CHAPTER ONE

RESEARCH METHODS: AN INTRODUCTION

1.1. Meaning of Research

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. The term 'Research' consists of two words:

Research = Re + Search 'Re' means again and again and 'Search' means to find out something.

Therefore, research means to observe the phenomena again and again from different dimensions. Some people consider research as a movement, a movement from the known to the unknown. It is actually a voyage of discovery.

Research is an academic activity and as such the term should be used in a technical sense. Based on these different scholars forward their understanding on the research as following which is currently under application:-

- According to **Clifford Woody** research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organizing and evaluating data; making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis.
- According to **D. Slesinger and M. Stephenson** define research as "the manipulation of things, concepts or symbols for the purpose of generalizing to extend, correct or verify knowledge, whether that knowledge aids in construction of theory or in the practice of an art."
  - Research is, thus, an original contribution to the existing stock of knowledge making for its advancement. It is the persuit of truth with the help of study, observation, comparison and experiment.
  - In short, the search for knowledge through objective and systematic method of finding solution to a problem is research.
  - The systematic approach concerning generalization and the formulation of a theory is also research. As such the term 'research' refers to the systematic method consisting of enunciating the problem, formulating a hypothesis, collecting the facts or data, analyzing

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

- **According to George J. Mouly** research is, "The systematic and scholarly application of the scientific method interpretedin its broader sense, to the solution of social studies a problems; conversely, any systematic study designed to promote the development of social studies as a science can be considered research."
- **Francis G. Cornell** "To be sure the best research is that which is reliable verifiable and exhaustive, so that it providesinformation in which we have confidence. The main point here is that research is, literally speaking, akind of human behaviour, an activity in which people engage. By this definition all intelligent humanbehaviour involves some research."
  - "In social studies, teachers, administrators, or others engage in 'Research' when they systematically and purposefully assemble information about schools, school children, the social matrix in which a school or school system is determined, the characteristic of the learner or the interaction between the school and pupil."
- **According to C. Francies Rummel** "Research is an endeavor to discover, develop and verify knowledge. It is an intellectual process thathas developed over hundreds of years, ever changing in purpose and form and always searching for truth."
- **According to W.S. Monroe**, University of Illinois states, "Research may be defined as a method of studying problemswhose solutions are to be derived partly or wholly from facts. The facts dealt with in research may bestatements of opinion, historical facts, those contained in records and reports, the results of tests,answers to questionnaires, experimental data of any sort, and so forth.

OBJECTIVES OF RESEARCH

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth ***which is hidden*** and ***which has not been discovered as yet***. Though each research study has its own specific purpose, we may think of research objectives as falling into a number of following broad groupings:

1. To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as ***exploratory or formulative*** research studies);

2. To portray accurately the characteristics of a particular individual, situation or a group (studies with this object in view are known as ***descriptive research*** studies);
3. To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as ***diagnostic research*** studies);
4. To test a hypothesis of a causal relationship between variables (such studies are known as ***hypothesis-testing research*** studies).

In general the research has the following three objectives:

1. Theoretical objective
2. Factual objective and
3. Application objective.

1. Theoretical Objective

Those researches whose objectives are theoretical formulate the new theories, principles or laws. Such type of research is ***explanatory*** because it explains the relationships of certain variables. These researches contribute some basic knowledge to the human knowledge. The researches in different disciplines *i.e*., Physics, Chemistry, Mathematics etc. have the theoretical objective.

2. Factual Objective

Those researches whose objective is factual find out new facts. This objective is by nature ***descriptive***. These researches describe facts or events which happened previously. Such type of research is done in history.

3. Application Objective

The research having application objective does not contribute a new knowledge in the fund of human knowledge but suggests new applications. By application we mean improvement and modification in practice. For example if anyone gives a new application of electricity then such type of research has application objective.

1.2 Types of Research

The basic types of research are as follows:

i. ***Descriptive vs. Analytical****:*

Descriptive research includes surveys and fact-finding enquiry of different kinds. The major purpose of descriptive research is description of the state of affairs as it exists at present. In social science and business research we quite often use the term *Ex post facto research* for

descriptive research studies. The main characteristic of this method is that the researcher has no control over the variables; he/she 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 event when they cannot control the variables. The methods of research utilized in descriptive research are survey methods of all kinds, including ***comparative*** and ***correlation*** methods. In *analytical research*, on the other hand, the researcher has to use facts or information already available, and analyze these to make a critical evaluation of the material.

ii. ***Applied vs. Fundamental:*** Research can either be applied (or action) research or fundamental (to basic or pure) research.

Applied research aims at finding a solution for an immediate problem facing a society or an industrial/business organization, whereas *fundamental research* is mainly concerned with generalizations and with the formulation of a theory.

Example of Fundamental Research:

- Research concerning some natural phenomenon or relating to pure mathematics
- Research studies, concerning human behavior carried on with a view to make generalizations about human behavior

Example of Applied Research:

- Research aimed at certain conclusions (say, a solution) facing a concrete social or business problem
- Research to identify social, economic or political trends that may affect a particular institution or the copy research (research to find out whether certain communications will be read and understood) or the marketing research or evaluation research.

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

iii. ***Quantitative vs. Qualitative****:*

Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity. Qualitative research, on the other hand, is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind.

For instance, when we are interested in investigating the reasons for human behaviour (i.e., why people think or do certain things), we quite often talk of 'Motivation Research', an important type of qualitative research. Attitude or opinion research i.e., research designed to find out how people feel or what they think about a particular subject or institution is also qualitative research. Qualitative research is specially important in the behavioral sciences where the aim is to discover the underlying motives of human behavior.

iv. ***Conceptual vs. Empirical****:*

Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones. On the other hand, empirical research relies on experience or observation alone, often without due regard for system and theory. It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment. We can also call it as experimental type of research. Empirical research is appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.

v. ***Some Other Types of Research:***

All other types of research are variations of one or more of the above stated approaches, based on either the purpose of research, or the time required to accomplish research, on the environment in which research is done, or on the basis of some other similar factor.

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.

Field-setting research or laboratory research or simulation research**:** depending upon the environment in which it is to be carried out.

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.

Exploratory Research: 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.

Conclusion-oriented and decision-oriented: While doing conclusion oriented research, a researcher is free to pick up a problem, redesign the enquiry as he proceeds and is prepared to conceptualize as he wishes. Decision-oriented research is always for the need of a decision maker and the researcher in this case is not free to embark upon research according to his own inclination. Example: Operations Research.

1.3 Motivation of doing Research

What makes people to undertake research? This is a question of fundamental importance. The possible motives for doing research may be either one or more of the following:

1. Desire to get a research degree along with its consequential benefits;
2. Desire to face the challenge in solving the unsolved problems, i.e., concern over practical problems initiates research;
3. Desire to get intellectual joy of doing some creative work;
4. Desire to be of service to society;
5. Desire to get respectability.

However, this is not an exhaustive list of factors motivating people to undertake research studies. Many more factors such as directives of government, employment conditions, curiosity about new things, desire to understand causal relationships, social thinking and awakening, and the like may as well motivate (or at times compel) people to perform research operations.

1.4 Research and Scientific Method

The two terms, research and scientific method, are closely related. Research, as we have already stated, can be termed as “an inquiry into the nature of, the reasons for, and the consequences of any particular set of circumstances, whether these circumstances are experimentally controlled or recorded just as they occur.

Research implies the researcher is interested in more than particular results; he/she is interested in the repeatability of the results and in their extension to more complicated and general situations." "The scientific method is one and same in the branches (of science) and that method is the method of all logically trained minds … the unity of all sciences consists alone in its methods, not its material; the man who classifies facts of any kind whatever, who sees their mutual relation and describes their sequences, is applying the Scientific Method and is a man of science.

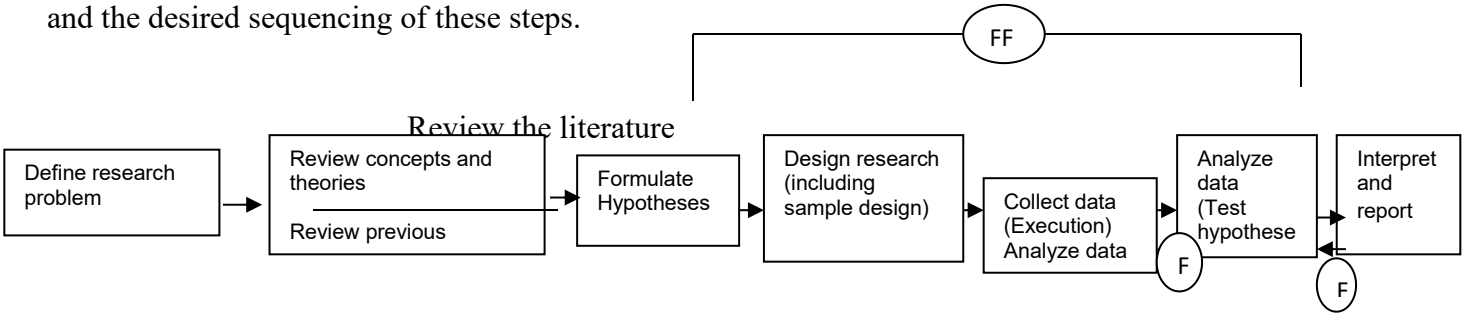
Scientific method is the pursuit of truth as determined by logical considerations. The ideal of science is to achieve a systematic interrelation of facts. Scientific method attempts to achieve "this ideal by experimentation, observation, logical arguments from accepted postulates and a combination of these three in varying proportions." In scientific method, logic aids in formulating propositions explicitly and accurately so that their possible alternatives become clear. The scientific method is, thus, based on certain basic postulates which can be stated as under:

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

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

1.5 Research Process

Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps.



Where F = feedback (Helps in controlling the sub-system to which it is transmitted)

FF= feed forward (Serves the vital function of providing criteria for evaluation)

At times, the first step determines the nature of the last step to be undertaken. If subsequent procedures have not been taken into account in the early stages, serious difficulties may arise which may even prevent the completion of the study. However, 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) generalizations and interpretation, and (11) preparation of the report or presentation of the results, i.e., formal write-up of conclusions reached.

Brief description of the above stated steps will be helpful.

1. **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/she 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.

The researcher must at the same time examine all available literature to get himself/herself acquainted with the selected problem. He/she 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

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.

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.

How does one go about developing working hypotheses? The answer is by using the following approach:

a. Discussions with colleagues and experts about the problem, its origin and the objectives in seeking a solution;
b. Examination of data and records, if available, concerning the problem for possible trends, peculiarities and other clues;
c. Review of similar studies in the area or of the studies on similar problems; and
d. Exploratory personal investigation which involves original field interviews on a limited scale with interested parties and individuals with a view to secure greater insight into the practical aspects of the problem.

Thus, working hypotheses arise as a result of a-priori thinking about the subject, examination of the available data and material including related studies and the counsel of experts and interested parties.

4. Preparing the research design:

The research problems have been formulated in clear cut terms, the researcher will be required to prepare a research design, and i.e., he /she 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.

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 organized 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. 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; 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:

i. By observation
ii. Through personal interview
iii. Through telephone interviews
iv. By mailing of questionnaires

v. Through schedules

The researcher should select one of these methods of collecting the data taking into consideration the nature of investigation, objective and scope of the inquiry, financial resources, available time and the desired degree of accuracy.

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. 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.

8. Analysis of data:

After the data have been collected, the researcher turns to the task of analyzing 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.

9. Hypothesis-testing:

After analyzing 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, generalizationsestablished on the basis of data may be stated as hypotheses to be tested by subsequent researches in times to come.

10. Generalizations and interpretation:

If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalization, i.e., to build a theory. As a matter of fact, the real value of research lies in its ability to arrive at certain generalizations. 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. Writing of report must be done with great care keeping in view the following:

The main text of the report should have the following parts:

a. ***Introduction:*** It should contain a clear statement of the objective of the research and an explanation of the methodology adopted in accomplishing the research. The scope of the study along with various limitations should as well be stated in this part.
b. ***Summary of findings:*** After introduction there would appear a statement of finding and recommendations in non-technical language. If the findings are extensive, they should be summarized.
c. ***Main report:*** The main body of the report should be presented in logical sequence and broken-down into readily identifiable sections.
d. ***Conclusion:*** Towards the end of the main text, researcher should again put down the results of his research clearly and precisely. In fact, it is the final summing up.

1.6 Criteria of Good Research

Whatever may be the types of research works and studies, one thing that is important is that they all meet on the common ground of scientific method employed by them. One expects scientific research to satisfy the following criteria:

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

REVIEW EXERCISE

Briefly describe the different steps involved in a research process.

1. What do you mean by research? Explain its significance in modern times.
2. Distinguish between Research methods and Research methodology.
3. Describe the different types of research, clearly pointing out the difference between an experiment and a survey.
4. Write short notes on:
   (1) Design of the research project;
   (2) Ex post facto research;
   (3) Motivation in research;
   (4) Objectives of research;
   (5) Criteria of good research;
   (7) Research and scientific method.
5. "Research is much concerned with proper fact finding, analysis and evaluation." Do you agree with this statement? Give reasons in support of your answer.

CHAPTER 2

DEFINING RESEARCH PROBLEM AND HYPOTHESIS FORMULATION

2.1. What is 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. Usually we say that a research problem does exist if the following conditions are met with:

i. There must be an individual (or a group or an organization), let us call it '*I*,' to whom the problem can be attributed. The individual or the organization, as the case may be, occupies an environment, say '*N*', which is defined by values of the uncontrolled variables, *Yj*.

ii. There must be at least two courses of action, say *C*1 and *C*2, to be pursued. A course of action is defined by one or more values of the controlled variables. For example, the number of items purchased at a specified time is said to be one course of action.

iii. There must be at least two possible outcomes, say *O*1 and *O*2, of the course of action, of which one should be preferable to the other. In other words, this means that there must be at least one outcome that the researcher wants, i.e., an objective.

iv. The courses of action available must provides some chance of obtaining the objective, but they cannot provide the same chance, otherwise the choice would not matter.

The individual or the organization can be said to have the problem only if '*I*' does not know what course of action is best, i.e., '*I*', must be in doubt about the solution. Thus, an individual or a group of persons can be said to have a problem which can be technically described as a research problem, if they (individual or the group), having one or more desired outcomes, are confronted with two or more courses of action that have some but not equal efficiency for the desired objective(s) and are in doubt about which course of action is best.

We can, thus, state the components 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.

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. There are several factors which may result in making the problem complicated. For instance, the environment may change affecting the efficiencies of the courses of action or the values of the outcomes; the number of alternative courses of action may be very large; persons not involved in making the decision may be affected by it and react to it favorably or unfavorably, and similar other factors.

In short the following are the main sources to which one may proceed for a suitable research problem:

1. Personal experiences of the investigator in the field of education are the main source for identifying suitable problem. Many of the problems confronted in the classroom, the school or the community lend themselves to investigation and they are perhaps more appropriate for the beginning researcher than are problems more remote from his own teaching experiences.
2. The other source of problem which is most frequently used by the investigator as suggested by the supervisors, is the extensive study of available literature-research abstracts, journals, hand-books of research international abstracts etc. He can draw an analogy for selecting a research problem or can think parallel problem in the field studied.
3. In the choice of a suitable problem, the researcher has to decide his field of investigation. He should study the field intensively in the specific area, this may enable him to identify a problem from the specific field.
4. The new innovations, technological changes and curricular developments are constantly bringing new problems and new-opportunities for Social Studies Research.
5. The most practical source of problem is to consult supervisor, experts of the field and most experienced person of the field. They may suggest most significant problem of the area. He can discuss certain issues of the area to emerge a problem.
6. It is a general practice that researchers suggest some problems in their research reports. The researcher can pick up a suitable problem for his own study.

2.2 Techniques and Approaches to Problem Definition

Defining a problem involves the task of laying down boundaries within which a researcher shall study the problem with a pre-determined objective in view. How to define a research problem is undoubtedly a herculean task. However, it is a task that must be tackled intelligently to avoid the perplexity encountered in a research operation. The usual approach is that the researcher should himself pose a question (or in case someone else wants the researcher to carry on research, the concerned individual, organization or an authority should pose the question to the researcher) and set-up techniques and procedures for throwing light on the question concerned for formulating or defining the research problem.

Defining a research problem properly and clearly is a crucial part of a research study and must in no case be accomplished hurriedly. However, in practice this is a frequently overlooked which causes a lot of problems later on. 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. In case there is some directive from an organizational authority, the problem then can be stated accordingly. The problem stated in a broad general way may contain various ambiguities which must be resolved by cool thinking and rethinking over the problem. At the same time the

feasibility of a particular solution has to be considered and the same should be kept in view while stating the problem.

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/she 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/she 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 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. Discussions with such persons should not only be confined to the formulation of the specific problem at hand, but should also be concerned with the general approach to the given problem, techniques that might be used, possible solutions, etc.

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 viableand may help in the development of working hypotheses.

In addition to what has been stated above, the following points must also be observed while defining a research problem:

a) Technical terms and words or phrases, with special meanings used in the statement of the problem, should be clearly defined.
b) Basic assumptions or postulates (if any) relating to the research problem should be clearly stated.
c) A straight forward statement of the value of the investigation (i.e., the criteria for the selection of the problem) should be provided.
d) The suitability of the time-period and the sources of data available must also be considered by the researcher in defining the problem.
e) The scope of the investigation or the limits within which the problem is to be studied mustbe mentioned explicitly in defining a research problem.

2.3 Problem formulation, Research Question and Hypothesis

It is the first and *most crucial step* in the research process

- Main function is to decide *what* you want to find out *about.*
- The way you formulate a problem determines almost every step that follows.

Steps in formulation of a research problem:

Working through these steps presupposes a reasonable level of knowledge in the broad subject area within which the study is to be undertaken. Without such knowledge it is difficult to clearly and adequately 'dissect' a subject area.

Step 1 Identify a broad field or subject area of *interest* to you.

Step 2 *Dissect* the broad area into sub areas.

Step 3 *Select* what is of most interest to you.

Step 4 Raise research questions.

Step 5 Formulate objectives.

Step 6 Assess your objectives.

Step 7 Double check

After selecting a problem, it should be stated carefully the researchers to delimit his task and isolate a specific problem before he can proceed with active planning of the study. This type of decision is culminated in the problem statement. Kerlinger has identified three criteria of good Problem Statements.

1. A problem should be concerned with relation between two or more variables.
2. It should be stated "clearly and unambiguously in question form."
3. It should be amenable to empirical testing.

Meeting these criteria in his problem statement will result, on the researcher's part, in a clear and concise idea of what he wants to do, this sets the stage for further planning.

CHARACTERISTICS OF A PROBLEM

Although selecting a research problem is one of the most difficult step for a student in a research process, it is unfortunately one for which the least guidance can be given.

A problem statement must have the following characteristics:

1. It should ask about a relationship between two or more variables.
2. It should be stated clearly and unambiguously, usually in question form.
3. It should be possible to collect data or answer the questions asked.
4. It should not represent a moral or ethical position.

1. **Relationship between Variables**

In this kind of problem the researcher manipulates a minimum of one variable to determine its effects on other variables, as opposed to a purely descriptive study in which the researcher

observes, counts or in some way measure the frequency of appearance of a particular variable in a particular setting. For example how many students in school have I.Q.'s in excess of 120?
Since no attempts need be made to deal with a relationship between variables, this problem requires only a "book-keeping" procedure, if however, the problem were worded; Are boys more likely than girls to have 1.0.'s in excess of 120 then it would involve the relationship between variables?

2. The Problem is Stated in Question Form

The problem should be in question form as:

1. What is the relationship between 1.0 and achievement?
2. Do students learn more from a directive teacher or a non directive teacher?
3. Is there a relationship between racial background and dropout rate?
4. Do more students continue in training program mes offering stipends or in program mes not offering stipends?
5. What is the relationship between role learning ability and socioeconomic status?

3. Empirical Test-ability

A problem should be testable by empirical methods, that is, through the collection of data. Moreover, for a student's purposes, it should lend itself to study by a single researcher, on a limited budget, within a year. The nature of the variables included in the problem is a good clue to its test-ability. An example of the kind of problem that is wise to avoid it: Does an extended experience in communal living improve a person's outlook on life? In addition to the magnitude and probable duration of studying such a problem, the variable themselves would be difficult to manipulate or measure.

4. Avoidance of Moral or Ethical Judgments

Questions about ideals or values are often more difficult to study than questions about aptitudes or performance, as, that would be difficult to test are: Should men define their feelings? The ethical consideration should also be taken into consideration in defining or stating a problem.

ASSUMPTIONS ABOUT THE PROBLEM

A good statement of a problem is based on some assumptions. An assumption is the supposition that it is taken for granted to better establish the scope, frame of reference and conditions under which the study will be conducted. The following are the major purposes of assumptions:

Assortment of Problem

1. It makes the research work feasible.
2. It delimits the scope of the problem.
3. It establishes the proper frame of reference.
4. It sets forth certain conditions of the study.
5. It aids in the development of testable hypotheses.
6. It helps in establishing the population and extent of generalization.
7. It also determines the statistical limits for accepting and rejecting of hypotheses.

WHAT IS A 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 proposition 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. Quite often a research hypothesis is a predictive statement, capable of being tested by scientific methods, that relates an independent variable to some dependent variable.

For example, consider statements like the following ones:

"Students who receive counseling will show a greater increase in creativity than students not receiving counseling" Or

"The automobile *A* is performing as well as automobile *B*."

These are hypotheses capable of being objectively verified and tested. Thus, we may conclude that hypothesis states what we are looking for and it is a proposition which can be put to a test to determine its validity

Characteristics of hypothesis:

- Hypothesis should be clear and precise.
- Hypothesis should be capable of being tested

- Hypothesis should state relationship between variables, if it happens to be a relational hypothesis.
- Hypothesis should be limited in scope and must be specific.
- Hypothesis should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned.
- Hypothesis should be consistent with most known facts i.e., it must be consistent with a substantial body of established facts.
- Hypothesis should be amenable to testing within a reasonable time.
- Hypothesis must explain the facts that gave rise to the need for explanation.

BASIC CONCEPTS CONCERNING TESTING OF HYPOTHESES

Basic concepts in the context of testing of hypotheses need to be explained.

Null hypothesis and alternative hypothesis*:* If we are to compare method *A* with method *B* about its superiority and if we proceed on the assumption that both methods are equally good, then this assumption is termed as the null hypothesis. As against this, we may think that the method *A* is superior or the method *B* is inferior, we are then stating what is termed as alternative hypothesis.

The null hypothesis is generally symbolized as *H*0 and the alternative hypothesis as *Ha*. Suppose we want to test the hypothesis that the population mean (μ) is equal to the hypothesis mean (μ *H*0)= 100.

Then we would say that the null hypothesis is that the population mean is equal to the hypothesized mean 100 and symbolically we can express as: *H*0: μ =μ *H*0=100

If our sample results do not support this null hypothesis, we should conclude that something else is true. What we conclude rejecting the null hypothesis is known as alternative hypothesis. In other words, the set of alternatives to the null hypothesis is referred to as the alternative hypothesis. If we accept *H*0, then we are rejecting *Ha* and if we reject *H*0, then we are accepting *Ha*. For *H*0: μμ= = *H*0 100

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.

a. ***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. For instance, Mr. Mohan of the Civil Engineering Department wants to test the load bearing capacity of an old bridge which must be more than 10tons.

b. ***Selecting a significance level:*** *T*he 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 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.

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

d. ***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.

e. ***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.

f. ***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 the value in case of one-tailed test (and /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 ofType II.

REVIEW EXERCISE

1. Describe fully the techniques of defining a research problem.
2. What is research problem? Define the main issues which should receive the attention of the researcher in formulating the research problem. Give suitable examples to elucidate your points.
3. How do you define a research problem? Give three examples to illustrate your answer.
4. What is the necessity of defining a research problem? Explain.
5. Write short notes on:
   (a) Experience survey;
   (b) Pilot survey;
   (c) Components of a research problem;
   (d) Rephrasing the research problem.
6. "The task of defining the research problem often follows a sequential pattern". Explain.
7. "Knowing what data are available often serves to narrow down the problem itself as well as the technique that might be used." Explain the underlying idea in this statement in the context of defining a research problem.
8. Write a comprehensive note on the "Task of defining a research problem".
9. What is a hypothesis? What characteristics it must possess in order to be a good research hypothesis?
10. The procedure of testing hypothesis requires a researcher to adopt several steps. Describe in brief all such steps.

CHAPTER 3

RESEACH PROPOSAL

3.1. What is a Research Proposal?

Research proposal is also called "Research Synopsis". A research proposal or research synopsis or an outline of proposed works required by many universities and institutions, serves as a useful basis for the evaluation of a project as well as a guide line for the researcher. The synopsis contains a clear and concise statement of the problem, the hypothesis involved, recognition of the significance of the problem, definitions of the important terms, assumptions and limitations, a resume of related literature, an analysis of proposed research producers, and a time schedule. This proposal or synopsis is placed before the research degree committee to examine its worth. The final approval is given by this committee at university level or research organizations. It is like a blue print of research project.

A proposal of research or synopsis is usually written in third person i.e. he or she or investigator, and in present or future tense. It is submitted to research degree committee's approval. This committee approves as it is or suggests some modifications or rejects the proposal. The researcher can begin only after the approval of the proposal by the committee.

3.2. Functions of Research Proposal

The following points are the main functions of research proposal:

- Research proposal is the guideline of research project that show/lead the researcher to the final research destination.
- It is all about what to be covered and what not be covered in research topic/title
- It is the plan to undertake research activity as that of plan to accomplish office activity (quarter, semi-quarter and annual plan)
- It describes what method to be used in order to achieve the problem we want to solve or assess.
- Research proposal is tell whom is the source of information and how many of them to be included in or not.
- It the time table and budget line that guides the researcher at what time to do what activity and using how much activity.

3.3. General Format of research Proposal

The preparation of a research proposal or synopsis is an important step in the research process. A worthwhile research work is likely to result only from a well-prepared and well-designed proposal or research synopsis. A research proposal includes the following essential parts:

1. The Problem and statement of the problem.
2. The Review of literature or theoretical framework of the study.
3. The Hypotheses and objectives.
4. The Methodology and procedure of the study.
5. Educational implications or significance of the problem.
6. Definitions, assumptions and delimitation.
7. A tentative structure of the report
8. Bibliography.

1. The Statement of the Problem

This attempt to focus on a stated goal gives direction to the research process. It must be limited enough in scope to make a definite conclusion possible. A problem suggests a specific answer or conclusion. The statement of the problem should be written in specific clear-cut words.

2. The Review of Related Literature

A brief summary of previous research should be given so that the researcher and reader may be familiar with what is already known and with what is still unknown and untested. The effective research is based upon past knowledge, this step helps to eliminate replication of what has been done and provides useful basis for the formulation of hypotheses and deciding the methodology of the study. A review of related literature should conclude with a comment of area of agreement and disagreement in findings.

3. The Hypotheses

A scientific study is based on hypotheses. It may be appropriate here to formulate a major hypothesis and several hypotheses. This approach clearly establishes the nature of the problem and the logic underlying the investigation. The hypothesis indicates the expected outcomes the investigation. The formulation of the hypotheses in advance of the data- gathering process is necessary for an unbiased investigation. The hypotheses should be first stated in positive or substantive form.

In every investigation hypotheses cannot be formulated but objectives of the study can be written to indicate the direction of the research work.

4. Methodology and Procedure of the Study

This part of the proposal outlines the entire research plan. Under this part of the synopsis method, sample, population, tools and statistical analysis techniques are described in view of testing the formulated hypotheses. It describes just what must be done, how it will be done, what data will be needed, what data-gathering devices will be employed, how sources of data will be selected, and how the data will be analyzed and conclusions be drawn.

5. Educational Implication or the Significance of the Problem

It is important part of research synopsis in which research points out the answer to the question or the solution to the problem may influence educational theory or practice. The implication of the finding of the study helps to give the project urgency, justifying its worth. Social Studies Research study must have its implication to educational practices.

6. Definitions, Assumptions and Limitations

The statement of the problem or topic of the study includes some terms. These terms or variables should be defined clearly. At this stage operational definitions of terms are usually given in research proposal so that statement of the problem must convey the specific meaning. The variables of the study should be defined clearly and unambiguously in operational terms.

A study involves several variables which play different roles in the investigation. The role of the variable depends on the assumptions of the study. The sample of the study will be representative of the population. The assumptions of the study vary study to study.

The feasibility of an investigation depends on the delimitations of the study. A study is delimited to its variables, sample, method, tools and statistical techniques of the study. These delimitations should be clearly mentioned in the synopsis of the study.

7. Structure of the Report

A tentative structure of the report is also written. It includes the list of chapters which will be included in the report of the research paper. These may be: Introductory or a theoretical framework. Review of literature, Methodology and procedure of the study. Data collection and Analysis of data, conclusions of the study.

8. Bibliography

The last part of the proposal provides the list of references in the form of bibliography which includes books of research, or conceptual framework, hand-books encyclopedia, journals and unpublished and published thesis on the related area of the study.

CRITERIA FOR EVALUATING PROPOSAL OR SYNOPSIS

Various agencies establish their own criteria for evaluating proposal of research project. The following are the some criteria which are commonly used for this purpose:

1. Significance of the proposed research for Indian education, including:
   a) Importance of the problem area from the standpoint of basic knowledge of problems of Indian education.
   b) Likely magnitude of the addition that will be made to knowledge if the project is successful, including the generalize ability of the results.
2. Quality of the proposed research project, including such considerations as :
   a) Extent to which the application exhibits through knowledge of pertinent previous work and relates the proposed research to it.
   b) Likelihood of success of the project.
   c) Adequacy of design, methodology and tools, where appropriate.
3. Qualifications of the investigator and professional personnel as evidenced by :
   (a) Experiences and previous research productivity.
   (b) Quality of the discussion and analysis in the application.
4. Adequacy of the facilities and arrangements available to the investigator to conduct the proposed study.
5. Reasonableness of the budget for the work to be done and the anticipated results. These criteria should be incorporated in preparing a research proposal.

REVIEW EXERCISE

1. What is a research proposal?
2. What is functions of research proposal?
3. Write and explain general format of research proposal?
4. Write criteria for evaluating proposal

CHAPTER 4

RESEARCH DESIGN (PLANNING OF RESEARCH PROJECT)

4.1. Meaning of Research Design

The formidable problem that follows the task of defining the research problem is the preparation of the design of the research project, popularly known as the "research design". Decisions regarding what, where, when, how much, by what means concerning an inquiry or a research study constitute a research design. "A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure."

The research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. As such the design includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data. More explicitly, the design decisions happen to be in respect of:

i. What is the study about?
ii. Why is the study being made?
iii. Where will the study be carried out?
iv. What type of data is required?
v. Where can the required data be found?
vi. What periods of time will the study include?
vii. What will be the sample design?
viii. What techniques of data collection will be used?
ix. How will the data be analysed?
x. In what style will the report be prepared?

Keeping in view the above stated design decisions; one may split the overall research design into the following parts:

a. *The sampling design* which deals with the method of selecting items to be observed for the given study;
b. *The observational design* which relates to the conditions under which the observations are to be made;
c. *The statistical design* which concerns with the question of how many items are to be observed and how the information and data gathered are to be analysed; and

d. *The operational design* which deals with the techniques by which the procedures specified in the sampling, statistical and observational designs can be carried out.

4.2. Important concepts Concerning Research Design

Before describing the different research designs, it will be appropriate to explain the various concepts relating to designs so that these may be better and easily understood.

1. ***Dependent and independent variables:*** A concept which can take on different quantitative values is called a variable. As such the concepts like weight, height, income are all examples of variables. Qualitative phenomena (or the attributes) are also quantified on the basis of the presence or absence of the concerning attribute(s).Phenomena which can take on quantitatively different values even in decimal points are called 'continuous variables'.* But all variables are not continuous.

If they can only be expressed in integer values, they are non-continuous variables or in statistical language 'discrete variables'. Age is an example of continuous variable, but the number of children is an example of non-continuous variable. If one variable depends upon or is a consequence of the other variable, it is termed as a dependent variable, and the variable that is antecedent to the dependent variable is termed as an independent variable. For instance, if we say that height depends upon age, then height is a dependent variable and age is an independent variable. Further, if in addition to being dependent upon age, height also depends upon the individual's sex, then height is a dependent variable and age and sex are independent variables. Similarly, readymade films and lectures are examples of independent variables, whereas behavioral changes, occurring as a result of the environmental manipulations, are examples of dependent variables.

2. ***Extraneous variable:*** Independent variables that are not related to the purpose of the study, but may affect the dependent variable are termed as extraneous variables. Suppose the researcher wants to test the hypothesis that there is a relationship between children's gains in social studies achievement and their self-concepts. In this case self-concept is an independent variable and social studies achievement is a dependent variable. Intelligence may as well affect the social studies achievement, but since it is not related to the purpose of the study undertaken by the researcher, it will be termed as an extraneous variable. Whatever effect is noticed on dependent variable as a result of extraneous variable(s) is technically described as an 'experimental error'. A study must always be so designed that the effect upon the

dependent variable is attributed entirely to the independent variable(s), and not to some extraneous variable or variables.

3. ***Control*:** One important characteristic of a good research design is to minimize the influence or effect of extraneous variable(s). The technical term 'control' is used when we design the study minimizing the effects of extraneous independent variables. In experimental researches, the term 'control' is used to refer to restrain experimental conditions.
4. ***Confounded relationship:*** When the dependent variable is not free from the influence of extraneous variable(s), the relationship between the dependent and independent variables is said to be confounded by an extraneous variable(s).
5. **Research hypothesis:** When a prediction or a hypothesis relationship is to be tested by scientific methods, it is termed as research hypothesis. The research hypothesis is a predictive statement that relates an independent variable to a dependent variable. Usually a research hypothesis must contain, at least, one independent and one dependent variable. Predictive statements which are not to be objectively verified or the relationships that are assumed but not to be tested, are not termed research hypotheses.
6. **Experimental and non-experimental hypothesis-testing research:** When the purpose of research is to test a research hypothesis, it is termed as hypothesis-testing research. It can be of the experimental design or of the non-experimental design. Research in which the independent variable is manipulated is termed 'experimental hypothesis-testing research' and a research in which an independent variable is not manipulated is called 'non-experimental hypothesis-testing research'. For instance, suppose a researcher wants to study whether intelligence affects reading ability for a group of students and for this purpose he randomly selects 50 students and tests their intelligence and reading ability by calculating the coefficient of correlation between the two sets of scores. This is an example of non-experimental hypothesis-testing research because herein the independent variable, intelligence, is not manipulated. But now suppose that our researcher randomly selects 50 students from a group of students who are to take a course in statistics and then divides them into two groups by randomly assigning 25 to Group A, the usual studies program, and 25 to Group B, the special studies program. At the end of the course, he administers a test to each group in order to judge the effectiveness of the training program on the student's performance-level. This is an example of experimental hypothesis-testing research because in this case the independent variable, viz., the type of training program, is manipulated.

7. ***Experimental and control groups*:** In an experimental hypothesis-testing research when a group is exposed to usual conditions, it is termed a 'control group', but when the group is exposed to some novel or special condition, it is termed an 'experimental group'. In the above illustration, the Group A can be called a control group and the Group B an experimental group. If both groups A and B are exposed to special studies program, then both groups would be termed 'experimental groups.' It is possible to design studies which include only experimental groups or studies which include both experimental and control groups.
8. ***Treatments:*** The different conditions under which experimental and control groups are put are usually referred to as 'treatments'. In the illustration taken above, the two treatments are the usual studies program and the special studies program. Similarly, if we want to determine through an experiment the comparative impact of three varieties of fertilizers on the yield of wheat, in that case the three varieties of fertilizers will be treated as three treatments.
9. ***Experiment*:** The process of examining the truth of a statistical hypothesis, relating to some research problem, is known as an experiment. For example, we can conduct an experiment to examine the usefulness of a certain newly developed drug. Experiments can be of two types viz., absolute experiment and comparative experiment. If we want to determine the impact of a fertilizer on the yield of a crop, it is a case of absolute experiment; but if we want to determine the impact of one fertilizer as compared to the impact of some other fertilizer, our experiment then will be termed as a comparative experiment. Often, we undertake comparative experiments when we talk of designs of experiments.
10. ***Experimental unit(s):***The pre-determined plots or the blocks, where different treatments are used, are known as experimental units. Such experimental units must be selected (defined) very carefully.

4.3. Features of Research Design

From what has been stated above, we can state the important features of a research design asunder:

(i) It is a plan that specifies the sources and types of information relevant to the research problem.

(ii) It is a strategy specifying which approach will be used for gathering and analysing the data.

(iii) It also includes the time and cost budgets since most studies are done under these two constraints.

In brief, research design must, at least, contain (a) a clear statement of the research problem; (b) procedures and techniques to be used for gathering information; (c) the population to be studied; and (d) methods to be used in processing and analyzing data.

Good design is often characterized by adjectives like flexible, appropriate, efficient, economical and so on. Generally, the design which minimizes bias and maximizes the reliability of the data collected and analyzed is considered a good design. The design which gives the smallest experimental error is supposed to be the best design in many investigations. Similarly, a design which yields maximal information and provides an opportunity for considering many different aspects of a problem is considered most appropriate and efficient design in respect of many research problems. Thus, the question of good design is related to the purpose or objective of the research problem and also with the nature of the problem to be studied. A design may be quite suitable in one case, but may be found wanting in one respect or the other in the context of some other research problem. One single design cannot serve the purpose of all types of research problems.

A research design appropriate for a particular research problem, usually involves the consideration of the following factors:

i. the means of obtaining information;
ii. the availability and skills of the researcher and his staff, if any;
iii. the objective of the problem to be studied;
iv. the nature of the problem to be studied; and
v. The availability of time and money for the research work.

If the research study happens to be an exploratory or a formulative one, wherein the major emphasis is on discovery of ideas and insights, the research design most appropriate must be flexible enough to permit the consideration of many different aspects of a phenomenon. But when the purpose of a study is accurate description of a situation or of an association between variables (or in what are called the descriptive studies), accuracy becomes a major consideration and a research design which minimizes bias and maximizes the reliability of the evidence collected is considered a good design.

Studies involving the testing of a hypothesis of a causal relationship between variables require a design which will permit inferences about causality in addition to the minimization of bias and

maximization of reliability. But in practice it is the most difficult task to put a particular study in a particular group, for a given research may have in it elements of two or more of the functions of different studies. It is only on the basis of its primary function that a study can be categorized either as an exploratory or descriptive or hypothesis-testing study and accordingly the choice of a research design may be made in case of a particular study. Besides, the availability of time, money, skills of the research staff and the means of obtaining the information must be given due weight age while working out the relevant details of the research design such as experimental design, survey design, sample design and the like.

4.4. Forms of Research Design

Here under this topic we will see two forms of research designs. These are no-experimental research design and experimental research design. The detail discussion will be as follows:

4.4.1 Research Design for Non-experimental Research

The following are non-experimental research design forms:

a. 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.

b) **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.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.

4.4.2 Research design for Experimental Research

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.

Experimental design refers to the framework or structure of an experiment and as such there are several experimental designs. We can classify experimental designs into two broad categories, viz., informal experimental designs and formal experimental designs. Informal experimental designs are those designs that normally use a less sophisticated form of analysis based on differences in magnitudes, whereas formal experimental designs offer relatively more control and use precise statistical procedures for analysis. Important experiment designs are as follows:

a) Informal experimental designs:

i. Before-and-after without control design.
ii. After-only with control design.
iii. Before-and-after with control design.

b) Formal experimental designs:

i. Completely randomized design (C.R. Design).
ii. Randomized block design (R.B. Design).
iii. Latin square design(L.S. Design).
iv. Factorial designs.

A. Informal experimental designs:

1. Before-and-after without control design.

In such a design a single test group or area is selected and the dependent variable is measured before the introduction of the treatment. The treatment is then introduced and the dependent variable is measured again after the treatment has been introduced. The effect of the treatment

would be equal to the level of the phenomenon after the treatment minus the level of the phenomenon before the treatment. The design can be represented thus:

Test area: Level of phenomenon before treatment (X)	Level of phenomenon after treatment (Y) Treatment introduced	Treatment Effect = (Y) – (X)

The main difficulty of such a design is that with the passage of time considerable extraneous variations may be there in its treatment effect.

2. **After-only with control design:** In this design two groups or areas (test area and control area) are selected and the treatment is introduced into the test area only. The dependent variable is then measured in both the areas at the same time. Treatment impact is assessed by subtracting the value of the dependent variable in the control area from its value in the test area. This can be exhibited in the following form:

Test area: Treatment introduced Treatment Level of phenomenon after treatment (Y)

Control area: ⟶ Level of phenomenon without treatment (Z)

Effect = (Y) – (Z)

The basic assumption in such a design is that the two areas are identical with respect to their behavior towards the phenomenon considered. If this assumption is not true, there is the possibility of extraneous variation entering into the treatment effect. However, data can be collected in such a design without the introduction of problems with the passage of time. In this respect the design is superior to before-and-after without control design.

3. **Before-and-after with control design.**

In this design two areas are selected and the dependent variable is measured in both the areas for an identical time-period before the treatment. The treatment is then introduced into the test area only, and the dependent variable is measured in both for an identical time-period after the introduction of the treatment. The treatment effect is determined by subtracting the change in the dependent variable in the control area from the change in the dependent variable in test area. This design can be shown in this way:

Test area:

Time Period I	Time Period II
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)

This design is superior to the above two designs for the simple reason that it avoids extraneous variation resulting both from the passage of time and from non-comparability of the test and control areas. But at times, due to lack of historical data, time or a comparable control area, we should prefer to select one of the first two informal designs stated above.

4. **Completely randomized design (C.R. design):**

Involves only two principles viz.,the principle of replication and the principle of randomization of experimental designs. It is the simplest possible design and its procedure of analysis is also easier. The essential characteristic of the design is that subjects are randomly assigned to experimental treatments (or vice-versa). For instance, if we have 10 subjects and if we wish to test 5 under treatment A and 5 under treatment B, the randomization process gives every possible group of 5 subjects selected from a set of 10 an equal opportunity of being assigned to treatment A and treatment B. One-way analysis of variance (or one-way ANOVA)* is used to analyze such a design. Even unequal replications can also work in this design. It provides maximum number of degrees of freedom to the error. Such a design is generally used when experimental areas happen to be homogeneous. Technically, when all the variations due to uncontrolled extraneous factors are included under the heading of chance variation, we refer to the design of experiment as C.R. design.

5. **Randomized block design (R.B. design)** is an improvement over the C.R. design.

In the R.B. design the principle of local control can be applied along with the other two principles of experimental designs. In the R.B. design, subjects are first divided into groups, known as blocks, such that within each group the subjects are relatively homogeneous in respect to some selected variable. The variable selected for grouping the subjects is one that is believed to be related to the measures to be obtained in respect of the dependent variable. The number of subjects in a given block would be equal to the number of treatments and one subject in each block would be randomly assigned to each treatment.

In general, blocks are the levels at which we hold the extraneous factor fixed, so that its contribution to the total variability of data can be measured. The main feature of the R.B. design is that in this each treatment appears the same number of times in each block. The R.B. design is analyzed by the two-way analysis of variance (two-way ANOVA)* technique.

6. **Latin square design (L.S. design)** is an experimental design very frequently used in agricultural research.

The conditions under which agricultural investigations are carried out are different from those in other studies for nature plays an important role in agriculture. For instance, an experiment has to be made through which the effects of five different varieties of fertilizers on the yield of a certain crop, say wheat, it to be judged. In such a case the varying fertility of the soil in different blocks in which the experiment has to be performed must be taken into consideration; otherwise the results obtained may not be very dependable because the output happens to be the effect not only of fertilizers, but it may also be the effect of fertility of soil. Similarly, there may be impact of varying seeds on the yield. To overcome such difficulties, the L.S. design is used when there are two major extraneous factors such as the varying soil fertility and varying seeds.

The Latin-square design is one wherein each fertilizer, in our example, appears five times but is used only once in each row and in each column of the design. In other words, the treatments in a L.S. design are so allocated among the plots that no treatment occurs more than once in any one row or any one column. The two blocking factors may be represented through rows and columns (one through rows and the other through columns). The following is a diagrammatic form of such a design in respect of, say, five types of fertilizers, viz., A, B, C, D and E and the two blocking factor viz., the varying soil fertility and the varying seeds:

7. **Factorial designs:**

Factorial designs are used in experiments where the effects of varying more than one factor are to be determined. They are specially important in several economic and social phenomena where usually a large number of factors affect a particular problem. Factorial designs can be of two types: (i) simple factorial designs and (ii) complex factorial designs. We take them separately

i. *Simple factorial designs:*

In case of simple factorial designs, we consider the effects of varying two factors on the dependent variable, but when an experiment is done with more than two factors, we use complex factorial designs. Simple factorial design is also termed as a 'two-factor-factorial design', whereas complex factorial design is known as 'multifactor- factorial design.' Simple factorial design may either be a 2 × 2 simple factorial design, or it may be, say, 3 × 4 or 5 × 3 or the like type of simple factorial design.

ii. *Complex factorial designs:*

Experiments with more than two factors at a time involve the use of complex factorial designs. A design which considers three or more independent variables simultaneously is called a complex factorial design. In case of three factors with one experimental variable having two treatments and two control variables, each one of which having two levels, the design used will be termed 2 × 2 × 2 complex factorial design which will contain a total of eight cells.

REVIEW EXERCISE

1. Explain the meaning and significance of a Research design.
2. Explain the meaning of the following in context of Research design.
   (a) Extraneous variables;
   (b) Confounded relationship;
   (c) Research hypothesis;
   (d) Experimental and Control groups;
   (e) Treatments.
3. Describe some of the important research designs used in experimental hypothesis-testing research study.
4. "Research design in exploratory studies must be flexible but in descriptive studies, it must minimize bias and maximize reliability." Discuss.
5. Give your understanding of a good research design. Is single research design suitable in all research studies? If not, why?
6. Explain and illustrate the following research designs:
   (a) Two group simple randomized design;
   (b) Latin square design;
   (c) Random replications design;
   (d) Simple factorial design;
   (e) Informal experimental designs.

CHAPTER 5

SOURCES AND METHODS OF DATA COLLECTION

The task of data collection begins after a research problem has been defined and research design/ plan chalked out. While deciding about the method of data collection to be used for the study, the researcher should keep in mind two types of data viz., primary and secondary.

5.1. Primary data

The *primary data* are those which are collected afresh and for the first time, and thus happen to be original in character.

5.1.1. Source

We collect primary data during the course of doing experiments in an experimental research but in case we do research of the descriptive type and perform surveys, whether sample surveys or census surveys, then we can obtain primary data either through observation or through direct communication with respondents in one form or another or through personal interviews

5.1.2. Data collection Method

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

1. Observation method,

The observation method is the most commonly used method especially in studies relating to behavioral 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. For instance, in a study relating to consumer behaviour, the investigator instead of asking the brand of wrist watch used by the respondent, may himself look at the watch.

The main advantage of this method is:

a) Subjective bias is eliminated, if observation is done accurately.

b) 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.

c) 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.

Limitation of observation method

a) Firstly, it is an expensive method.

b) Secondly, the information provided by this method is very limited.

c) 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.

In case the observation is characterized by a careful definition of the units to be observed, the style of recording the observed information, standardized 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 observation.*

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*.

2. 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. 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. 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.

Types of interviews:

- *Structured interviews:* Such interviews involve the use of a set of predetermined questions and of highly standardized techniques of recording. The interviewer in a structured interview follows a rigid procedure laid down, asking questions in a form and order prescribed.
- *Unstructured interviews:* are characterized by a flexibility of approach to questioning. Unstructured interviews do not follow a system of pre-determined questions and standardized 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.
- *Focused 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 *clinical interview* is concerned with broad underlying feelings or motivations or with the course of individual's life experience.

- *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.

(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; callbacks 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.

Demerit of telephone interview

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

3. Through questionnaires

It is being adopted by private individuals, research workers, private and public organizations 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.

Merit of questionnaire

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 of questionnaire

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 dispatched.
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.
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.

Researcher should note the following with regard to these three main aspects of a questionnaire:

1. *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. 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.

2. *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.

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.

3. *Question formulation and wording:*

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.

(For instance, instead of asking. "How many razor blades do you use annually?" The more realistic question would be to ask, "How many razor blades did you use last week?

4. 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.
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, and hardworking and should have patience and perseverance.
This method of data collection is very useful in extensive enquiry 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 organizations. Population census all over the world is conducted through this method.

5. Other methods which include

a. Warranty cards
b. Distributor audits
c. Pantry audits
d. Consumer panel
e. Using mechanical devices
f. Through projective techniques
g. Depth interviews, and
h. Content analysis.

5.2. Secondary

The secondary data, on the other hand, are those which have already been collected by someone else and which have already been passed through the statistical process. Secondary data means data that are already available i.e., they refer to the data which have already been collected and analyzed by someone else. When the researcher utilizes secondary data, then he/she has to look into various sources from where he can obtain them. In this case he/she is certainly not confronted with the problems that are usually associated with the collection of original data.

5.2.1. Source

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 organizations;
(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.
(f) reports prepared by research
(g) Scholars, universities, economists, etc. in different fields; and public records and statistics, historical documents, and other sources of published information.

Before using secondary data, must see that they possess following characteristics:

1. Reliability of data: The reliability can be tested by finding out such things about the said data:(a) who collected the data? (b) What were the sources of data? (c) Were they collected by using proper methods (d) At what time were they collected?(e) Was there any bias of the compiler? (f) What level of accuracy was desired? Was it achieved?

2. Suitability of data: The data that are suitable for one enquiry may not necessarily be found suitable in another enquiry. Hence, if the available data are found to be unsuitable, they should not be used by the researcher. In this context, the researcher must very carefully scrutinize the definition of various terms and units of collection used at the time of collecting the data from the

primary source originally. Similarly, the object, scope and nature of the original enquiry must also be studied. If the researcher finds differences in these, the data will remain unsuitable for the present enquiry and should not be used.

3. Adequacy of data: If the level of accuracy achieved in data is found inadequate for the purpose of the present enquiry, they will be considered as inadequate and should not be used by the researcher. The data will also be considered inadequate, if they are related to an area which may be either narrower or wider than the area of the present enquiry.

5.2.2. Data collection Method

Thus, there are various methods of data collection. As such the researcher must judiciously select the method/methods for his own study, keeping in view the following factors:

1. ***Nature, scope and object of enquiry:*** This constitutes the most important factor affecting the choice of a particular method. The method selected should be such that it suits the type of enquiry that is to be conducted by the researcher. This factor is also important in deciding whether the data already available (secondary data) are to be used or the data not yet available (primary data) are to be collected.
2. ***Availability of funds:*** Availability of funds for the research project determines to a large extent the method to be used for the collection of data. When funds at the disposal of the researcher are very limited, he will have to select a comparatively cheaper method which may not be as efficient and effective as some other costly method. Finance, in fact, is a big constraint in practice and the researcher has to act within this limitation.
3. ***Time factor:*** Availability of time has also to be taken into account in deciding a particular method of data collection. Some methods take relatively more time, whereas with others the data can be collected in a comparatively shorter duration. The time at the disposal of the researcher, thus, affects the selection of the method by which the data are to be collected.
4. ***Precision required:*** Precision required is yet another important factor to be considered at the time of selecting the method of collection of data.

The most desirable approach with regard to the selection of the method depends on the nature of the particular problem and on the time and resources (money and personnel) available along with the desired degree of accuracy.

REVIW EXERCISE

1. Enumerate the different methods of collecting data.
2. Examine the merits and limitations of the observation method in collecting material. Illustrate your answer with suitable examples.
3. Describe some of the major projective techniques and evaluate their significance as tools of scientific social research.
4. How does the case study method differ from the survey method? Analyse the merits and limitation of case study method in sociological research.
5. Clearly explain the difference between collection of data through questionnaires and schedules.
6. Discuss interview as a technique of data collection.
7. What are the guiding considerations in the construction of questionnaire? Explain.
8. Distinguish between an experiment and survey. Explain fully the survey method of research.
9. “Experimental method of research is not suitable in management field.” Discuss, what are the problems in the introduction of this research design in business organization?

CHAPTER 6

SAMPLE DESIGN AND PROCEDURE

Introduction

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.

6.1. Sampling Procedure

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

a. **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.

b. **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.

c. **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.

d. **Size of sample:** This refers to the number of items to be selected from the universe to constitute a sample. This is 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 fulfills the requirements of efficiency, representativeness, reliability and flexibility.

e. **Parameters of interest:** In determining the sample design, one must consider the question of the specific population parameters which are of interest.

f. **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.

g. **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.

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 organization.

Sampling errors are the random variations in the sample estimates around the true population parameters. Since they occur randomly and are equally likely to be in either direction, their nature happens to be of compensatory type and the expected value of such errors happens to be equal to zero. Sampling error decreases with the increase in the size of the sample, and it happens to be of a smaller magnitude in case of homogeneous population.

Sampling error can be measured for a given sample design and size. The measurement of sampling error is usually called the 'precision of the sampling plan'.

There are different types of sample designs based on two factors viz., the representation basis and the element selection technique.

6.2 Sampling Techniques

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

A. **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 judgmental 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 organizers 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 judgment of the organizers of the study plays an important part in this sampling design.

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 favorable to his point of view and if that happens, the entire inquiry may get vitiated.

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. This type of sampling is very convenient and is relatively inexpensive.

B. **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. Random sampling from a finite population refers to that method of sample selection which give each possible sample combination an equal probability of being picked up and each item in the entire population to have an equal chance of being included in the sample.

In brief, the implications of random sampling (or simple random sampling) are:

(a) It gives each element in the population an equal probability of getting into the sample; and all choices are independent of one another.

(b) It gives each possible sample combination an equal probability of being chosen.

COMPLEX RANDOM SAMPLING DESIGNS

Probability sampling under restricted sampling techniques, as stated above, may result in complex random sampling designs. Such designs may as well be called 'mixed sampling

designs' for many of such designs may represent a combination of probability and non-probability sampling procedures in selecting a sample. Some of the popular complex random sampling designs are as follows:

(i) Systematic sampling:

In some instances, the most practical way of sampling is to select every i^{th}item on a list. Sampling of this type is known as systematic sampling. An element of randomness is introduced into this kind of sampling by using random numbers to pick up the unit with which to start. For instance, if a 4 per cent sample is desired, the first item would be selected randomly from he first twenty-five and thereafter every 25th item would automatically be included in the sample. Thus, in systematic sampling only the first unit is selected randomly and the remaining units of the sample are selected at fixed intervals.

(ii) Stratified sampling:

If a population from which a sample is to be drawn does not constitute a homogeneous group, stratified sampling technique is generally applied in order to obtain a representative sample. Under stratified sampling the population is divided into several sub-populations that are individually more homogeneous than the total population (the different sub-populations are called 'strata') and then we select items from each stratum to constitute a sample. Since each stratum is more homogeneous than the total population, we are able to get more precise estimates for each stratum and by estimating more accurately each of the component parts, we get a better estimate of the whole. In brief, stratified sampling results in more reliable and detailed information.

The following three questions are highly relevant in the context of stratified sampling:

a) How to form strata?
b) How should items be selected from each stratum?
c) How many items be selected from each stratum or how to allocate the sample size of each stratum?

(iii) Cluster sampling:

If the total area of interest happens to be a big one, a convenient way in which a sample can be taken is to divide the area into a number of smaller non-overlapping areas and then to randomly

select a number of these smaller areas (usually called clusters), with the ultimate sample consisting of all (or samples of) units in these small areas or clusters.

(iv) 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 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.

(v) 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 nationalized banks in Ethiopia and we want to take a sample of few banks for this purpose.

(vi) Sampling with probability proportional to size:

In case the cluster sampling units do not have the same number or approximately the same number of elements, it is considered appropriate to use a random selection process where the probability of each cluster being included in the sample is proportional to the size of the cluster. For this purpose, we have to list the number of elements in each cluster irrespective of the method of ordering the cluster.

(vii) Sequential sampling:

This sampling design is somewhat complex sample design. The ultimate size of the sample under this technique is not fixed in advance, but is determined according to mathematical decision rules on the basis of information yielded as survey progresses. This is usually adopted in case of acceptance sampling plan in context of statistical quality control. When a particular lot is to be accepted or rejected on the basis of a single sample, it is known as single sampling; when the decision is to be taken on the basis of two samples, it is known as double sampling and in case the decision rests on the basis of more than two samples but the number of samples is certain and decided in advance, the sampling is known as multiple sampling. But when the number of samples is more than two but it is neither certain nor decided in advance, this type of system is often referred to as sequential sampling. Thus, in brief, we can say that in sequential sampling, one can go on taking samples one after another as long as one desires to do so.

6.3 Central limit Theorem and Sampling Theory

6.3.1 Central limit Theorem

When sampling is from a normal population, the means of samples drawn from such a population are themselves normally distributed. But when sampling is not from a normal population, the size of the sample plays a critical role. When *n* is small, the shape of the distribution will depend largely on the shape of the parent population, but as *n* gets large ($n > 30$), the shape of the sampling distribution will become more and more like a normal distribution, irrespective of the shape of the parent population.

The theorem which explains this sort of relationship between the shape of the population distribution and the sampling distribution of the mean is known as the central limit theorem. This theorem is by far the most important theorem in statistical inference. It assures that the sampling distribution of the mean approaches normal distribution as the sample size increases. In formal terms, we may say that the central limit theorem states that "the distribution of means of random samples taken from a population having mean μ and finite variance σ^2 approaches the normal distribution with mean μ and variance $\sigma 2 /n$ as *n* goes to infinity."

"The significance of the central limit theorem lies in the fact that it permits us to use sample statistics to make inferences about population parameters without knowing anything about the shape of the frequency distribution of that population other than what we can get from the sample."

6.3.2 SAMPLING THEORY

Sampling theory is a study of relationships existing between a population and samples drawn from the population. Sampling theory is applicable only to random samples. For this purpose the population or a universe may be defined as an aggregate of items possessing a common trait or traits. In other words, a universe is the complete group of items about which knowledge is sought. The universe may be finite or infinite. Finite universe is one which has a definite and certain number of items, but when the number of items is uncertain and infinite, the universe is said to be an infinite universe.

Similarly, the universe may be hypothetical or existent. In the former case the universe in fact does not exist and we can only imagine the items constituting it. Tossing of a coin or throwing a dice are examples of hypothetical universe. Existent universe is a universe of concrete objects i.e., the universe where the items constituting it really exist. On the other hand, the term sample refers to that part of the universe which is selected for the purpose of investigation. The theory of

sampling studies the relationships that exist between the universe and the sample or samples drawn from it.

The main problem of sampling theory is the problem of relationship between a parameter and a statistic. The theory of sampling is concerned with estimating the properties of the population from those of the sample and also with gauging the precision of the estimate. This sort of movement from particular (sample) towards general (universe) is what is known as statistical induction or statistical inference. In more clear terms "from the sample we attempt to draw inference concerning the universe. In order to be able to follow this inductive method, we first follow a deductive argument which is that we imagine a population or universe (finite or infinite) and investigate the behavior of the samples drawn from this universe applying the laws of probability." The methodology dealing with all this is known as sampling theory.

Sampling theory is designed to attain one or more of the following objectives:

(*i*) *Statistical estimation:* Sampling theory helps in estimating unknown population parameters from a knowledge of statistical measures based on sample studies. In other words, to obtain an estimate of parameter from statistic is the main objective of the sampling theory. The estimate can either be a point estimate or it may be an interval estimate. Point estimate is a single estimate expressed in the form of a single figure, but interval estimate has two limits viz., the upper limit and the lower limit within which the parameter value may lie. Interval estimates are often used in statistical induction.

(*ii*) *Testing of hypotheses:* The second objective of sampling theory is to enable us to decide whether to accept or reject hypothesis; the sampling theory helps in determining whether observed differences are actually due to chance or whether they are really significant.

(*iii*) *Statistical inference:* Sampling theory helps in making generalization about the population/ universe from the studies based on samples drawn from it. It also helps in determining the accuracy of such generalizations.

The theory of sampling can be studied under two heads viz., the sampling of attributes and the sampling of variables and that too in the context of large and small samples (By small sample is commonly understood any sample that includes 30 or fewer items, whereas alarge sample is one in which the number of items is more than 30). When we study some qualitative characteristic of

the items in a population, we obtain statistics of attributes in the form of two classes; one class consisting of items wherein the attribute is present and the other class consisting of items wherein the attribute is absent. The presence of an attribute may be termed as a 'success' and its absence a 'failure'.

Thus, if out of 600 people selected randomly for the sample, 120 are found to possess a certain attribute and 480 are such people where the attribute is absent. In such a situation we would say that sample consists of 600 items (i.e., $n = 600$) out of which 120 are successes and 480 failures. The probability of success would be taken as 120/600 = 0.2 (i.e., $p = 0.2$) and the probability of failure or $q = 480/600 = 0.8$. With such data the sampling distribution generally takes the form of binomial probability distribution. If n is large, the binomial distribution tends to become normal distribution which may be used for sampling analysis. We generally consider the following three types of problems in case of sampling of attributes:

i. The parameter value may be given and it is only to be tested if an observed 'statistic' is its estimate.
ii. The parameter value is not known and we have to estimate it from the sample.
iii. Examination of the reliability of the estimate i.e., the problem of finding out how far the estimate is expected to deviate from the true value for the population.

REVIEW EXERCISE

1. What do you mean by 'Sample Design'? What points should be taken into consideration by a researcher in developing a sample design for this research project.
2. How would you differentiate between simple random sampling and complex random sampling designs? Explain clearly giving examples.

3. Why probability sampling is generally preferred in comparison to non-probability sampling? Explain the procedure of selecting a simple random sample.

4. Under what circumstances stratified random sampling design is considered appropriate? How would you select such sample? Explain by means of an example.

5. Distinguish between:

   (a) Restricted and unrestricted sampling;

   (b) Convenience and purposive sampling;

   (c) Systematic and stratified sampling;

   (d) Cluster and area sampling.

6. Under what circumstances would you recommend:

   (a) A probability sample?

   (b) A non-probability sample?

   (c) A stratified sample?

   (d) A cluster sample?

7. Explain and illustrate the procedure of selecting a random sample.

8. "A systematic bias results from errors in the sampling procedures". What do you mean by such a systematic bias? Describe the important causes responsible for such a bias.

9. (a)The following are the number of departmental stores in 10 cities: 35, 27, 24, 32, 42, 30, 34, 40, 29 and 38.If we want to select a sample of 15 stores using cities as clusters and selecting within clusters proportional to size, how many stores from each city should be chosen? (Use a starting point of 4).

   (b)What sampling design might be used to estimate the weight of a group of men and women?

CHAPTER 7

DATA ANALYSIS (AN OVERVIEW)

The data, after collection, has to be processed and analyzed 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.

7.1 Data Processing

With this brief introduction concerning the concepts of processing and analysis, we can now proceed with the explanation of all the processing operations.

1. **Editing**

Editing of data is a process of examining the collected raw data (especially 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.

Field editing consists in the review of the reporting forms by the investigator for completing (translating or rewriting) what the latter has written in abbreviated and/or in illegible form at the time of recording the respondents' responses.

Central editing should take place when all forms or schedules have been completed and returned to the office. This type of editing implies that all forms should get a thorough editing by a single editor in a small study and by a team of editors in case of a large inquiry.

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 un dimensionality 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.

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 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 summarizing 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.

7.2 Data Analysis

The term analysis refers to the computation of certain measures along with searching for patterns of relationship that exist among data-groups. Thus, “in the process of analysis, relationships or differences supporting or conflicting with original or new hypotheses should be subjected to statistical tests of significance to determine with what validity data can be said to indicate any conclusions”.

Analysis of data in a general way involves a number of closely related operations which are performed with the purpose of summarizing the collected data and organizing these in such a manner that they answer the research question(s).

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 categorized as descriptive analysis and inferential analysis (Inferential analysis is often known as statistical analysis). "*Descriptiveanalysis* is largely the study of distributions of one variable.

STATISTICAL ANALYSIS OF DATA

Statistics is the body of mathematical techniques or processes for gathering, describing organizing and interpreting numerical data. Since research often yields such quantitative data, statistics is a basic tool of measurement and research. The research worker who uses statistics is concerned with more than the manipulation of data, statistical methods goes back to fundamental purposes of analysis. Research in education may deal with two types of statistical data application.

1. Descriptive Statistical Analysis, and
2. Inferential Statistical Analysis.

7.2.1 Descriptive analysis

Descriptive statistical analysis is concerned with numerical description of a particular group observed and any similarity to those outside the group cannot be taken for granted. The data describe one group and that one group only.

Much simple educational research involves descriptive statistics and provides valuable information about the nature of a particular group or class.

Data collected from tests and experiments often have little meaning or significance until they have been classified or rearranged in a systematic way. This procedure leads to the organization of materials into few heads.

i. Determination of range of the interval between the largest and smallest scores.
ii. Decision as to the number and size of the group to be used in classification.

Class interval is therefore, helpful for grouping the data in suitable units and the number and size of these class intervals will depend upon the range of scores and the kinds of measures with

which one is dealing. The number of class intervals which a given range will yield can be determined approximately by dividing the range by the interval tentatively chosen.

Most commonly used methods of analysis data statistically are:

1. Calculating frequency distribution usually in percentages of items under study.
2. Testing data for normality of distribution skewness and kurtosis.
3. Calculating percentiles and percentile ranks.
4. Calculating measures of central tendency-mean, median and mode and establishing norms.
5. Calculating measures of dispersion-standard deviation mean deviation, quartile deviation and range.
6. Calculating measures of relationship-coefficient of correlation, Reliability and validity by the Rank-difference and Product moment methods.
7. Graphical presentation of data-Frequency polygon curve, Histogram, Cumulative frequency

a) Polygon and Ogive etc.

While analyzing their data investigations usually make use of as many of the above simple statistical devices as necessary for the purpose of their study.

7.3 Inferential analysis

Inferential statistical analysis involves the process of sampling, the selection for study of a small group that is assumed to be related to the large group from which it is drawn. The small group is known as the sample; the large group, the population or universe, A statistics is a measure based on a sample. A statistic computed from a sample may be used to estimate a parameter, the corresponding value in the population which it is selected.

The primary purpose of research is to discover principles' that have universal application. But to study a whole population in order to arrive at generalization would be impracticable if not impossible.

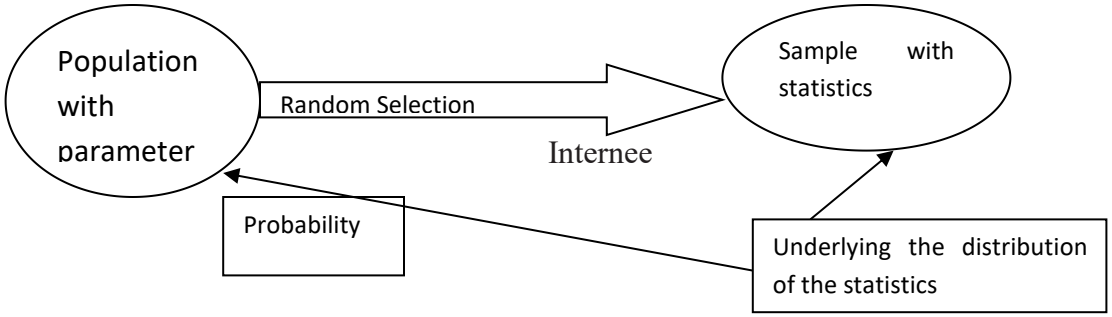
A measured value based upon sample data is statistic. A population value estimated from a statistic is a parameter. A sample is a small proportion of a population selected for analysis. By observing the sample, certain inferences may be made about the population. Samples are not selected haphazardly, but are chosen in a deliberate way so that the influence of chance or probability can be estimated.

Several types of sampling procedures are described each one is particularly appropriate in a given set of circumstances.

INFERENCE FROM STATISTICS TO PARAMETERS

The basic ideas of inference are to estimate the parameters with the help of sample statistics which play an extremely important role in educational research. These basic ideas, of which the concept of underlying distribution is a part, comprise the foundation for testing hypotheses using statistical techniques.

The chain of reasoning from statistics to parameters is a part of what we call inferential statistics. The inference is from the statistics to the parameters. This chain of reasoning has been illustrated with help of the following diagram:



(a) We have a population and want to make decisions about measures of the population namely parameters.
(b) We have a random sample and compute measures of the sample which are termed as statistics.
(c) The statistics are used to estimate parameters with sample fluctuation.
(d) We have to obtain the sample statistics which are the facts that we have to infer back to the parameters in the light of the underlying distribution and probability.

REVIEW EXERCISE

1. "Processing of data implies editing, coding, classification and tabulation". Describe in brief these four operation pointing out the significance of each in context of research study.

2. Why tabulation is considered essential in a research study? Narrate the characteristics of a good table.

3. What points one should observe while using percentages in research studies?

4. Write a brief note on different types of analysis of data pointing out the significance of each.
5. How will you differentiate between descriptive statistics and inferential statistics? Describe the important
6. statistical measures often used to summarize the survey/research data.

CHAPTER 8

INTERPRETATION & REPORTING THE RESEARCH RESULT

8.1. Meaning & Techniques of Interpretation

Meaning of interpretation

Interpretation refers to the task of drawing inferences from the collected facts after an analytical and/or experimental study. It is a search for broader meaning of research findings. The task of interpretation has two major aspects

- The effort to establish continuity in research through linking the results of a given study with those of another, and
- The establishment of some explanatory concepts.

Interpretation is concerned with relationships within the collected data, partially overlapping analysis. Interpretation also extends beyond the data of the study to include the results of other research, theory and hypotheses."

Thus, interpretation is the device through which the factors that seem to explain what has been observed by researcher in the course of the study can be better understood and it also provides a theoretical conception which can serve as a guide for further researches.

WHY INTERPRETATION?

It is being considered a basic component of research process because of the following reasons:

i. It is through interpretation that the researcher can well understand the abstract principle that works beneath his findings.
ii. Interpretation leads to the establishment of explanatory concepts that can serve as a guide for future research studies; it opens new avenues of intellectual adventure and stimulates the quest for more knowledge.
iii. Researcher can better appreciate only through interpretation why his findings are what they are and can make others to understand the real significance of his research findings.
iv. The interpretation of the findings of exploratory research study often results into hypotheses for experimental research and as such interpretation is involved in the transition from exploratory to experimental research. Since an exploratory study does not have a hypothesis to start with, the findings of such a study have to be interpreted on a *post-factum* basis in which case the interpretation is technically described as '*post factum*' interpretation.

TECHNIQUE OF INTERPRETATION

The technique of interpretation often involves the following steps:

i. Researcher must give reasonable explanations of the relations which he has found and he must interpret the lines of relationship in terms of the underlying processes and must try to find out the thread of uniformity that lies under the surface layer of his diversified research findings. In fact, this is the technique of how generalization should be done and concepts be formulated.

ii. Extraneous information, if collected during the study, must be considered while interpreting the final results of research study, for it may prove to be a key factor in understanding the problem under consideration.

iii. It is advisable, before embarking upon final interpretation, to consult someone having insight into the study and who is frank and honest and will not hesitate to point out omissions and errors in logical argumentation. Such a consultation will result in correct interpretation and, thus, will enhance the utility of research results.

iv. Researcher must accomplish the task of interpretation only after considering all relevant factors affecting the problem to avoid false generalization. He must be in no hurry while interpreting results, for quite often the conclusions, which appear to be all right at the beginning, may not at all be accurate.

8.2 **Organization & Types of Reports**

Research reports are the product of slow, painstaking, accurate inductive work. The usual steps involved in writing report are: (a) logical analysis of the subject-matter; (b) preparation of the final outline; (c) preparation of the rough draft; (d) rewriting and polishing; (c) preparation of the final bibliography; and (f) writing the final draft.

I. *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 order 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.

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

III. ***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.

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

V. ***Preparation of the final bibliography:*** Next in order comes the task of the preparation of the final bibliography. The bibliography, which is generally appended to the research report, is a list of books in some way pertinent to the research which has been done. It should contain all those works which the researcher has consulted. The bibliography should be arranged alphabetically and may be divided into two parts; the first part may contain the names of books and pamphlets, and the second part may contain the names of magazine and newspaper articles.

TYPES OF REPORTS

Research investigation can be presented in a number of ways viz., a technical report, a popular report, an article, a monograph or at times even in the form of oral presentation. Which method(s) of presentation to be used in a particular study depends on the circumstances under which the study arose and the nature of the results. A *technical report* is used whenever a full written report of the study is required whether for recordkeeping or for public dissemination. A *popular report* is used if the research results have policy implications. We give below a few details about the said two types of reports:

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.

(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 problems 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.

C. ORAL PRESENTATION

The merit of this approach lies in the fact that it provides an opportunity for give-and-take decisions which generally lead to a better understanding of the findings and their implications. But the main demerit of this sort of presentation is the lack of any permanent record concerning the research details and it may be just possible that the findings may fade away from people's memory even before an action is taken.

In order to overcome this difficulty, a written report may be circulated before the oral presentation and referred to frequently during the discussion. Oral presentation is effective when

supplemented by various visual devices. Use of slides, wall charts and blackboards is quite helpful in contributing to clarity and in reducing the boredom, if any.

Thus, research results can be reported in more than one ways, but the usual practice adopted, in academic institutions particularly, is that of writing the Technical Report and then preparing several research papers to be discussed at various forums in one form or the other. But in practical field and with problems having policy implications, the technique followed is that of writing a popular report. Researches done on governmental account or on behalf of some major public or private organizations are usually presented in the form of technical reports.

REVIW EXERCISE

1. Write a brief note on the 'task of interpretation' in the context of research methodology.
2. "Interpretation is a fundamental component of research process", Explain. Why so?
3. Describe the precautions that the researcher should take while interpreting his findings.
4. "Interpretation is an art of drawing inferences, depending upon the skill of the researcher". Elucidate the given statement explaining the technique of interpretation.