applicable to area sampling.

Multi-stage sampling

Multi-stage sampling is a further development of the principle of cluster sampling. Suppose we want to investigate the working efficiency of nationalised banks in India and we want to take a sample of few banks for this purpose. The first stage is to select large primary sampling unit such as states in a country. Then we may select certain districts and interview all banks in the chosen districts. This would represent a two-stage sampling design with the ultimate sampling units being clusters of districts.

Sample Size Determination and Approaches

In sampling analysis, the most ticklish question is: What should be the size of the sample or how large or small should be '*n*'? If the sample size ('*n*') is too small, it may not serve to achieve the objectives and if it is too large, we may incur huge cost and waste resources.

As a general rule, one can say that the sample must be of an optimum size i.e., it should neither be excessively large nor too small. Technically, the sample size should be large enough to give a confidence interval of desired width and as such the size of the sample must be chosen by some logical process before sample is taken from the universe. Size of the sample should be determined by a researcher keeping in view the following points:

(i) *Nature of universe:* Universe may be either homogenous or heterogenous in nature. If the items of the universe are homogenous, a small sample can serve the purpose. But if the items are heterogenous, a large sample would be required. Technically, this can be termed as the dispersion factor.

(ii) *Number of classes proposed:* If many class-groups (groups and sub-groups) are to be formed, a large sample would be required because a small sample might not be able to give a reasonable number of items in each class-group.

(iii) *Nature of study:* If items are to be intensively and continuously studied, the sample should be small. For a general survey the size of the sample should be large, but a small sample is considered appropriate in technical surveys.

(iv) *Type of sampling:* Sampling technique plays an important part in determining the size of the sample. A small random sample is apt to be much superior to a larger but badly selected sample.

(v) *Standard of accuracy and acceptable confidence level:* If the standard of accuracy or the level of precision is to be kept high, we shall require relatively larger sample. For doubling the accuracy for a fixed significance level, the sample size has to be increased fourfold.

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(vi) *Availability of finance:* In practice, size of the sample depends upon the amount of money available for the study purposes. This factor should be kept in view while determining the size of sample for large samples result in increasing the cost of sampling estimates.

(vii) *Other considerations:* Nature of units, size of the population, size of questionnaire, availability of trained investigators, the conditions under which the sample is being conducted, the time available for completion of the study are a few other considerations to which a researcher must pay attention while selecting the size of the sample.

There are two alternative approaches for determining the size of the sample. The first approach is "**to specify the precision of estimation** desired and then to determine the sample size necessary to insure it" and the second approach "**uses Bayesian statistics** to weigh the cost of additional information against the expected value of the additional information."

The first approach is capable of giving a mathematical solution, and as such is a frequently used technique of determining '*n*'. The limitation of this technique is that it does not analyse the cost of gathering information *vis-a-vis* the expected value of information.

The second approach is theoretically optimal, but it is seldom used because of the difficulty involved in measuring the value of information. Hence, we shall mainly concentrate here on the first approach.

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UNIT-III: MEASURMENT AND SCALING TECHNIQUES

Nature of measurement and scaling- Measurement scales - Scaling Techniques - Constructing, Drafting and refining the questionnaires.

NATURE OF MEASUREMENT AND SCALING

A manager of an organization has to take many management related decisions in his day-to-day life. The decisions may relate to the manufacturing or marketing of products, hiring or firing of employees, and so on. Some of these decisions depend on the' quantitative data for which the units of measurement can be subjected to a statistical analysis. However, there are decisions, which depend on behavioural data, which is not suitable for direct statistical analysis. Thus, for management purposes the manager has to measure physical objects as well as abstract concepts.

Measurement is a relatively difficult when it concerns qualitative or abstract phenomena, Measurement may be defined as the process of assigning numbers to objects or observations, the level of measurement being a function of the rules under which the numbers are assigned.

In technical terms, measurement is a process of mapping aspects of a domain onto other aspects of a range according to some rule of correspondence. It is easy to assign numbers in respect of characteristics of some objects, but it is relatively difficult in respect of others. For instance, measuring things like social conformity, intelligence, or marital adjustment is very difficult and requires much closer attention than measuring physical weight, biological age or a person's financial assets. In other words, the quantitative characteristics like weight, height etc., can be measured directly with some standard unit of measurement, but it is not that easy to measure properties like motivation to succeed, ability to stand stress and the like.

Measurement scales

In the process of measurement, one has to devise some form of scale in the range and, then map the properties of objects from the domain onto this scale. The scales of measurement can be considered in terms of their mathematical properties. The primary scales of measurement are:

(a) Nominal Scale

(b) Ordinal Scale

(c) Interval Scale

(d) Ratio Scale

Nominal Scale

Nominal scale is simply a system of assigning numbers or symbols to events in order to label them. These numbers are just convenient labels for the particular class of events and as such have no quantitative value. Thus, the nominal scale simply allows the categorization of responses into a number of mutually exclusive categories.

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The typical applications of nominal scale are in classification of responses by a social class, like or dislike, yes or no, male or female and so on. The counting of members in each group is the only possible arithmetic operation when a nominal scale is employed. Accordingly, we are restricted to use mode as the measure of central tendency. There is no generally used measure of dispersion for nominal scales. Chi--square test is the most common test of statistical significance of association and for the measures of correlation we calculate the contingency coefficient.

Nominal scale is the least powerful level of measurement. It indicates no order or distance relationship and has no arithmetic origin. A nominal scale simply describes differences between units by assigning them to categories. In spite their limitations, nominal scales are very useful and widely used in surveys when data are being classified by major sub-groups of the population.

Ordinal scale

The ordinal scale allows the respondents to rank some alternatives by some common characteristics. It simply places events in order, but there is no attempt to make the intervals of the scale equal in terms of some rule. Rank orders represent ordinal scales and are frequently used in research relating to qualitative phenomena.

Ordinal measures have no absolute values, and the real differences between adjacent ranks may not be equal. All that can be said is that one person is higher or lower on the scale than another, but more precise comparisons cannot be made. Thus, the use of an ordinal scale implies a statement of' greater than' or 'less than'. However, the magnitude of difference in ranks cannot be determined.

Since the numbers of this scale have only a rank meaning, the appropriate measure of central tendency is the positional average i.e. median. A measure of dispersion can be based on the percentiles or quartiles of the distribution. Correlations are restricted to various rank order methods. Statistical significance is tested through the use of non-parametric methods.

Interval scale

In the case of interval scale, the intervals are adjusted in terms of some rule that has been established as a basis for making the units equal. Interval scales can have an arbitrary zero point with numbers placed at equally appearing intervals. Interval scale takes care of the limitations of the nominal and the ordinal scales. Interval scale also incorporates the concept of equality of interval and so provides more powerful measurement than ordinal scales.

A number of mathematical and statistical operations in including addition, subtractions and computations of the mean can be performed on the internally-scaled data. Mean is the appropriate measure of central tendency, while standard deviation is the most widely used measure of dispersion. The generally used tests for statistical significance are the' Z', 't' test and 'F'. Correlation is studied by the product moment correlation coefficient.

The primary limitation of the interval scale is the lack of an absolute or true zero of measurement. That is, it does not have the capacity to measure the complete absence of a characteristic.

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Ratio scale

Ratio scale has an absolute or true zero of measurements. It represents the actual amounts of variables. Measures of physical dimensions such as weight, height, distance etc. come under this category. In general, all statistical techniques are applicable with ratio scales and all mathematical operations that one can carry out with real numbers can also be carried out with ratio scale values.

Multiplication and division can only be used with the ratio scale, but not with other scales. Geometric and harmonic means can be used as measures of central tendency and coefficients of variation may also be calculated.

Scaling

In research we quite often face measurement problem (since we want a valid measurement but may not obtain it), specially when the concepts to be measured are complex and abstract and we do not possess the standardised measurement tools. Alternatively, we can say that while measuring attitudes and opinions, we face the problem of their valid measurement. Similar problem may be faced by a researcher, of course in a lesser degree, while measuring physical or institutional concepts. As such we should study some procedures which may enable us to measure abstract concepts more accurately. This brings us to the study of scaling techniques.

While measuring attitudes and opinions, we face the problem of their valid measurement. Similar problems are faced while measuring physical and institutional concepts. Thus, we need procedures, which may enable us to measure abstract concepts more precisely. A scale is a continuum consisting of the highest point and lowest point along with several intermediate points between the extreme points. The scale-point positions are so related to each other that when the first point happens to be the highest point, the second point indicates a higher degree in terms of a given characteristics as compared to the third point and so on. Scaling describes the procedures of assigning numbers to various degrees of opinion, attitudes and other concepts. It may be defined as a ‘procedure for the assignment of numbers to a property of objects in order to impart some of the characteristics of numbers to the properties in questions.

Scaling can be done in the following two ways:

i) Making a judgment about some characteristic of an individual and then placing him directly on a scale that has been defined in terms of that characteristic.

ii) Constructing questionnaires in such a way that the score of individual’s responses assigns him a place on a scale.

SCALING TECHNIQUES

Scaling techniques are broadly classified as comparative and noncomparative. Comparative scales involve the direct measurement of stimulus objects and data have only ordinal or rank-order properties.

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These scales are further classified as paired comparisons, rank-order and Q-sort procedures. Main advantage of comparative scales is that they are easily understood, easy to apply and involve fewer theoretical assumptions. Non-comparative scaling is the most widely used scaling technique in marketing research. In non-comparative scales each object is scaled independently of the others and the resulting data generally have interval or ratio scales properties. Non-comparative scales include continuous rating and itemized rating scales. Itemized rating scales are further classified as Likert Type and Semantic Differential scales.

COMPARATIVE SCALING TECHNIQUES

The following scaling techniques are used to do a comparative study among different sets of variables.

Paired Comparisons

In this method the respondent can express his attitude by making a choice between two objects, say between Coke and Pepsi according to some criterion. In general, if there are 'n' stimuli to judge, the number of judgements required in a paired comparison is N= n (n–1)/2.

Paired comparison provides ordinal data, but the same may be converted into an interval scale by the method of the 'Law of Comparative Judgement' developed by L.L. Thurstone. This technique involves the conversion of frequencies of preferences into a table of proportions which are then transformed into Z matrix by referring to the table of area under the normal curve.

Rank Order Scaling

Rank order scaling is commonly used to measure preferences for brands as well as attributes. In rank order scaling respondents are presented with several objects simultaneously and asked to rank them according to some criterion. Ranks are obtained by asking the respondents to assign a rank of 1 to the most preferred brand, 2 to the second most preferred and so on until a rank n is assigned to the least preferred brand.

Q-Sort and Scaling

Q-Sort scaling discriminate among a relatively large number of objects quickly. This technique uses a rank-order procedure in which objects are sorted into piles based on similarity with respect to some criterion. For example, respondents are given 100 attitude statements on individual cards and asked to place them into 11 piles, ranging from "most highly agreed with" to "least agreed with". The number of objects to be placed in each pile is pre-specified, often to result in a roughly normal distribution of objects over the whole set.

NON-COMPARATIVE SCALES

In non-comparative scales each object is scaled independently of the others and the resulting data generally assumed to be interval or ratio scaled. Non-comparative scales include continuous rating and itemized rating scales. The rating scale gives a qualitative description of a number of

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characteristics of an individual. An object is judged in absolute terms against some specified criteria i.e. properties of objects judged without reference to other similar objects. The ratings may be in the forms as 'like. Dislike', 'above average, average, below average', or other classifications with more categories such as 'excellent- good- average- below average- poor', and so on. There is no specific rule whether to use a two-points scale, three-points scale or scale with still more points. Since more points on a scale provide an opportunity for greater sensitivity of measurement so in practice, three to seven points scales are generally used.

Rating scale are further classified as

a) Graphic rating scale

b) Itemized rating scale.

Graphic Rating Scale

It is a simple and commonly used scale. Under it, the various points are usually put along the line to form a continuum and the rater indicates his rating by simply making the appropriate point on a line that runs from one extreme to the other.

Itemized Rating Scales

The itemized rating scale also known as numerical scale, presents a series of statements from which a respondent selects one as best reflecting his evaluation. These statements are ordered progressively in terms of more or less of some property. The respondents are required to select the specified statement that best describes the object being rated.

Suppose, a manager wishes to inquire as to how well does a worker get along with his fellow workers? In such a situation, he may ask the respondent to select, one of the following statements to express his opinion:

i) He is almost always involved in some friction with a fellow worker.

ii) He is often at odds with one or more of his fellow workers.

iii) He sometimes gets involved in friction.

iv) He infrequently becomes involved in friction with others.

v) He almost never gels involved in friction with fellow workers.

Itemized rating scales are widely used in marketing research and form the basic components of more complex scales, such as multi-item rating scales. The commonly used itemized rating scales are the Likert and Semantic and differential scales.

SCALE CONSTRUCTION TECHNIQUES

While measuring attitudes of the people we generally follow the technique of preparing the attitude scale in such a way that the score of the individual responses assigns him a place on a scale. Under

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this approach, the respondent expresses his agreement or disagreement with a number of statements relevant to the issue. While developing such statements we take care that

a. the statements must illicit responses, which are psychologically related to the attitude being measured;

b. the statements need be such that they discriminate not only between extremes of attitude but also among individuals who differ slightly.

Arbitrary Scales

Arbitrary scales are developed on ad hoc basis and are designed largely through the researcher's own subjective selection of items. The researcher first collects few statements or items, which he believes are unambiguous and appropriate to a given topic. Some of these are selected for inclusion in the measuring instrument and then people are asked to check in a list the statements with which they agree.

Arbitrary scales can be developed very easily and quickly and are relatively less expensive. The primary limitation of arbitrary scales is that we do not have objective evidence that such scales measure the concepts for which they have been developed. We have simply to rely on researcher's insight and competence.

Thurstone Differential scale

Thurstone Differential Scales have been developed using consensus scale approach. Under such an approach the selection of items is made by a panel of judges who evaluate the items in terms of whether they are relevant to the topic area and unambiguous in implication.

Likert-type Scales (or Summated Scales)

The summated scales assume that the individual items in the scale are monotonically related to the underlying 'characteristics and summation of the item scores is related linearly to the attitude. The summated scales consist of a number of statements, which express either a favourable or unfavourable attitude towards the given object.

The respondent indicates his agreement or disagreement with each statement in the instrument. Each response is given a numerical score, indicating its favourableness or unfavourableness, and the scores are totalled to measure the respondent's attitude. The overall score represents the respondent's position on the continuum of favourable-unfavourableness towards an issue. For the statements implying negative attitudes, the scoring is reversed.

Most frequently used summated scales in the study of attitudes follow the pattern devised by Likert. For this reason, they are often referred to as Likert type scales. In a Likert scale, instead of having just agree and disagree in the scale we can have intensities varying from strongly agree to strongly disagree. For example, when a respondent is asked to express his opinion whether he considers his job quite pleasant the respondent may respond in any-one of the following ways:

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(i) Strongly agree, (ii) agree, (iii) undecided, (iv) disagree, (v) strongly disagree.

These five points constitute the scales. At one extreme of the scale there is strong agreement with the given statement and at the other, strong disagreement, and between them lie intermediate points.

Semantic Differential Scale

The Semantic Differential is a seven-point rating scale with points associated with bipolar labels. The object being rated is called the concept. The respondents rate objects on a number of itemized seven-point rating scales bounded at each end by one of two bipolar adjectives and central category representing neutral. In this scale only the extremes have names and in between categories have either blank spaces or number.

Factor Scales

Factor scales are developed through factor analysis or on the basis of intercorrelations of items which indicate that a common factor accounts for the relationships between items. Factor scales are particularly "useful in uncovering latent attitude dimensions and approach scaling through the concept of multiple-dimension attribute space.

Multidimensional scaling:

Multidimensional scaling (MDS) is relatively more complicated scaling device, but with this sort of scaling one can scale objects, individuals or both with a minimum of information. Multidimensional scaling (or MDS) can be characterized as a set of procedures for portraying perceptual or affective dimensions of substantive interest. It "provides useful methodology for portraying subjective judgements of diverse kinds."

MDS is used when all the variables (whether metric or non-metric) in a study are to be analysed simultaneously and all such variables happen to be independent. The underlying assumption in MDS is that people (respondents) "perceive a set of objects as being more or less similar to one another on a number of dimensions (usually uncorrelated with one another) instead of only one." Through MDS techniques one can represent geometrically the locations and interrelationships among a set of points. In fact, these techniques attempt to locate the points, given the information about a set of interpoint distances, in space of one or more dimensions such as to best summarise the information contained in the interpoint distances. The distances in the solution space then optimally reflect the distances contained in the input data.

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UNIT-IV: DATA COLLECTION, PROCESSING AND ANALYSIS

Sources of data: Primary and secondary Data- Data collection Method, Processing and Analyzing of data.

Sources of Data

It is important for a researcher to know the sources of data which he requires for different purposes. Data are nothing but the information. There are two sources of information or data they are - Primary and Secondary data. The data are name after the source. Primary data refers to the data collected for the first time, whereas secondary data refers to the data that have already been collected and used earlier by somebody or some agency. For example, the statistics collected by the Government of India relating to the population is primary data for the Government of India since it has been collected for the first time. Later when the same data are used by a researcher for his study of a particular problem, then the same data become the secondary data for the researcher. Both the sources of information have their merits and demerits.

The selection of a particular source depends upon the

(a) purpose and scope of enquiry,

(b) availability of time,

(c) availability of finance,

(d) accuracy required,

(e) statistical tools to be used,

(f) sources of information (data), and

(g) method of data collection.

(a) Purpose and Scope of Enquiry:

The purpose and scope of data collection or survey should be clearly set out at the very beginning. It requires the clear statement of the problem indicating the type of information which is needed and the use for which it is needed. If for example, the researcher is interested in knowing the nature of price change over a period of time, it would be necessary to collect data of commodity prices. It must be decided whether it would be helpful to study wholesale or retail prices and the possible uses to which such information could be put. The objective of an enquiry may be either to collect specific information relating to a problem or adequate data to test a hypothesis. Failure to set out clearly the purpose of enquiry is bound to lead to confusion and waste of resources.

After the purpose of enquiry has been clearly defined, the next step is to decide about the scope of the enquiry. Scope of the enquiry means the coverage with regard to the type of information, the subject-matter and geographical area. For instance, an enquiry may relate to India as a whole or a

state or an industrial town wherein a particular problem related to a particular industry can be studied.

(b) Availability of Time:

The investigation should be carried out within a reasonable period of time, failing which the information collected may become outdated, and would have no meaning at all. For instance, if a producer wants to know the expected demand for a product newly launched by him and the result of the enquiry that the demand would be meagre takes two years to reach him, then the whole purpose of enquiry would become useless because by that time he would have already incurred a huge loss. Thus, in this respect the information is quickly required and hence the researcher has to choose the type of enquiry accordingly.

(c) Availability of Resources:

The investigation will greatly depend on the resources available like number of skilled personnel, the financial position etc. If the number of skilled personnel who will carry out the enquiry is quite sufficient and the availability of funds is not a problem, then enquiry can be conducted over a big area covering a good number of samples, otherwise a small sample size will do.

(d) The Degree of Accuracy Desired:

Deciding the degree of accuracy required is a must for the investigator, because absolute accuracy in statistical work is seldom achieved. This is so because (i) statistics are based on estimates, (ii) tools of measurement are not always perfect and (iii) there may be unintentional bias on the part of the investigator, enumerator or informant. Therefore, a desire of 100% accuracy is bound to remain unfulfilled. Degree of accuracy desired primarily depends upon the object of enquiry. For example, when we buy gold, even a difference of 1/10th gram in its weight is significant, whereas the same will not be the case when we buy rice or wheat. However, the researcher must aim at attaining a higher degree of accuracy, otherwise the whole purpose of research would become meaningless.

(e) Statistical Tools to Be Used:

A well-defined and identifiable object or a group of objects with which the measurements or counts in any statistical investigation are associated is called a *statistical unit*. For example, in socio-economic survey the unit may be an individual, a family, a household or a block of locality. A very important step before the collection of data begins is to define clearly the statistical units on which the data are to be collected. In number of situations the units are conventionally fixed like the physical units of measurement, such as meters, kilometers, quintals, hours, days, weeks etc., which are well defined and do not need any elaboration or explanation. However, in many statistical investigations, particularly relating to socio-economic studies, arbitrary units are used which must be clearly defined. This is a must because in the absence of a clear cut and precise definition of the statistical units, serious errors in the data collection may be committed in the sense that we may

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collect irrelevant data on the items, which should have, in fact, been excluded and omit data on certain items which should have been included. This will ultimately lead to fallacious conclusions.

(f) Sources of Information (Data):

After deciding about the unit, a researcher has to decide about the source from which the information can be obtained or collected. For any statistical inquiry, the investigator may collect the data first hand or he may use the data from other published sources, such as publications of the government/semi-government organizations or journals and magazines etc.

(g) Method of Data Collection:

There is no problem if secondary data are used for research. However, if primary data are to be collected, a decision has to be taken whether (i) census method or (ii) sampling technique is to be used for data collection. In census method, we go for total enumeration i.e., all the units of a universe have to be investigated. But in sampling technique, we inspect or study only a selected representative and adequate fraction of the population and after analysing the results of the sample data we draw conclusions about the characteristics of the population. Selection of a particular technique becomes difficult because where population or census method is more scientific and 100% accuracy can be attained through this method, choosing this becomes difficult because it is time taking, it requires more labor and it is very expensive. Therefore, for a single researcher or for a small institution it proves to be unsuitable. On the other hand, sample method is less time taking, less laborious and less expensive but a 100% accuracy cannot be attained through this method because of sampling and non-sampling errors attached to this method. Hence, a researcher has to be very cautious and careful while choosing a particular method.

DATA COLLECTION METHOD

COLLECTION OF PRIMARY DATA

There are several methods of collecting primary data, particularly in surveys and descriptive researches. Important ones are:

(i) observation method,

(ii) interview method,

(iii) through questionnaires,

(iv) through schedules, and

(v) other methods which include

(a) warranty cards; (b) distributor audits; (c) pantry audits; (d) consumer panels; (e) using mechanical devices; (f) through projective techniques; (g) depth interviews, and (h) content analysis.

Observation Method

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The observation method is the most commonly used method specially in studies relating to behavioural sciences. In a way we all observe things around us, but this sort of observation is not scientific observation. Observation becomes a scientific tool and the method of data collection for the researcher, when it serves a formulated research purpose, is systematically planned and recorded and is subjected to checks and controls on validity and reliability. Under the observation method, the information is sought by way of investigator's own direct observation without asking from the respondent. The main advantage of this method is that subjective bias is eliminated, if observation is done accurately. Secondly, the information obtained under this method relates to what is currently happening; it is not complicated by either the past behaviour or future intentions or attitudes. Thirdly, this method is independent of respondents' willingness to respond and as such is relatively less demanding of active cooperation on the part of respondents as happens to be the case in the interview or the questionnaire method. This method is particularly suitable in studies which deal with subjects (i.e., respondents) who are not capable of giving verbal reports of their feelings for one reason or the other

However, observation method has various limitations.

- Firstly, it is an expensive method.
- Secondly, the information provided by this method is very limited.
- Thirdly, sometimes unforeseen factors may interfere with the observational task. At times, the fact that some people are rarely accessible to direct observation creates obstacle for this method to collect data effectively

While using this method, the researcher should keep in mind things like:

What should be observed?
How the observations should be recorded?
Or
how the accuracy of observation can be ensured?
In case the observation is characterised by a careful definition of the units to be observed, the style of recording the observed information, standardised conditions of observation and the selection of pertinent data of observation, then the observation is called as ***structured observation.*** But when observation is to take place without these characteristics to be thought of in advance, the same is termed *as* ***unstructured observation***. Structured observation is considered appropriate in descriptive studies, whereas in an exploratory study the observational procedure is most likely to be relatively unstructured.

We often talk about participant and non-participant types of observation in the context of studies, particularly of social sciences. This distinction depends upon the observer's sharing or not sharing the life of the group he is observing. If the observer observes by making himself, more or less, a member of the group he is observing so that he can experience what the members of the group experience, the observation is called as the ***participant observation***. But when the observer observes as a detached emissary without any attempt on his part to experience through participation what others feel, the observation of this type is often termed as ***non-participant***

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observation. (When the observer is observing in such a manner that his presence may be unknown to the people he is observing, such an observation is described as *disguised observation.*)

There are several merits of the participant type of observation:

(i) The researcher is enabled to record the natural behaviour of the group.

(ii) The researcher can even gather information which could not easily be obtained if he observes in a disinterested fashion.

(iii) The researcher can even verify the truth of statements made by informants in the context of a questionnaire or a schedule.

Sometimes we talk of ***controlled*** **and** ***uncontrolled observation***. If the observation takes place in the natural setting, it may be termed as uncontrolled observation, but when observation takes place according to definite pre-arranged plans, involving experimental procedure, the same is then termed controlled observation. In non-controlled observation, no attempt is made to use precision instruments. The major aim of this type of observation is to get a spontaneous picture of life and persons. It has a tendency to supply naturalness and completeness of behaviour, allowing sufficient time for observing it. But in controlled observation, we use mechanical (or precision) instruments as aids to accuracy and standardisation. Such observation has a tendency to supply formalised data upon which generalisations can be built with some degree of assurance. The main pitfall of non-controlled observation is that of subjective interpretation. There is also the danger of having the feeling that we know more about the observed phenomena than we actually do. Generally, controlled observation takes place in various experiments that are carried out in a laboratory or under controlled conditions, whereas uncontrolled observation is resorted to in case of exploratory researches.

Interview Method

The interview method of collecting data involves presentation of oral-verbal stimuli and reply in terms of oral-verbal responses. This method can be used through personal interviews and, if possible, through telephone interviews.

a) ***Personal interviews:*** Personal interview method requires a person known as the interviewer asking questions generally in a face-to-face contact to the other person or persons. (At times the interviewee may also ask certain questions and the interviewer responds to these, but usually the interviewer initiates the interview and collects the information.) This sort of interview may be in the form of direct personal investigation or it may be indirect oral investigation. In the case of direct personal investigation, the interviewer has to collect the information personally from the sources concerned. He has to be on the spot and has to meet people from whom data have to be collected.

This method is particularly suitable for intensive investigations. But in certain cases, it may not be possible or worthwhile to contact directly the persons concerned or on account of the extensive scope of enquiry, the direct personal investigation technique may not be used. In such cases an

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indirect oral examination can be conducted under which the interviewer has to cross-examine other persons who are supposed to have knowledge about the problem under investigation and the information, obtained is recorded. Most of the commissions and committees appointed by government to carry on investigations make use of this method.

The method of collecting information through personal interviews is usually carried out in a structured way. As such we call the interviews as ***structured interviews***. Such interviews involve

the use of a set of predetermined questions and of highly standardised techniques of recording.

Thus, the interviewer in a structured interview follows a rigid procedure laid down, asking questions in a form and order prescribed. As against it, the ***unstructured interviews*** are characterised by a flexibility of approach to questioning. Unstructured interviews do not follow a system of pre-determined questions and standardised techniques of recording information. In a non-structured interview, the interviewer is allowed much greater freedom to ask, in case of need, supplementary questions or at times he may omit certain questions if the situation so requires. He may even change the sequence of questions. He has relatively greater freedom while recording the responses to include some aspects and exclude others. But this sort of flexibility results in lack of comparability of one interview with another and the analysis of unstructured responses becomes much more difficult and time-consuming than that of the structured responses obtained in case of structured interviews. Unstructured interviews also demand deep knowledge and greater skill on the part of the interviewer. Unstructured interview, however, happens to be the central technique of collecting information in case of exploratory or formulative research studies. But in case of descriptive studies, we quite often use the technique of structured interview because of its being more economical, providing a safe basis for generalisation and requiring relatively lesser skill on the part of the interviewer

Focussed interview, clinical interview and the non-directive interview. *Focussed interview* is meant to focus attention on the given experience of the respondent and its effects. Under it the interviewer has the freedom to decide the manner and sequence in which the questions would be asked and has also the freedom to explore reasons and motives. The main task of the interviewer in case of a focussed interview is to confine the respondent to a discussion of issues with which he seeks conversance. Such interviews are used generally in the development of hypotheses and constitute a major type of unstructured interviews.

The *clinical interview* is concerned with broad underlying feelings or motivations or with the course of individual's life experience. The method of eliciting information under it is generally left to the interviewer's discretion. In case of *non-directive interview*, the interviewer's function is simply to encourage the respondent to talk about the given topic with a bare minimum of direct questioning. The interviewer often acts as a catalyst to a comprehensive expression of the respondents' feelings and beliefs and of the frame of reference within which such feelings and beliefs take on personal significance.

Merits of the interview method are as follows:

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(i) More information and that too in greater depth can be obtained.

(ii) Interviewer by his own skill can overcome the resistance, if any, of the respondents; the interview method can be made to yield an almost perfect sample of the general population.

(iii) There is greater flexibility under this method as the opportunity to restructure questions is always there, especially in case of unstructured interviews.

(iv) Observation method can as well be applied to recording verbal answers to various questions.

(v) Personal information can as well be obtained easily under this method.

(vi) Samples can be controlled more effectively as there arises no difficulty of the missing returns; non-response generally remains very low.

(vii) The interviewer can usually control which person(s) will answer the questions. This is not

possible in mailed questionnaire approach. If so desired, group discussions may also be held.

(viii) The interviewer may catch the informant off-guard and thus may secure the most spontaneous reactions than would be the case if mailed questionnaire is used.

(ix) The language of the interview can be adopted to the ability or educational level of the person interviewed and as such misinterpretations concerning questions can be avoided.

(x) The interviewer can collect supplementary information about the respondent's personal characteristics and environment which is often of great value in interpreting results.

Weaknesses of the interview method.

Among the important weaknesses, mention may be made of the following:

(i) It is a very expensive method, specially when large and widely spread geographical sample is taken.

(ii) There remains the possibility of the bias of interviewer as well as that of the respondent; there also remains the headache of supervision and control of interviewers.

(iii) Certain types of respondents such as important officials or executives or people in high income groups may not be easily approachable under this method and to that extent the data may prove inadequate.

(iv) This method is relatively more-time-consuming, specially when the sample is large and recalls upon the respondents are necessary.

(v) The presence of the interviewer on the spot may over-stimulate the respondent, sometimes even to the extent that he may give imaginary information just to make the interview interesting.

(vi) Under the interview method the organisation required for selecting, training and supervising the field-staff is more complex with formidable problems.

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(vii) Interviewing at times may also introduce systematic errors.

(viii) Effective interview presupposes proper rapport with respondents that would facilitate free and frank responses. This is often a very difficult requirement.

(b) ***Telephone interviews:***

This method of collecting information consists in contacting respondents on telephone itself. It is not a very widely used method, but plays important part in industrial surveys, particularly in developed regions.

The chief merits of such a system are:

1. It is more flexible in comparison to mailing method.

2. It is faster than other methods i.e., a quick way of obtaining information.

3. It is cheaper than personal interviewing method; here the cost per response is relatively low.

4. Recall is easy; call-backs are simple and economical.

5. There is a higher rate of response than what we have in mailing method; the non-response is generally very low.

6. Replies can be recorded without causing embarrassment to respondents.

7. Interviewer can explain requirements more easily.

8. At times, access can be gained to respondents who otherwise cannot be contacted for one reason or the other.

9. No field staff is required.

10. Representative and wider distribution of sample is possible.

Demerits

But this system of collecting information is not free from demerits. Some of these may be highlighted.

1. Little time is given to respondents for considered answers; interview period is not likely to exceed five minutes in most cases.

2. Surveys are restricted to respondents who have telephone facilities.

3. Extensive geographical coverage may get restricted by cost considerations.

4. It is not suitable for intensive surveys where comprehensive answers are required to various questions.

5. Possibility of the bias of the interviewer is relatively more.

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6. Questions have to be short and to the point; probes are difficult to handle.

COLLECTION OF DATA THROUGH QUESTIONNAIRES

This method of data collection is quite popular, particularly in case of big enquiries. It is being adopted by private individuals, research workers, private and public organisations and even by governments. In this method a questionnaire is sent (usually by post) to the persons concerned with a request to answer the questions and return the questionnaire. A questionnaire consists of a number of questions printed or typed in a definite order on a form or set of forms. The questionnaire is mailed to respondents who are expected to read and understand the questions and write down the reply in the space meant for the purpose in the questionnaire itself. The respondents have to answer the questions on their own.

The method of collecting data by mailing the questionnaires to respondents is most extensively employed in various economic and business surveys.

Merits

The merits claimed on behalf of this method are as follows:

1. There is low cost even when the universe is large and is widely spread geographically.

2. It is free from the bias of the interviewer; answers are in respondents' own words.

3. Respondents have adequate time to give well thought out answers.

4. Respondents, who are not easily approachable, can also be reached conveniently.

5 Large samples can be made use of and thus the results can be made more dependable and

reliable.

Demerits

The main demerits of this system can also be listed here:

1. Low rate of return of the duly filled in questionnaires; bias due to no-response is often indeterminate.

2. It can be used only when respondents are educated and cooperating.

3. The control over questionnaire may be lost once it is sent.

4. There is inbuilt inflexibility because of the difficulty of amending the approach once questionnaires have been despatched.

5. There is also the possibility of ambiguous replies or omission of replies altogether to certain questions; interpretation of omissions is difficult.

6. It is difficult to know whether willing respondents are truly representative.

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7. This method is likely to be the slowest of all.

Main aspects of a questionnaire

Quite often questionnaire is considered as the heart of a survey operation. Hence it should be very carefully constructed. If it is not properly set up, then the survey is bound to fail. This fact requires us to study the main aspects of a questionnaire viz.,

1. the general form,
2. question sequence and
3. question formulation and wording.

General form

So far as the general form of a questionnaire is concerned, it can either be structured or unstructured questionnaire. Structured questionnaires are those questionnaires in which there are definite, concrete and pre-determined questions. The questions are presented with exactly the same wording and in the same order to all respondents. Resort is taken to this sort of standardisation to ensure that all respondents reply to the same set of questions. The form of the question may be either closed (i.e., of the type 'yes' or 'no') or open (i.e., inviting free response) but should be stated in advance and not constructed during questioning. Structured questionnaires may also have fixed alternative questions in which responses of the informants are limited to the stated alternatives. Thus, a highly structured questionnaire is one in which all questions and answers are specified and comments in the respondent's own words are held to the minimum.

Question sequence:

In order to make the questionnaire effective and to ensure quality to the replies received, a researcher should pay attention to the question-sequence in preparing the questionnaire. A proper sequence of questions reduces considerably the chances of individual questions being misunderstood. The question-sequence must be clear and smoothly-moving, meaning thereby that the relation of one question to another should be readily apparent to the respondent, with questions that are easiest to answer being put in the beginning. The first few questions are particularly important because they are likely to influence the attitude of the respondent and in seeking his desired cooperation.

The following type of questions should generally be avoided as opening questions in a questionnaire:

1. questions that put too great a strain on the memory or intellect of the respondent;

2. questions of a personal character;

3. questions related to personal wealth, etc.

Question formulation and wording:

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With regard to this aspect of questionnaire, the researcher should note that each question must be very clear for any sort of misunderstanding can do irreparable harm to a survey. Question should also be impartial in order not to give a biased picture of the true state of affairs. Questions should be constructed with a view to their forming a logical part of a well thought out tabulation plan. In general, all questions should meet the following standards—

(a) should be easily understood;

(b) should be simple i.e., should convey only one thought at a time;

(c) should be concrete and should conform as much as possible to the respondent's way of thinking.

Essentials of a good questionnaire:

- Questionnaire should be comparatively short and simple i.e.; the size of the questionnaire should be kept to the minimum.
- Questions should proceed in logical sequence moving from easy to more difficult questions. Personal and intimate questions should be left to the end.
- Technical terms and vague expressions capable of different interpretations should be avoided in a questionnaire.
- Questions may be dichotomous (yes or no answers), multiple choice (alternative answers listed) or open-ended. The latter type of questions is often difficult to analyse and hence should be avoided in a questionnaire to the extent possible.
- There should be some control questions in the questionnaire which indicate the reliability of the respondent.
- Questions affecting the sentiments of respondents should be avoided.
- Adequate space for answers should be provided in the questionnaire to help editing and tabulation.
- There should always be provision for indications of uncertainty, e.g., "do not know," "no preference" and so on.
- Brief directions with regard to filling up the questionnaire should invariably be given in the questionnaire itself.
- Finally, the physical appearance of the questionnaire affects the cooperation the researcher receives from the recipients and as such an attractive looking questionnaire, particularly in mail surveys, is a plus point for enlisting cooperation.
- The quality of the paper, along with its colour, must be good so that it may attract the attention of recipients.

Constructing, Drafting and refining the questionnaires

1. The researcher must keep in view the problem he is to study for it provides the starting point for developing the Questionnaire/Schedule.
2. He must be clear about the various aspects of his research problem to be dealt with in the course of his research project.

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3. Appropriate form of questions depends on the nature of information sought, the sampled respondents and the kind of analysis intended.
4. The researcher must decide whether to use closed or open-ended question.
5. Questions should be simple and must be constructed with a view to their forming a logical part of a well thought out tabulation plan. The units of enumeration should also be defined precisely so that they can ensure accurate and full information.
6. Rough draft of the Questionnaire/Schedule be prepared, giving due thought to the appropriate sequence of putting questions. Questionnaires or schedules previously drafted (if available) may as well be looked into at this stage.
7. Researcher must invariably re-examine, and in case of need may revise the rough draft for a better one. Technical defects must be minutely scrutinised and removed.
8. Pilot study should be undertaken for pre-testing the questionnaire. The questionnaire may be edited in the light of the results of the pilot study.
9. Questionnaire must contain simple but straight forward directions for the respondents so that they may not feel any difficulty in answering the questions.

Collection of Data Through Schedules

This method of data collection is very much like the collection of data through questionnaire, with little difference which lies in the fact that schedules (proforma containing a set of questions) are being filled in by the enumerators who are specially appointed for the purpose. These enumerators along with schedules, go to respondents, put to them the questions from the proforma in the order the questions are listed and record the replies in the space meant for the same in the proforma. In certain situations, schedules may be handed over to respondents and enumerators may help them in recording their answers to various questions in the said schedules.

Enumerators explain the aims and objects of the investigation and also remove the difficulties which any respondent may feel in understanding the implications of a particular question or the definition or concept of difficult terms. This method requires the selection of enumerators for filling up schedules or assisting respondents to fill up schedules and as such enumerators should be very carefully selected. The enumerators should be trained to perform their job well and the nature and scope of the investigation should be explained to them thoroughly so that they may well understand the implications of different questions put in the schedule.

Enumerators should be intelligent and must possess the capacity of cross-examination in order to find out the truth. Above all, they should be honest, sincere, hardworking and should have patience and perseverance. This method of data collection is very useful in extensive enquiries and can lead to fairly reliable results. It is, however, very expensive and is usually adopted in investigations conducted by governmental agencies or by some big organisations. Population census all over the world is conducted through this method.

Some Other Methods of Data Collection

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1. Warranty cards: Warranty cards are usually postal sized cards which are used by dealers of consumer durables to collect information regarding their products. The information sought is printed in the form of questions on the 'warranty cards' which is placed inside the package along with the product with a request to the consumer to fill in the card and post it back to the dealer.

2. Distributor or store audits: Distributor or store audits are performed by distributors as well as manufactures through their salesmen at regular intervals. Distributors get the retail stores audited through salesmen and use such information to estimate market size, market share, seasonal purchasing pattern and so on. The data are obtained in such audits not by questioning but by observation.

3. Pantry audits: Pantry audit technique is used to estimate consumption of the basket of goods at the consumer level. In this type of audit, the investigator collects an inventory of types, quantities and prices of commodities consumed. Thus, in pantry audit data are recorded from the examination of consumer's pantry. The usual objective in a pantry audit is to find out what types of consumers buy certain products and certain brands, the assumption being that the contents of the pantry accurately portray consumer's preferences.

4. Consumer panels: An extension of the pantry audit approach on a regular basis is known as 'consumer panel', where a set of consumers are arranged to come to an understanding to maintain detailed daily records of their consumption and the same is made available to investigator on demands. In other words, a consumer panel is essentially a sample of consumers who are interviewed repeatedly over a period of time.

5. Use of mechanical devices: The use of mechanical devices has been widely made to collect information by way of indirect means. Eye camera, Pupillometric camera, Psychogalvanometer, Motion picture camera and Audiometer are the principal devices so far developed and commonly used by modern big business houses, mostly in the developed world for the purpose of collecting the required information.

6. Projective techniques: Projective techniques (or what are sometimes called as indirect interviewing techniques) for the collection of data have been developed by psychologists to use projections of respondents for inferring about underlying motives, urges, or intentions which are such that the respondent either resists to reveal them or is unable to figure out himself. In projective techniques the respondent in supplying information tends unconsciously to project his own attitudes or feelings on the subject under study. Projective techniques play an important role in motivational researches or in attitude surveys.

We may now briefly deal with the important projective techniques.

(i) ***Word association tests:*** These tests are used to extract information regarding such words which have maximum association. In this sort of test the respondent is asked to mention the first word that comes to mind, ostensibly without thinking, as the interviewer reads out each word from a list

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(ii) *Sentence completion tests:* These tests happen to be an extension of the technique of word association tests. Under this, informant may be asked to complete a sentence (such as: persons who wear Khadi are...) to find association of Khadi clothes with certain personality characteristics. Several sentences of this type might be put to the informant on the same subject. Analysis of replies from the same informant reveals his attitude toward that subject, and the combination of these attitudes of all the sample members is then taken to reflect the views of the population. This technique permits the testing not only of words (as in case of word association tests), but of ideas as well and thus, helps in developing hypotheses and in the construction of questionnaires. This technique is also quick and easy to use, but it often leads to analytical problems, particularly when the response happens to be multidimensional.

(iii) *Story completion tests:* Such tests are a step further wherein the researcher may contrive stories instead of sentences and ask the informants to complete them. The respondent is given just enough of story to focus his attention on a given subject and he is asked to supply a conclusion to the story.

(iv) *Verbal projection tests:* These are the tests wherein the respondent is asked to comment on or to explain what other people do. For example, why do people smoke? Answers may reveal the respondent's own motivations.

(v) *Pictorial techniques:* There are several pictorial techniques. The important ones are as follows:

(a) *Thematic apperception test (T.A.T.):* The TAT consists of a set of pictures (some of the pictures deal with the ordinary day-to-day events while others may be ambiguous pictures of unusual situations) that are shown to respondents who are asked to describe what they think the pictures represent. The replies of respondents constitute the basis for the investigator to draw inferences about their personality structure, attitudes, etc.

(b) *Rosenzweig test:* This test uses a cartoon format wherein we have a series of cartoons with words inserted in 'balloons' above. The respondent is asked to put his own words in an empty balloon space provided for the purpose in the picture. From what the respondents write in this fashion, the study of their attitudes can be made.

(c) *Rorschach test:* This test consists of ten cards having prints of inkblots. The design happens to be symmetrical but meaningless. The respondents are asked to describe what they perceive in such symmetrical inkblots and the responses are interpreted on the basis of some pre-determined psychological framework. This test is frequently used but the problem of validity still remains a major problem of this test.

(d) *Holtzman Inkblot Test (HIT):* This test from W.H. Holtzman is a modification of the Rorschach Test explained above. This test consists of 45 inkblot cards (and not 10 inkblots as we find in case of Rorschach Test) which are based on colour, movement, shading and other factors involved in inkblot perception. Only one response per card is obtained from the subject (or the respondent) and the responses of a subject are interpreted at three levels of form appropriateness. Form responses are interpreted for knowing the accuracy (F) or inaccuracy (F–) of respondent's precepts;

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shading and colour for ascertaining his affectional and emotional needs; and movement responses for assessing the dynamic aspects of his life. in which they have been assigned various roles.

(viii) *Sociometry:* Sociometry is a technique for describing the social relationships among individuals in a group. In an indirect way, sociometry attempts to describe attractions or repulsions between individuals by asking them to indicate whom they would choose or reject in various situations. Thus, sociometry is a new technique of studying the underlying motives of respondents. "Under this an attempt is made to trace the flow of information amongst groups and then examine the ways in which new ideas are diffused. Sociograms are constructed to identify leaders and followers." Sociograms are charts that depict the sociometric choices. There are many versions of the sociogram pattern and the reader is suggested to consult specialised references on sociometry for the purpose. This approach has been applied to the diffusion of ideas on drugs amongst medical practitioners.

7. Depth interviews: Depth interviews are those interviews that are designed to discover underlying motives and desires and are often used in motivational research. Such interviews are held to explore needs, desires and feelings of respondents. In other words, they aim to elicit unconscious as also other types of material relating especially to personality dynamics and motivations. As such, depth interviews require great skill on the part of the interviewer and at the same time involve considerable time. Unless the researcher has specialised training, depth interviewing should not be attempted.

8. Content-analysis: Content-analysis consists of analysing the contents of documentary materials such as books, magazines, newspapers and the contents of all other verbal materials which can be either spoken or printed.

Collection of Secondary Data

Secondary data means data that are already available i.e., they refer to the data which have already been collected and analysed by someone else. When the researcher utilises secondary data, then he has to look into various sources from where he can obtain them. In this case he is certainly not confronted with the problems that are usually associated with the collection of original data. Secondary data may either be published data or unpublished data. Usually published data are available in:

(a) various publications of the central, state are local governments;

(b) various publications of foreign governments or of international bodies and their subsidiary organisations;

(c) technical and trade journals;

(d) books, magazines and newspapers;

(e) reports and publications of various associations connected with business and industry, banks, stock exchanges, etc.;

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(f) reports prepared by research scholars, universities, economists, etc. in different fields; and

(g) public records and statistics, historical documents, and other sources of published information.

The sources of unpublished data are many; they may be found in diaries, letters, unpublished biographies and autobiographies and also may be available with scholars and research workers, trade associations, labour bureaus and other public/ private individuals and organisations.

PROCESSING AND ANALYZING OF DATA

Processing of Data

The data, after collection, has to be processed and analysed in accordance with the outline laid down for the purpose at the time of developing the research plan. This is essential for a scientific study and for ensuring that we have all relevant data for making contemplated comparisons and analysis. Technically speaking, processing implies editing, coding, classification and tabulation of collected data so that they are amenable to analysis. The term analysis refers to the computation of certain measures along with searching for patterns of relationship that exist among data-groups.

PROCESSING OPERATIONS

1. Editing: Editing of data is a process of examining the collected raw data (specially in surveys) to detect errors and omissions and to correct these when possible. As a matter of fact, editing involves a careful scrutiny of the completed questionnaires and/or schedules. Editing is done to assure that the data are accurate, consistent with other facts gathered, uniformly entered, as completed as possible and have been well arranged to facilitate coding and tabulation.

2. Coding: Coding refers to the process of assigning numerals or other symbols to answers so that responses can be put into a limited number of categories or classes. Such classes should be appropriate to the research problem under consideration. They must also possess the characteristic of exhaustiveness (i.e., there must be a class for every data item) and also that of mutual exclusively which means that a specific answer can be placed in one and only one cell in a given category set. Another rule to be observed is that of unidimensional by which is meant that every class is defined in terms of only one concept.

3. Classification: Most research studies result in a large volume of raw data which must be reduced into homogeneous groups if we are to get meaningful relationships. This fact necessitates classification of data which happens to be the process of arranging data in groups or classes on the basis of common characteristics. Data having a common characteristic are placed in one class and in this way the entire data get divided into a number of groups or classes. Classification can be one of the following two types, depending upon the nature of the phenomenon involved:

(a) *Classification according to attributes:* As stated above, data are classified on the basis of common characteristics which can either be descriptive (such as literacy, sex, honesty, etc.) or numerical (such as weight, height, income, etc.). Descriptive characteristics refer to qualitative phenomenon which cannot be measured quantitatively; only their presence or absence in an

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individual item can be noticed. Data obtained this way on the basis of certain attributes are known as *statistics of attributes* and their classification is said to be classification according to attributes.

(b) *Classification according to class-intervals:* Unlike descriptive characteristics, the numerical characteristics refer to quantitative phenomenon which can be measured through some statistical units. Data relating to income, production, age, weight, etc. come under this category. Such data are known as *statistics of variables* and are classified on the basis of class intervals.

4. Tabulation: When a mass of data has been assembled, it becomes necessary for the researcher to arrange the same in some kind of concise and logical order. This procedure is referred to as tabulation. Thus, tabulation is the process of summarising raw data and displaying the same in compact form (i.e., in the form of statistical tables) for further analysis. In a broader sense, tabulation is an orderly arrangement of data in columns and rows.

Tabulation is essential because of the following reasons.

1. It conserves space and reduces explanatory and descriptive statement to a minimum.

2. It facilitates the process of comparison.

3. It facilitates the summation of items and the detection of errors and omissions.

4. It provides a basis for various statistical computations.

Analyzing of Data

Analysis we mean the computation of certain indices or measures along with searching for patterns of relationship that exist among the data groups.

Analysis, particularly in case of survey or experimental data, involves estimating the values of unknown parameters of the population and testing of hypotheses for drawing inferences. Analysis may, therefore, be categorised as

- Descriptive Analysis and
- Inferential Analysis (Inferential analysis is often known as statistical analysis).

Descriptive analysis

Analysis is largely the study of distributions of one variable. This study provides us with profiles of companies, work groups, persons and other subjects on any of a multiple of characteristics such as size. Composition, efficiency, preferences, etc. This sort of analysis may be in respect of one variable (described as unidimensional analysis), or in respect of two variables (described as bivariate analysis) or in respect of more than two variables (described as multivariate analysis).

In this context we work out various measures that show the size and shape of a distribution(s) along with the study of measuring relationships between two or more variables.

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- *Correlation analysis* studies the joint variation of two or more variables for determining the amount of correlation between two or more variables.
- *Causal analysis* is concerned with the study of how one or more variables affect changes in another variable. It is thus a study of functional relationships existing between two or more variables. This analysis can be termed as regression analysis. Causal analysis is considered relatively more important in experimental researches, whereas in most social and business researches our interest lies in understanding and controlling relationships between variables then with determining causes *per se* and as such we consider correlation analysis as relatively more important.
- In modern times, with the availability of computer facilities, there has been a rapid development of *multivariate analysis* which may be defined as "all statistical methods which simultaneously analyse more than two variables on a sample of observations".

Usually the following analyses are involved when we make a reference of multivariate analysis:

(a) *Multiple regression analysis:* This analysis is adopted when the researcher has one dependent variable which is presumed to be a function of two or more independent variables. The objective of this analysis is to make a prediction about the dependent variable based on its covariance with all the concerned independent variables.

(b) *Multiple discriminant analysis:* This analysis is appropriate when the researcher has a single dependent variable that cannot be measured, but can be classified into two or more groups on the basis of some attribute. The object of this analysis happens to be to predict an entity's possibility of belonging to a particular group based on several predictor variables.

(c) *Multivariate analysis of variance* (*or multi-ANOVA*): This analysis is an extension of two-way ANOVA, wherein the ratio of among group variance to within group variance is worked out on a set of variables.

(d) *Canonical analysis:* This analysis can be used in case of both measurable and non-measurable variables for the purpose of simultaneously predicting a set of dependent variables from their joint covariance with a set of independent variables.

Inferential analysis

Inferential analysis is concerned with the various tests of significance for testing hypotheses in order to determine with what validity data can be said to indicate some conclusion or conclusions. It is also concerned with the estimation of population values. It is mainly on the basis of inferential analysis that the task of interpretation (i.e., the task of drawing inferences and conclusions) is performed.

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UNIT-V: DATA PRESENTATION AND REPORT WRITING

Diagrammatic and graphical presentation: Techniques - Merits and Demerits - Report writing - Types and layout of research reports.

DIAGRAMMATIC AND GRAPHICAL PRESENTATION: TECHNIQUES - MERITS AND DEMERITS

Diagrams play an important role in statistical data presentation. Diagrams are nothing but geometrical figures like lines, bars, circles, squares, etc. Diagrammatic data presentation allows us to understand the data in an easier manner.

Advantages of Diagrammatic Data Presentation

Advantages of Graphical Representation of Data

Graphical representation of reports enjoys various advantages which are as follows:

1. Acceptability: Such report is acceptable to the busy persons because it easily highlights about the theme of the report. This helps to avoid wastage of time.
2. Comparative Analysis: Information can be compared in terms of graphical representation. A Such comparative analysis helps for quick understanding and attention.
3. Less cost: Information if descriptive involves huge time to present properly. It involves more money to print the information but graphical presentation can be made in short but catchy view to make the report understandable. It obviously involves less cost.
4. Decision Making: Business executives can view the graphs at a glance and can make decision very quickly which is hardly possible through descriptive report.
5. Logical Ideas: If tables, design and graphs are used to represent information then a logical sequence is created to clear the idea of the audience.
6. Helpful for less literate Audience: Less literate or illiterate people can understand graphical representation easily because it does not involve going through line by line of any descriptive report.
7. Less Effort and Time: To present any table, design, image or graphs require less effort and time. Furthermore, such presentation makes quick understanding of the information.
8. Less Error and Mistakes: Qualitative or informative or descriptive reports involve errors or mistakes. As graphical representations are exhibited through numerical figures, tables or graphs, it usually involves less error and mistake.
9. A complete Idea: Such representation creates clear and complete idea in the mind of audience. Reading hundred pages may not give any scope to make decision. But an instant

view or looking at a glance obviously makes an impression in the mind of audience regarding the topic or subject.

10. Use in the Notice Board: Such representation can be hanged in the notice board to quickly raise the attention of employees in any organization.

Disadvantages of Graphical Representation of Data

Graphical representation of reports is not free from limitations. The following are the problems of graphical representation of data or reports:

1. Costly: Graphical representation pf reports are costly because it involves images, colours and paints. Combination of material with human efforts makes the graphical presentation expensive.
2. More time: Normal report involves less time to represent but graphical representation involves more time as it requires graphs and figures which are dependent to more time.
3. Errors and Mistakes: Since graphical representations are complex, there is- each and every chance of errors and mistake. This causes problems for better understanding to general people.
4. Lack of Secrecy: Graphical representation makes full presentation of information which may hamper the objective to keep something secret.
5. Problems to select the suitable method: Information can be presented through various graphical methods and ways. Which should be the suitable method is very hard to select.
6. Problem of Understanding: All may not be able to get the meaning of graphical representation because it involves various technical matters which are complex to general people.

General Principles of Diagrammatic Presentation of Data

A diagrammatic presentation is a simple and effective method of presenting the information that any statistical data contains. Here are some general principles of diagrammatic presentation which can help you make them a more effective tool of understanding the data:

- Write a suitable title on top which conveys the subject matter in a brief and unambiguous manner. If you want to provide more details about the title, then you can mention them in the footnote below the diagram.
- construct a diagram in a manner that immediately impacts the viewer. Ensure that you draw it neatly with an appropriate balance between its length and breadth. Further, make sure that the diagram is neither too large nor too small. You can also use different colors or shades to emphasize different aspects of the problem.
- Draw the diagram accurately using proper scales of measurement. You should never compromise accuracy for attractiveness.

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- Select the design of the diagram carefully keeping in view the nature of the data and also the objective of the investigation.
- If you use different shades or colors to depict the different characteristics in the diagram, then ensure that you provide an index explaining them.
- If you are using a secondary source, then ensure that you specify the source of data.
- Try to keep your diagram as simple as possible.

DIAGRAMMATIC AND GRAPHICAL PRESENTATION: TECHNIQUES

Charts are an excellent way to condense large amounts of information into easy-to-understand formats that clearly highlight the points you'd like to make. There are many different chart types available, and sometimes the hardest part is deciding which chart type is best for your need.

When presenting your information, you should think about what you want your readers to take away from the information and make those points stand out. Different types of charts are best for certain circumstances. Decide what you want the take-away to be, then choose the type of graph that will best clearly and concisely present your information.

Vertical Bar Charts

Vertical bar charts are best for comparing data that is grouped by discrete categories. Vertical bar charts are best when you don't have too many groups (less than 10 is usually good). Each bar is separated by blank space which indicates that there is no inherent order to your groups.

Stacked Bar Charts

Stacked bar charts are a great choice if you not only want to convey the size of a group relative to other groups, but also illustrate the parts that make up the whole group.

Histogram

A histogram is visually interesting combination of a vertical bar chart and a line chart. The continuous variable shown on the X-axis is broken into discrete intervals and the number of data you have in that discrete interval determines the height of the bar. Histograms are great for illustrating distributions of your data.

Horizontal Bar

The horizontal bar chart is similar to a vertical bar chart but is typically used when the number of categories is large (greater than 10 or so) or you have long labels that you would like to display for each category. It's much easier to read the labels when they are displayed in proper orientation.

Pie Charts

Pie charts are easy to read and fun to look at making them a great choice if you want to understand the parts of a whole. It's a good practice to order the pieces of your pie according to size an always ensure the total of all the pieces add up to 100%.

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Line Charts

Line charts are used to show resulting data relative to a continuous variable - most commonly time or money. They are great for projections of performance beyond your data. If you plot your sales vs. month on a line chart over the past two years, it is easy for the reader to identify any trends that may be useful as you plan for the upcoming year.

A dual axis chart allows you to plot data using two y-axes and a shared x-axis. It's used with three data sets, one of which is based on a continuous set of data and another which is better suited to being grouped by category. This should be used to visualize a correlation or the lack thereof between these three data sets.

Area Charts

An area chart is similar to a line chart, but the space between the x-axis and the line is filled with a color or pattern. It is useful for showing part-to-whole relations, such as showing individual sales reps' contribution to total sales for a year. It helps you analyse both overall and individual trend information.

Scatter Plot

A scatter plot chart will show the relationship between two different variables. Scatter plots are useful for quickly understanding if there is a relationship between to variables. If the data forms a band extending from lower left to upper right, there most likely a positive correlation between the two variables. If the band runs from upper left to lower right, a negative correlation is probable. If it is hard to see a pattern, there is probably no correlation.

Bubble Chart

A bubble chart is similar to a scatter plot but you can introduce a third variable to the visualization by having the size of the bubble indicate the value of the three variables. Again, really good option for understanding relationships between continuous variables.

Funnel Chart

Funnel charts are most often used to represent how something moves through different stages in a process. A funnel chart displays values as progressively decreasing proportions amounting to 100 percent in total. Funnel charts start at 100% and ends with a lower percentage indicating how something drops out of the process at each step or stage. A very common use of a funnel chart is to track sales conversions in a sales pipeline.

Bullet Chart

Used typically to display performance data relative to a goal. A bullet graph reveals progress toward a goal, compares this to another measure, and provides context in the form of a rating or performance.

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Heat Map

A heat map shows the relationship between two items and provides rating information, such as high to low or poor to excellent. The rating information is displayed using varying colors or saturation.

A heat map is a two-dimensional representation of data in which values are represented by colors. A simple heat map provides an immediate visual summary of information. More elaborate heat maps allow the viewer to understand complex data sets. There can be many ways to display heat maps, but they all share one thing in common – they use color to communicate relationships between data values that would be would be much harder to understand if presented numerically in a spreadsheet.

Box Plot

A box plot provides you a quick way to visually summarize your data including average values, variation in the data and whether outliers are present. Multiple box plots allow easy comparisons between different groups of continuous data.

REPORT WRITING

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 favour 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.

Different 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;

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(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 organisation 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 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:

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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

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.

TYPES OF REPORTS

Research reports vary greatly in length and type. In each individual case, both the length and the form are largely dictated by the problems at hand. For instance, business firms prefer reports in the letter form, just one or two pages in length. Banks, insurance organisations and financial institutions are generally fond of the short balance-sheet type of tabulation for their annual reports to their customers and shareholders.

(A) Technical Report

In the technical report the main emphasis is on (i) the methods employed, (it) assumptions made in the course of the study, (iii) the detailed presentation of the findings including their limitations and supporting data.

A general outline of a technical report can be as follows:

1. *Summary of results:* A brief review of the main findings just in two or three pages.

2. *Nature of the study:* Description of the general objectives of study, formulation of the problem in operational terms, the working hypothesis, the type of analysis and data required, etc.

3. *Methods employed:* Specific methods used in the study and their limitations. For instance, in

sampling studies we should give details of sample design viz., sample size, sample selection, etc.

4. *Data:* Discussion of data collected, their sources, characteristics and limitations. If secondary

data are used, their suitability to the problem at hand be fully assessed. In case of a survey, the manner in which data were collected should be fully described.

5. *Analysis of data and presentation of findings:* The analysis of data and presentation of the findings of the study with supporting data in the form of tables and charts be fully narrated. This, in fact, happens to be the main body of the report usually extending over several chapters.

6. *Conclusions:* A detailed summary of the findings and the policy implications drawn from the results be explained.

7. *Bibliography:* Bibliography of various sources consulted be prepared and attached.

8. *Technical appendices:* Appendices be given for all technical matters relating to questionnaire, mathematical derivations, elaboration on particular technique of analysis and the like ones.

9. *Index:* Index must be prepared and be given invariably in the report at the end.

The order presented above only gives a general idea of the nature of a technical report; the order of presentation may not necessarily be the same in all the technical reports. This, in other words, means that the presentation may vary in different reports; even the different sections outlined above will not always be the same, nor will all these sections appear in any particular report.

It should, however, be remembered that even in a technical report, simple presentation and ready availability of the findings remains an important consideration and as such the liberal use of charts and diagrams is considered desirable.

(B) Popular Report

The popular report is one which gives emphasis on simplicity and attractiveness. The simplification should be sought through clear writing, minimization of technical, particularly mathematical, details and liberal use of charts and diagrams. Attractive layout along with large print, many subheadings, even an occasional cartoon now and then is another characteristic feature of the popular report. Besides, in such a report emphasis is given on practical aspects and policy implications.

We give below a general outline of a popular report.

1. *The findings and their implications:* Emphasis in the report is given on the findings of most practical interest and on the implications of these findings.

2. *Recommendations for action:* Recommendations for action on the basis of the findings of the study is made in this section of the report.

3. *Objective of the study:* A general review of how the problem arise is presented along with the

specific objectives of the project under study.

4. *Methods employed:* A brief and non-technical description of the methods and techniques used, including a short review of the data on which the study is based, is given in this part of the report.

5. *Results:* This section constitutes the main body of the report wherein the results of the study are presented in clear and non-technical terms with liberal use of all sorts of illustrations such as charts, diagrams and the like ones.

6. *Technical appendices:* More detailed information on methods used, forms, etc. is presented in the form of appendices. But the appendices are often not detailed if the report is entirely meant for general public.

There can be several variations of the form in which a popular report can be prepared. The only important thing about such a report is that it gives emphasis on simplicity and policy implications from the operational point of view, avoiding the technical details of all sorts to the extent possible.

LAYOUT OF RESEARCH REPORTS

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 matters.

(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

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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 summarised 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 splitted 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 behaviour. 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 summarises 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.

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IMPORTANT QUESTIONS

UNIT I

1.What do you mean by research? Explain its significance in modern times.
2.Describe the different types of research (Very Important)
3.Briefly describe the different steps involved in a research process. (Very Important)
4.What is a hypothesis? What characteristics it must possess in order to be a good research hypothesis?
5.The procedure of testing hypothesis requires a researcher to adopt several steps. Describe in brief all. (Very Important)

UNIT II

1.Explain the meaning and significance of a Research design and important types of research design. (Very Important).
2. What do you mean by 'Sample Design'? and explain different types of sampling methods (Very Important).

UNIT III

1.What is the meaning of measurement in research? and explain different types of measurement scale. (Very Important).
2. Explain different types of scaling techniques (Very Important).
3. What are the steps to followed for Constructing, Drafting and refining the questionnaires. (Very Important).

UNIT IV

1.Explain different sources of data for a research and Enumerate the different methods of collecting data (very Important).
2. What you mean by processing and Analysing of data? (Very Important).

UNIT V

1. What are the various techniques of Diagrammatic and graphical presentation of data and its merits and demerits? (Very Important).
2. Explain the significance of a research report and narrate the various steps involved in writing such a report.
3. Describe, in brief, the layout of a research report, covering all relevant points (very important).