M.A. 3rd Semester
Economics (CBCS)

DSC Course Code: ECON233

Research Methodology

Lessons 1-14

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DSC Course Code: ECON-233
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Chapter-1
RESEARCH METHODOLOGY: AN INTRODUCTION

Structure

1.0 Learning Objectives

After going through this lesson you will be able to:

- Understand the meaning of research
- List the significance of research
- Explain the different types of research
- Explain the different approaches
- Explicate in detail the research problem

1.1 Introduction

The search for knowledge is a never ending process and in its simplest form this process has been called research. The world has evolved as a result of steady efforts to discover new things. In the current times research has become an organized and specialized field. Newer methods to conduct research have come up. However, whatever be the field in which research is being carried out, the research methodology parameters remain the same, even if the objectives and the population to which the problem is being addressed is

different.Certain basic rules, often referred to as standard operating procedures, are common to all fields, although they can be easily developed for scientific research and are fuzzy for social science research. Differences exist between one subject and other, but there is also interdependence. It has been seen that there are inputs of theoretical considerations in empirical studies and in a theoretical study we look for empirical evidences to support the theory.

Thus, conducting research to deal with any problem is a scientific, systematic, and interlinked exercise, which requires experience and knowledge. This chapter is an attempt to understand the nature and scope of research.

1.2 Concept and Meaning of Research

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

1.2.1 Definitions

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

a) William Emory defines Research as “any organized enquiry designed and carried outto provide information for solving a problem”

b) The new Oxford English Dictionary defines research is “the scientific investigationinto and study of material, sources etc inorder to establish facts and the reach newnew conclusions”.

c) Redman and Mory defines, research as “a systematised effort to gain newknowledge’’.

d) “A careful investigation or inquiry specially through search for new facts in anybranch of knowledge” Advanced Leaner’s Dictionary.

e) P.M Cook outlines the term ‘Research’ in a popular way. To him, ‘research’ is an honest, exhaustive intelligent searching for facts and their meanings or implications, with reference to a problem. In an easy to remember method, he lists the attributes of research taking the clue from each initial alphabet of the word:

R - Rational way of thinking

E - Expert and exhaustive treatment

S - Search for solution

E - Exactness

A - Analysis

R - Relationship of facts

C - Critical observation, careful recording, constructive attitude and condensed generalization

H - Honesty and hardworking

Research is, thus, an original addition to the available knowledge which contributes to the further advancement. It is an attempt to pursue truth through the methods of study, observation, comparison and experiment.

1.3 Significance of Research

"All progress is born of enquiry. Doubt is often better than overconfidence, for it leads to enquiry & enquiry leads to invention". Increased amount of research make progress possible. Research inculcates scientific and inductive thinking and it promotes the development of logical habits of thinking and organization. The significance of research can be summed up as follows.

1. **Research leads to discovery and innovation-** Research helps us to discover the unknown, be it the physical world or the social world. It enables us to explore new things and provides newer opportunities for growth. Research open doors for new innovations.
2. **Research improves decision- making-** Research inculcates the habit of logical and inductive thinking, thereby improving our decision-making facilities. All business organizations and governments make their decisions after careful analysis of the prevailing circumstances. Research tools are actively used by them for decisions regarding their policies and day to day work.
3. **Research helps in ascertaining trends-** The strength to face the future is based on ourability to make certain predictions about future. These predictions are not shots in the dark, but based on an analysis of the past trends. E.g. the growth predictions made by the finance minister are based on a careful trend analysis of selected economic indicators. The business cycles are predicted using technique like barometric forecasting, index number etc.
4. **Provides the basis for government policies-** Almost all policies of the government find their basis in research. For instance, government's budgets rest in part on an analysis of the needs and desires of the people and on the availability of revenues to meet these needs. The cost of the needs has to be equated to probable revenues and this is a field where research is most needed. Through research we can devise alternative policies and can as well examine the consequences of each of these alternatives.

5. **Research has special significance in solving various operational and planning problems of business and industry-** Operations research and market research, along with motivational research, are considered crucial and their results assist, in more than one way, in taking business decisions. Market research is the investigation of the structure and development of a market for the purpose of formulating efficient policies for purchasing, production and sales. Operation research refers to the application of mathematical, logical and analytical techniques to the solution of business problems of cost minimization or of profit maximization or what can be termed as optimization problems. Motivational research of determining why people behave as they do is mainly concerned with market characteristics. All these are of great help to people in business and industry who are responsible for taking business decisions.
6. **Research is equally important for social scientist in studying social relationships and in seeking answers to various social problems-** Social scientist use research to understand the dynamics of social relationships. It helps us to understand the working of social groups and social structures. As a result several misconceptions are removed and new insights are gained which makes social progress possible.

In addition to this, the significance of research can be understood with the following points.

a. To the students who are to write a Ph. D; it is careerism.
b. To Professionals in research methodology, research means a source of livelihood.
c. To Philosophers & thinkers research may mean the outlet for new ideas and insights.
d. To literary man research means the development of new styles & creative work.
e. To the intellectuals research mean the generalization of new theories.

1.4 Types of Research

Research can be classified on the basis of purpose, time methodology, setting etc. However one can broadly classify research as Basic or Applied research.

1. **Basic research-** Research for the sake of enhancing knowledge is termed as basic research. Basic or pure research is done with the intention of over powering the unknown. It is an intellectual exploration and the outcome of such research may or may not have any practical relevance. It is primarily concerned with developing and formulating theories and generalizations.
2. **Applied Research –** Appliedor practical research is termed as “need Based” research having practical relevance. The goal of applied research in terms of adding to scientific knowledge base requires a secondary position. The basic aim of such research is to find solutions to problems being faced by society, government or business. Since it is specific in nature, its results are oriented and are driven by clear aim, the time and cost factors are well planned and budgeted.

3. **Qualitative Research -** Qualitative Research is especially important in the behavioral sciences were the aim is to discover the underlying motives of human behavior. Such a research tries to measure the attitudes and opinions of the people using the technique of interview and observation. Various projective techniques like thematic appreciation test, word association test, sentence completion test are used. Such a research is also called as motivation research.
4. **Quantitative research -** Quantitative Research is based on the measurement of quantity or amount. It is applicable to a phenomenon that is phenomenon relating to or involving quality or kind. An example of this kind of research is a study conducted to find out the proportion of school students using self driven vehicles for commuting to school for a given area.
5. **Longitudinal Research –**This kind of research is generally spread over a long period of time. In this kind of study the problem or the phenomenon is studied over a consecutive stretch of time e.g. in marketing research a panel of potential consumers can be chosen. They are subject to variations in the advertisement to judge the most effective advertisement campaign and their purchasing behavior is recorded after exposure to each advertisement over a considerable stretch of time.
6. **Simulation Research –** As the word 'simulation' suggest, this research involves the creation of an artificial environment which is similar to the real environment. Thereafter, within this artificial environment the variables are manipulated and studied. Simulation research permits us to observe the dynamic behavior of the consumer under controlled conditions.
7. **Empirical Research -** This is a data based research in which primary data is collected and the data is analyzed and subject to hypothesis testing, often referred to as experimental research.Empirical Researches rely on experiments or observation alone, often without due regard for system of theory. It is data based research coming up with conclusions which are capable of been variable of observation and experiment.
8. **Historical Research-** Historical Research is that which utilize historical sources like documents remains etc to study events ideas of the past including the philosophy of persons and groups at any remote point of time.

1.5 Research Approaches

The above description of types of research brings to light the fact that there are two basic approaches to research, viz., Quantitative approach and the qualitative approach. The former involves the generations of data in quantitative form which can be subjected to rigorous quantitative analysis in a formal and rigid fashion. This approach can be further sub-classified into inferential, experimental and simulation approaches to research. The purpose of inferential approach to research is to form a data base from which to infer characteristics or relationships of population. This usually means survey research where a sample of population is studied (questioned or observed) to determine its characteristics, and it is then

inferred that the population has the same characteristics. Experimental approach is characterized by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables. Simulation approach involves the construction of an artificial environment within which relevant information and data can be generated. This permits an observation of the dynamic behavior of the system (or its sub-system) under controlled conditions. The term simulations refer to "the operation of a numerical model that represents the structure of a dynamic process. Given the values of initial conditions, parameters and exogenous variables, a simulation is run to represent the behavior of the process over time." Simulation approach can also be useful in building models for understanding future conditions.

Qualitative approach to research is concerned with subjective assessment of attitudes, opinions and behavior. Research in such a situation is a function of researcher's insights and impressions. Such an approach to research generates results either in non-quantitative form or in the form which are not subjected to rigorous quantitative analysis. Generally, the techniques of focus group interviews, projective techniques and depth interviews are used.

1.6 Criteria of good research

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

(a) A good research has a well defined goal. It should have a clear statement of objectives.

(b) It should have a systematic plan of work. A specific programme helps in monitoring and carrying out the research within a budgeted time and cost framework and at the same time yields conclusive results.

(c) A good research contributes towards the existing knowledge bank. It aims at increasing the understanding of existing and new facts and ideas.

(d) Good research is logical. A clear logical argument is required to communicate an ordered sequence of ideas and activities and hence support research conclusions.

(e) The results of the good research should be verifiable. The research if replicated should yield same conclusions. A research thus relies on concrete data collected from real life situation would have good chances of yielding valid results.

(f) A good research is frank. In other words it lists the flaws in the research and also explains the impact of such flaws on research results.

1.7 Research problem

The first and the foremost stage in the research process is to select and properly define a research problem. A researcher must find the problem and formulate it so that it becomes susceptible to research.In general research problem refers to some kind of difficulty the researcher encounters or experience in context of either a practical or theoretical situation, which he/she would like to resolve and find a solution to. A research problem is generally said to exist if the following conditions emerge.

1. 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, $Y_{j.}$
2. There must be at least two courses of action, say C1 and C2, 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.
3. There must be at least two possible outcomes, say O1 and O2, 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.
4. The courses ofaction available must provide some of obtaining the objective, but they cannot provide the same chance, otherwise the choice would not matter. Thus, if P $(O_j/I,C_j,N)$ represents the probability that an outcome $O_j$will occur, if I select C_j in N, then P $(O_1/I,C_1,N) \neq P(O_1/I,C_2,N)$. In simple words, we can say that the choices must have unequal efficiencies for the desired outcomes.

Over the above conditions, 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’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 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 numberof alternatives courses of action may be very large; persons nit involved in making the decisions may be affected by it and react to it favourably or unfavourably, and similar other factors. All such elements (or at least the important ones) may be thought of in context of a research problem**.**

1.7.1 Selection of research problem

The research problem undertaken for the study must be carefully selected. The task is difficult one, although it may not appear to be so. Help may be taken from a research guide in this connection. Nevertheless, every researcher must find out his own salvation for research problems cannot be borrowed. A problem must spring from the researcher's mind like a plant springing from its own seed. If our eyes need glasses, it is not the optician alone who decides about the number of the lens we require. We have to see ourselves and enable him to prescribe for us the right number by cooperating with him. Thus, a research guide can at the most only help a researcher choose a subject. However, the following points may be observed by a researcher in selecting a research problem or a subject for research:

(i) Subject which is overdone should not ne normally chosen, for it will be a difficult task to throw any new light in such a case.

(ii) Controversial subject should not become the choice of an average researcher.

(iii) Too narrow or too vague problems should be avoided.

(iv) The subject selected for research should be familiar and feasible so that the related research material or sources of research are within one's reach. Even then it is quite difficult to supply definitive ideas concerning how a researcher should obtain ideas for his research. For this purpose, a researcher should contact an expert or a professor in the University who is already engaged in research.He may as well read articles published and current literature available on the subject and may think how the techniques and ideas discussed therein might be applied to the solution of other problems. He may discuss with others what he has in his mind concerning a problem. In this way he should make all possible efforts in selecting a problem.

(v) The importance of the subject, the qualifications and the training of a researcher, the costs involved, and the time factor are few other criteria that must also be considered in selecting a problem. In other words, before the final selection of a problem is done, a researcher must ask himself the following questions:

  (a) Whether he is well equipped in terms of his background to carry out the research?

  (b) Whether the study falls within the budget he can afford?

  (c) Whether the necessary cooperation can be obtained from those who must participate in research as subjects?

If the answers to all these questions are in the affirmative, one may become sure so far as the practicability of the study is concerned.

(vi) The selection of a problem must be preceded by a preliminary study. This may not be necessary when the problem requires the conduct of a research closely similar to one that has already been done. But when the field of inquiry is relatively new and does have available set of well developed techniques, a brief feasibility study must always be undertaken.

If the subject for research is selected properly by observing the above mentioned points, the research will not be a boring drudgery, rather it will be love's labour. In fact, zest for work is a must. The subject or the problem selected must involve the researcher and must have an upper most place in his mind so that he may undertake all pains needed for the study.

1.7.2 Need of research problem

A problem clearly stated is a problem half solved. This statement signifies the need for defining a research problem. The problem to be investigated must be defined unambiguously for that will help to discriminate relevant data from the irrelevant ones. A proper definition of research problem will enable the researcher to be on the track whereas an ill-defined problem may create hurdles. Questions like: What data are to be collected? What characteristics of data are relevant and need to be studied? What relations are to be explored? What techniques are to be used for the purpose? And similar other questions crop up in the mind of the researcher who can well plan his strategy and find answers to all such questions only when the research problem has been well defined. Thus, defining a research problem properly is a prerequisite for any study and is a step of the highest importance. Infact, formulation of a problem is often more essential than its solution. It is only careful detailing the research problem that we can work out the research design and can smoothly carry on all the consequent steps involved while doing research.

1.7.3 Techniques involved

Let us start with the question: What does one mean when he/shewants to define a research problem? The answer may be that one wants to state the problem along with the bounds within which it is to be studied. In other words, 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.

Defining a research problem properly and clearly is a crucial part of a research study and must in no case be accompanied hurriedly. However, in practice this is frequently overlooked which causes a lot of problem later on. Hence, the research problem should be defined in a systematic manner, giving due weightage to all relating points. The technique for the purpose involves the undertaking of the following steps generally one after the other: (i) statement of the problem in the 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.

A brief description of all these points will be helpful.

(i) **Statement of the problem in a general way-**The entire 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. Whenthe researcher can himself state the problem or he can seek the guidance of the guide or the subject expert in accomplishing the 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 form an organizational authority, the problemthen 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 should consider once again all those that induced him to make a general statement concerning the problem. For a better understanding of the nature of the problem involved, he can enter into discussion with those who have a good knowledge of the problem concerned or similar other problems. The researcher should also keep in view the environment within which the problem is to be studied and understood.

(iii) **Surveying the available literature-** All available literature concerning the problem at hand must necessarily be surveyed and examined before a definition of the research problem is given. This means that the researcher must be well-conversant with relevant theories in the field, reports and records as also all other relevant literature. He must devote sufficient time in reviewing of research already undertaken on related problems. This is done to find out what data and other materials, if any, are available for operational purposes. “Knowing what data are available often serves to narrow the problem itself as well as the technique that might be used”. This would also help the 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 expectation and so on. All this will enable the 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 and 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 himsharpen his focus of attention on specific aspects within the field. Discussion 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 whichthe problem has got to be studied) has been defined, discussions over the problem have taken place and the available literature hasbeen surveyed and examined, rephrasing the problem into analytical or operational terms is not a difficult task. Through rephrasing , the researcher puts the research problem in as specific terms as possible so that it may become operationally viable and may help in the development of the 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 the 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 must be mentioned explicitly in defining a research problem.

1.8 Summary

Research is a scientific enquiry which is carried out scientifically or systematically or critically. It aims at seeking knowledge and endeavours to discover new facts or principles. A good research study should possess objectivity, control, generalizability, free from personal biases and systematic approach as its basic features. Business research mainly covers production, personnel, marketing, financial, material and general management areas. Research can be fundamental or basic research, applied research, descriptive research,

historical research, formulative or exploratory research, experimental research and ex-post-facto research. These researches can be carried out by adopting qualitative as well as approaches. The qualitative approach to research is focused on understanding a phenomenon from a closer perspective. The approach tends to approximate phenomena from a larger number of individuals issuing survey methods. Problem definition, review of literature, development of working hypothesis, research design, data collection, data analysis, hypothesis testing, data interpretation and preparation of the report are that various steps involved to carry out a research in desired manner.

1.9 Glossary

- **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.
- **Basic research-** Research for the sake of enhancing knowledge is termed as basic research. Basic or pure research is done with the intention of over powering the unknown. It is an intellectual exploration and the outcome of such research may or may not have any practical relevance. It is primarily concerned with developing and formulating theories and generalizations.
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- **Qualitative Research -** Qualitative Research is especially important in the behavioral sciences were the aim is to discover the underlying motives of human behavior. Such a research tries to measure the attitudes and opinions of the people using the technique of interview and observation. Various projective techniques like thematic appreciation test, word association test, sentence completion test are used. Such a research is also called as motivation research.
- **Quantitative research -** Quantitative Research is based on the measurement of quantity or amount. It is applicable to a phenomenon that is phenomenon relating to or involving quality or kind. An example of this kind of research is a study conducted to find out the proportion of school students using self driven vehicles for commuting to school for a given area.

1.10 Answers to Self-Check Exercises

1. Define research?
2. What are significance of research?
3. Write a short note on Applied Research?
4. Explain in brief Qualitative and Quantitative Research?

1.11 Suggested Readings

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1.12 Terminal Questions

1. Define research? What is its significance?
2. Describe the technique of defining a research problem.

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Chapter-2
RESEARCH DESIGN

Structure

2.0 Learning Objectives

After going through this lesson you will be able to:

- Understand the meaning of research Design
- List out the characteristics of a research design
- Explain the need and different types for research design

2.1 Introduction

Once the research proposal is acknowledged by the sponsors, the researcher faces the vital task of working out the details. He has to explain on the method of drawing a sample, the method of collecting and arranging the data and build up an instrument for collecting and arranging the data. All these tasks which are concerned with working out the condition of conducting a research are detailed in research design. Through this design, a researcher is able to test the authenticity of the hypothesis on the basis of resulting data. It is the basis on which the problem is studied further. Hence it is very important that aresearcher devotes sufficient time and energy in developing a research design. The current chapter will discuss the need for developing a research design and will elaborate on different types of research design.

2.2 Meaning of Research Design

A Research Design is the logical and systematic planning in directing the research. It is a part of the planning stage of research, a blueprint for the collection, measurement and analysis of data. But in practices in most of the basis it is just a plan of study. The research design can either be formal or informal. Research design is also known by different names such as research outline, plan, and blue print. In the words of Fred N. Kerlinger, it is the plan, structure and strategy of investigation conceived so as to obtain answers to research questions and control variance. The plan includes everything the investigator will do from writing the hypothesis and their operational implications to the final analysis of data. The structure is the outline, the scheme, the paradigms of the operation of the variables. The strategy includes the methods to be used to collect and analyze the data. At the beginning this plan (design) is generally vague and tentative. It undergoes many modifications and changes as the study progresses and insights into it deepen. The working out of the plan consists of making a series of decisions with respect to what, why, where, when, who and how of the research.

2.2.1 Definitions of Research Design

1. “It constitutes the blue print for the collection, measurement and analysis of data”

   - Philips Bernard S.

2. It “provides a systematic plan of procedure for the researcher to follow”

   -Best John N

3. “The design research from controlling general scientific model into varied researchprocedure”

   - P.V. Young

4. “A research design is “the programme that guides the investigator in the process ofcollecting, analysis and interpreting observations”.

   – David and Shava

A research design addressers itself to the following questions:

a) Why the study is being conducted?
b) What is the study all about?
c) When will the study be carried out?
d) Where will the study be conducted?
e) What is the kind of data required?
f) Where is the required data available?
g) What is the technique of collecting data?
h) What is the method of data analysis adopted?
i) What will be the method of sampling used?
j) What will be the format of reporting the results?

2.3 Characteristics of Good Research Design

A good research design has following characteristics:

1. **Objectivity–** The design shows no proclivity towards any side and the resultant data collected under this design would be free from bias.
2. **Reliability-** A good design would deliver consistent results each time the research is repeated under the design. The response given by the respondent is genuine and would remain the same.
3. **Validity-** The design would deliver accurate and correct results. It collects and measures what it is supposed to do and nothing else.
4. **Generalization-** It means that the results collected under this design, which hold true for a sample must hold true for the entire population.

2.4 Need for Research Design

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

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

2.5 Functions of a Research Design

The function of a research design is to make certain that necessary data in accord with the problem at hand is collected precisely and economically. A research design tells the

researcher as to what steps to follow, what things to be observed, what is the study all about, why is the study being carried out, what things are to be observed, how many observations are to be made, where will the study be carried out, what will be the size of the sample and how the sample units should be collected, what techniques of data collection will be used. It helps to locate the variables and tells us how to control variables. It outlines the possible conclusion to be drawn from the analysis. Finally; it tells us in what style will the report be prepared. The research design aims to provide answers to research questions as validly, objectively, accurately and economically as possible and to bring empirical evidence to bear on the research problem by controlling variance.

2.6 Types of Research Design

Different research designs can be conveniently described if we categorize them as (1) research design in case of exploratory research studies; (2) research design in case of descriptive and diagnostic research studies, and (3) research design in case of hypothesis-testing research studies.We take up each category separately.

1. **Research design in case of exploratory research studies**- Exploratory research studies are also termed as formulative research studies. The main purpose of such studies is that of formulating a problem for more precise investigation or of developing the working hypotheses from an operational point of view. The major emphasis in such studies is on the discovery of ideas and insights. As such the research design appropriate for such studies must be flexible enough to provide opportunity for considering different aspects of a problem under study. Inbuilt flexibility in research design is needed because the research problem, broadly defined initially, is transformed into one with more precise meaning in exploratory studies, which infact may necessitate changes in the research procedure for gathering relevant data. Generally, the following three methods in the context of research design for such studies are talked about: (a) the survey of concern in literature; (b) the experience survey and (c) the analysis of 'insight-stimulating' examples.

a) *The survey of concerning literature* happens to be the most simple and fruitful method of formulating precisely the research problem or developing hypothesis. Hypotheses stated by earlier workers may be reviewed and their usefulness be evaluated as a basis for further research. It may also be considered whether the already stated hypotheses suggest new hypothesis. In this way the researcher should review and build upon the work already done by others, but in cases where hypotheses have not yet been formulated, his task is to review the available material for deriving the relevant hypotheses from it.

Besides, the bibliographical survey of studies, already made in one's area of interest may as well be made by the researcher for precisely formulating the problem. He should also make an attempt to apply concepts and theories developed in different research contexts to the area in which he is himself working. Sometimes, the works of creative writers also provide a fertile ground for hypothesis – formulation and as such may be looked into by the researcher.

b) *Experience survey* means the survey of people who have had practical experience with the problem to be studied. The object of such a survey is to obtain insight into the relationships between variables and new ideas relating to the research problem. For such a survey people who are competent and can contribute new ideas may be carefully selected as respondents to ensure a representation of different types of experience. The respondents so selected may then be interviewed by the investigator. The researcher must prepare an interview schedule for the systematic questioning of informants. But the interview must ensure flexibility in the sense that the respondents should be allowed to raise issues and questions which the investigator has not previously considered. Generally, the experience-collecting interview is likely to be long and may last for few hours. Hence, it is often considered desirable to send a copy of the questions to be discussed to the respondents well in advance. This will also give an opportunity to the respondents for doing some advance thinking over the various issues involved so that, at the time of interview, they may be able to contribute effectively. Thus, an experience survey may enable the researcher to define the problem more concisely and help in the formulation of the research hypothesis. This survey may as well provide information about the practical possibilities for doing different types of research.

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

Now, what sorts of examples are to be selected and studied? There is no clear cut answer to it. Experience indicates that for particular problems certain types of instances are more appropriate than others. One can mention few examples of 'insight-stimulating' cases such as the reactions of strangers, the reactions of marginal individuals, the study of individuals who are in transition from one stage to another, the reactions of individuals from different social strata and the like. In general, cases that provide sharp contrasts or have striking features are considered relatively more useful while adopting this method of hypotheses formulation.

Thus, in an exploratory or formulative research study which merely leads to insights or hypotheses, whatever method or research design outlined above is adopted, the only thing essential is that it must continue to remain flexible so that many different facets of a problem may be considered as and when they arise and come to the notice of the researcher.

2. Research design in case of descriptive and diagnostic research studies- Descriptive research studies are those studies which are concerned with describing the characteristics of a particular individual, or of a group, whereas diagnostic research studies

determine the frequency with which something occurs or its association with something else. The studies concerning whether certain variables are associated are examples of diagnostic research studies. As against this, studies concerned with specific predictions, with narration of facts and characteristics concerning individual, group or situation are all examples of descriptive research studies. Most of the social research comes under this category. From the point of view of the research design, the descriptive is well as diagnostic studies share common requirements and as such we may group together these two types of research studies. In descriptive as well as in diagnostic studies, the researcher must be able to define clearly, what he wants to measure and must find adequate methods for measuring it along with a clear cut definition of 'population' he wants to study. Since the aim is to obtain complete and accurate information in the said studies, the procedure to be used must be carefully planned. The research design must make enough provision for protection against bias and must maximize reliability, with due concern for the economical completion of the research study. The design in such studies must be rigid and not flexible and must focus attention on the following:

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

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

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

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

(e) Processing and analyzing the data.

(f) Reporting the findings.

In a descriptive/diagnostic study the first step is to specify the objectives with sufficient precision to ensure that the data collected are relevant. If this is not done carefully, the study may not provide the desired information.

Then the question of selecting the methods by which the data are to be obtained comes. In other words, techniques for collecting the information must be devised. Several methods, viz. observation, questionnaires, interviewing, examination of records etc., with their merits and limitations, are available for the purpose and the researcher may use one or more of these methods which have been discussed in detail in later chapters. While designing data-collection procedure, adequate safeguards against bias and unreliability must be ensured. Whichever method is selected, questions must be well examined and be made unambiguous; interviewers must be instructed not to express their own opinion; observers must be trained so that they uniformly record a given item of behavior. It is always desirable to pre-test the data collection instruments before they are finally used for the study purposes. In other words, we can say that "*structural instruments*" are used in such studies.

In most of the descriptive/diagnostic studies the researcher takes out sample(s) and then wishes to make statements about the population on the basis of the sample analysis or analyses. More often than not, sample has to be designed. Different sample designs have been discussed in detail in a separate chapter in this book. Here we may only mention that the problem of designing samples should be tackled in such a fashion that the samples may yield accurate information with a minimum amount of research effort. Usually one or more forms of probability sampling, or what is often described as random sampling, are used.

To obtain data free from errors introduced by those responsible for collecting them, it is necessary to supervise closely the staff of field workers as they collect and record information. Checks may be set up to ensure that the data collecting staff perform their duty honestly and without prejudice. “As data are collected, they should be examined for completeness, comprehensibility, consistency and reliability.”

The data collected must be processed and analysed. This includes steps like coding the interview replies, observations, etc.; tabulating the data; and performing several statistical computations. To the extent possible,, the processing and analyzing procedure should be planned in detail before actual work is started. This will prove economical in the sense that the researcher may avoid unnecessary labour such as preparing tables for which he later finds he has no use or on the other hand, re-doing some tables because he failed to include relevant data. Coding should be done carefully to avoid error in coding and for this purpose the reliability of coders needs to be checked. Similarly, the accuracy of tabulation may be checked by having a sample of the tables re-done. In case of mechanical tabulation the material (i.e., the collected data or information) must be entered on appropriate cards which is usually done by punching holes corresponding to a given code. The accuracy of punching is to be checked and ensured. Finally, statistical computations are needed and as such averages, percentages and various coefficients must be worked out. Probability and sampling analysis may as well be used. The appropriate statistical operations, along with the use of appropriate tests of significance should be carried out to safeguard the drawing of conclusions concerning the study.

Last of all comes the question of reporting the findings. This is the task of communicating the findings to others and the researcher must do it in an efficient manner. The layout of the report needs to be well planned so that all things relating to the research study may be well presented in simple and effective style.

Thus, the research design in case of descriptive/diagnostic studies is a comparative design throwing light on all points narrated above and must be prepared keeping in view the objective(s) of the study and the resources available. However, it must ensure the minimization of bias and maximization of reliability of the evidence collected. The said design can be appropriately referred to as a survey design since it takes into account all the steps involved in a survey concerning a phenomenon to be studied.

The difference between research designs in respect designs in respect of the above two types of research studies can be conveniently summarized in tabular form as under:

Research Design	Type of study	
	Exploratory of Formulative	Descriptive/Diagnostic
Overall design	Flexible design (design must provide opportunity for considering different aspects of the problem)	Rigid design (design must make enough provision for protection against bias and must maximize reliability)
(i) Sampling Design	Non-probability sampling design (purposive or judgment sampling)	Probability sampling design (random sampling)
(ii) Statistical design	No pre-planned design for analysis	Pre-planned design for analysis.
(iii) Observational design	Unstructured instruments for collection of data	Structured or well thought out instruments for collection of data
(iv) Operational design	No fixed decisions about the operational procedures	Advanced decisions about operational procedures.

3. 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 casual relationships between variables. Such studies require procedures that will not only reduce bias and increase reliability, but will permit drawing inferences about casualty. Usually experiments meet this requirement. Hence, when we talk of research design in such studies, we often mean the design of experiments.

Professor R.A. Fisher's name is associated with experimental designs. Beginning of such designs was made by him when he was working at Rothamsted Experimental Station (Centre for Agricultural Research in England). As such the study of experimental designs has its origin in agricultural research. Professor Fisher found that by dividing agricultural fields Field or plots into different blocks and then by conducting experiments in each of these blocks, whatever information is collected and inferences drawn from them, happens to be more reliable. This fact inspired him to develop certain experimental designs for testing hypotheses concerning scientific investigations. Today, the experimental designs are being used in researches relating to phenomena of several disciplines. Since experimental designs originated in the context of agricultural operations, we still use, though in a technical sense, several terms of agriculture (such as treatment, yield, plot, block etc.) in experimental designs.

Basic Principles of Experimental Designs

Professor Fisher has enumerated three principles of experimental designs:

(1) The Principle of Replication; (2) the Principle of Randomization; and the (3) Principle of Local Control.

According to the Principle of Replication, the experiment should be repeated more than once. Thus each treatment is applied in many experimental units instead of one. By doing so the statistical accuracy of the experiments is increased. For example, suppose we are to examine the effect of two varieties of rice. For this purpose we may divide the field into two parts and grow one variety in one part and the other variety in the other part. We can then compare the yield of the two parts and draw conclusion on that basis. But if we are to apply the principle of replication to this experiment, then we first divide the field into several parts, grow one variety in half of these parts and the other variety in the remaining parts. We can then collect the data of yield of the two varieties and draw conclusion by comparing the same. The result so obtained will be more reliable in comparison to the conclusion we draw without applying the principle of replication. The entire experiment can even be repeated several times for better results. Conceptually replication does not present any difficulty, but computationally it does. For example, if an experiment requiring a two-way analysis of variance is replicated, it will then require a three-way analysis of variance since replication itself may be a source of variation in the data. However, it should be remembered that replication is introduced in order to increase the precision of a study; that is to say, to increase the accuracy with which the main effects and interactions can be estimated.

The Principle of Randomization provides protection, when we conduct an experiment, against the effects of extraneous factors by randomization. In other words, this principle indicates that we should design or plan the experiment in such a way that the variations caused by extraneous factors can all be combined under the general heading of “chance.” For instance, if we grow one variety of rice, say, in the first half of the parts of a field and the other variety is grown in the other half, then it is just possible that the soil fertility may be different in the first half in comparison to the other half. If this is so, our results would not be realistic. In such a situation, we may assign the variety of rice to be grown in different parts of the field on the basis of some random sampling technique, i.e., we may apply randomization principle and protect ourselves against the effects of the extraneous factors (soil fertility differences in the given case.) As such, through the application of the principle of randomization, we can have a better estimate of the experimental error.

The *Principle of Local Control* is another important principle of experimental designs. Under it the extraneous factor, the known source of variability, is made to vary deliberately over as wide a range as necessary and this needs to be done in such a way that the variability it causes can be measured and hence eliminated from the experimental error. This means that we should plan the experiment in a manner that we can perform a two-way analysis of variance, in which the total variability of the data is divided into three components

attributed to treatments (varieties of rice in our case), the extraneous factor (soil fertility in our case) and experimental error. In other words, according to the principle of local control, we first divide the field into several homogeneous parts, known as blocks, and then each such block is divided into parts equal to the number of treatments. Then the treatments are randomly assigned to these parts of a block. Dividing the field into several homogenous parts is known as 'blocking'. In general, blocks are the levels at which we hold an extraneous factor fixed, so that we can measure its contribution to the total variability of the data by means of a two-way analysis of variance. In brief, through the principle of local control we can eliminate the variability due to extraneous factor(s) from the experimental error.

Important Experimental Designs

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 experimental 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.

We may briefly deal with each of the above stated informal as well as formal experimental designs.

(i) 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 minus the level of the phenomenon before the treatment. The design can be represented thus :

Test area:	Level of phenomenon before treatment (X)	Treatment introduced →	Level of Phenomenon after treatment (Y)
	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	Level of phenomenon after treatment (Y)
Control area :	⟶	Level of phenomenon without treatment (Z)
	Treatment 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 this 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 are 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 :

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

Treatment Effect = (Y-X) m- (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 this 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 homogenous. 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 homogenous 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.

Let us illustrate the R.B. design with the help of an example. Suppose four different forms of a standardized test in statistics were given to each of five students (selected one from each of the I.Q. blocks) and following are the scores which they obtained.

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

If each student separately randomized the order in which he or she took the four tests (by using random numbers or some similar device), we refer to the design of this experiment as a R.B. design. The purpose of this randomization is to take care of such possible extraneous factors (say as fatigue) or perhaps the experience gained from repeatedly taking the test.

(6) Latin squares 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, is 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 the 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 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 factors viz., the varying soil fertility and the varying seeds :

		FERTILITY LEVEL				
Seeds		I	II	III	IV	V
Differences	X1	A	B	C	D	E
	X2	B	C	D	E	A
	X3	C	D	E	A	B
	X4	D	E	A	B	C
	X5	E	A	B	C	D

The above diagram clearly show that in a L.s. design the field is divided into as many blocks as there are varieties of fertilizers and then each block is again divided into as many parts as there are varieties of fertilizers in such a way that each of the fertilizer variety is used in each of the block (whether column-wise or row wise)only once. The analysis of the L.S. design is very similar to the two-way ANOVA technique.

The merit of this experimental design is that it enables differences in fertility gradients in the field to be eliminated in comparison to the effects of different varieties of fertilizer on the yield of cop. But this design suffers from one limitation, and it is that although each row and each column represents equally all fertilizers varieties, there may be considerable difference in the row and column means both up and across the field. This, in other words, means that in L.S. design we must assume that there is no interaction between treatments and blocking factors. This defect can, however, be removed by taking the means of rows and columns equal to the field mean by adjusting the results. Another limitation of this design is that it requires number of rows, columns and treatments to be equal. This reduces the utility of this design. In case of (2X2) L.S. design, there are no degrees of freedom available for the mean square error and hence the design cannot be used. If treatments are10 or more, than each row and each column will be larger in size so that rows and columns may not be homogenous. This may make the application of the principle of local control ineffective. Therefore, L.S. design of orders (5X5) to (9X9) are generally used.

(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 phenomenon 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 'multi-factor-factorial design'. Simple factorial design may either be a 2x2 simple factorial design, or it may be, say, 3x4 or 5x3 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 as 2x2x2 complex factorial design which will contain a total of eight cells as shown below.

Experimental Variable				
	Treatment A		Treatment B	
	Control Variable2 Level I	Control Variable2 Level II	Control Variable Level III	Control Variable Level IV
Control Variable1 Level 2	Cell 1	Cell 3	Cell 5	Cell 7
Control Variable1 Level 2	Cell 2	Cell 4	Cell 6	Cell 8

Factorial designs are used mainly because of the two advantages (i) they provide equivalent accuracy (as happens in the case of experiments with only one factor) with less labour and as such are a source of economy. Using factorial designs, we can determine the main effects of two (in simple factorial design) or more (in case of complex factorial design) factors (or variables) in one single experiment. (ii) They permit various other comparisons of interest. For example, they give information about such effects which cannot be obtained by treating one single facto at a time. The determination of interaction effects is possible in case of factorial designs.

2.7 Techniques for Preparing Research Design

Research design is an important step in the research process which cannot be bypassed. Thenature, type, length and complexity of research designs vary considerably for different studies. However, following are the essential steps involved in preparing a good research design;

1. **Formulate the research problem clearly and setup the objectives-**It is true that the choice of a research problem depends on researcher's interest, resources and values. Research design will differ according to the purpose of research. For example, the study whose purpose is exploration would require a flexible design but the design will have to be rigid in descriptive or diagnostic study. So first of all formulate the research problem and setup the objectives.
2. **Review previous published literature dealing with the problem-** In the next step gothrough all the existing literature related to the problem. It helps to know if the problem has been investigated earlier. If so how and to what extent? Moreover, it will sensitize you to the methods and procedures which have been used by others investigating the same area.
3. **Clearly and explicitly specify hypotheses-** The third major step in a research design is to clearly state the hypotheses to be tested. Hypotheses are tentative solutions of a problem. Clear and careful statement of the hypotheses entails clear conceptual definition of the major variables involved and helps the researcher in delimiting the scope of the study.

4. **Clearly describe the data which will be necessary for an adequate test of the hypotheses and explain how such data will be obtained-** After you have stated your hypotheses clearly describe the data you will need to test the hypotheses, the sources primary or secondary from which you will collect data and the tools and techniques which will be used for collecting data.
5. **Describe the methods for processing and analysis the data-**Now identify the methods of analysis appropriate for treating the data. This involves selection of appropriate statistical techniques. Be as specific as possible in describing the approach you will use, but do not propose to employ a technique that you do not really understand because every techniques serves a special purpose and has a special set of assumptions which must be met before it can be used for analysis and interpretation.
6. **Prepare a working guide with time and budget estimates-** lastly prepare a working guide which gives details about the funding, costing and timing of various steps of research study.

2.8 Summary

In this chapter we have studied about research design, its various characteristics, need for a research design and different types of research design. In simple words research design includes a number of components whichare interdependent and which demand a series of decisions regarding definitions,scope, methods, techniques, procedures, instruments, time, place, expenditure andadministration aspects. There are different types of research design and the researcher has to decide in advance before collection of the data as to which design will prove to be appropriate for his research.

2.9 Glossary

- **Research Design-**A Research Design is the logical and systematic planning in directing the research. It is a part of the planning stage of research, a blueprint for the collection, measurement and analysis of data. But in practices in most of the basis it is just a plan of study
- **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 phenomenon 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
- **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 ‘multi-factor-factorial design’. Simple factorial design may either be a 2x2 simple factorial design, or it may be, say, 3x4 or 5x3 or the like type of simple factorial design.

- **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.

2.10 Answers to Self-Check Exercises

1 Define research design?

2 Distinguish between Experimental and Explanatory Research.

3 Distinguish between Pre-test and Post-test Research Design.

4 Why do we need a research design?

2.11 Suggested Readings

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2.12 Terminal Questions

1. What is a research design? What are the characteristics of a good research design?
2. Explicate some of the important research designs used in experimental hypothesis testing research study.

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CHAPTER-3
COLLECTION OF PRIMARY DATA

Structure

3.0 Learning Objectives

After reading this chapter, you will beableto:

- discuss the necessity and usefulness of data collection,
- explain and distinguish between primary data and secondary data,
- describe different methods of collecting primary data and their merits and demerits,
- examine the choice of a suitable method.

3.1 Introduction

Inchapter 2, we have discussed a boutthes election of a research problem and formulation of research design. A research design is a blue print which directs the plan of action to complete the research work. As we have mentioned earlier, the collection of dataisan important part in the process of research work. The quality and credibility of the results derived from the application ofresearch methodology depends upon the relevant, accurate and adequate data. In this chapter, we shall study about the various sources of data and methods of collecting the primary data with their merits and limitations and also the choice of suitable method for data collection.

3.2 Meaning and Need for Data

Data is required to make a decision in any business situation. The researcher is faced with one of the most difficult problems of obtaining suitable, accurate and adequate data. Utmost care must be exercised while collecting data because the quality of the research results depends upon the reliability of the data.

The data directly collected by the researcher, with respect to the problem under study, is knownas primary data. Primary data is also the firsthand data collected by the researcher for theimmediate purpose of the study.Primary data is the data that is collected by the researchers for the purpose of investigation. Thisdata is original in character and generated by surveys. Primary data is the information collected during the course of experiment in an experimental research. It can also be obtained throughobservations or through direct communication with the persons associated with the selectedsubject by performing surveys or descriptive research.The data may be classified as primary and secondary data. Let us now discuss these two kinds of data in detail.

3.3 Primary and Secondary Data

The **Primary data** are original data which are collected for the first time for a specific purpose. Such data are published by authorities who themselves are responsible for their collection. The **Secondary data** on the other hand, are those which have already been collected by some other agency and which have already been processed. Secondary data may be available in the form of **published** or **unpublished** sources. For instance, population census datacollected by the Government in a country is primary data for that Government. But the same data be comes secondary for those researchers who use it later. In case you have decided to collect primary data for your investigation, you have to identify the sources from where you can collect that data. For example, if you wish to study the problems of the workers of X Company Ltd., then the workers who are working in that company are the source. On the other hand, if you have decided to use secondary data,you have to identify the secondary source who have already collected the related data for their study purpose. With the above discussion, we can understand that the difference between primary and secondary data is only in terms of degree. That is that the data which is primary in the hands of one be comes secondary in the hands of another.

3.4 Benefits &Limitations of Primary Data

Benefits of Primary data cannot be neglected. A research can be conducted without secondarydata but a research based on only secondary data is least reliable and may have biases becausesecondary data has already been manipulated by human beings. In statistical surveys it isnecessary to get information from primary sources and work on primary data: for example, thestatistical records of female population in a country cannot be based on newspaper, magazineand other printed sources. One such source is old and secondly they contain limited informationas well as they can be misleading and biased.

1. **Validity:** Validity is one of the major concerns in a research. Validity is the quality of a research that makes it trustworthy and scientific. Validity is the use of scientific methods in research to make it logical and acceptable. Using primary data in research can improves the validity of research. First hand information obtained from a sample that is representative of the target population will yield data that will be valid for the entire target population.
2. **Authenticity:** Authenticity is the genuineness of the research. Authenticity can be at stake if the researcher invests personal biases or uses misleading information in the research. Primary research tools and data can become more authentic if the methods chosen to analyze and interpret data are valid and reasonably suitable for the data type. Primary sources are more authentic because the facts have not been overdone. Primary source can be less authentic if the source hides information or alters facts due to some personal reasons. There are methods that can be employed to ensure factual yielding of data from the source.
3. **Reliability:** Reliability is the certainty that the research is enough true to be trusted on. For example, if a research study concludes that junk food consumption does not increase the risk of cancer and heart diseases. This conclusion should have to be drawn from a sample whose size, sampling technique and variability is not questionable. Reliability improves with using primary data. In the similar research mentioned above if the researcher uses experimental method and questionnaires the results will be highly reliable. On the other hand, if he relies on the data available in books and on internet he will collect information that does not represent the real facts.

One limitation of primary data collection is that it consumes a lot of time. The researchers willneed to make certain preparations in order to handle the different demands of the processes andat the same time, manage time effectively. Besides time consumption, the researchers willcollect large volumes of data when they collect primary data. Since they will interact withdifferent people, they will end up with large volumes of data, which they will need to gothrough when analyzing and evaluating their findings. The primary data also require the greaterproportion of workforce to be engaged in the collection of information and analysis, which enhances complexity of operations. There is requirement of large amount of resources to collectprimary data.

3.5 MethodsofCollectingPrimaryData

If the available secondary data does not meet the requirements of the present study, the researcher has to collect primary data. Asmentioned earlier, the data which is collected for the first time by the researcher for his own purpose is called primary data. There are several methods of collecting primary data, such as observation, interview through reporters, questionnaires and schedules. Let us study about them in detail.

3.5.1 Observation Method

The Concise Oxford Dictionary defines observationas, 'accurate watching and noting of phenomena as they occurinnature with regard to cause and effector mutual relations'. Thus observation is not only a systematic watching but italso involves listening and reading, coupled with consideration of the seen phenomena. It involves three processes. They are: sensation, attention or concentration and perception.

Under this method, the researcher collects information directly through observation rather than through the reports of others. It is a process of recording relevant information without asking anyone specific questions and in some cases, even with out theknowledgeoftherespondents.Thismethodofcollection is highly effective in behavioural surveys. For instance, a study onbehaviour of visitors in trade fairs, observing the attitude of workers on the job, bargaining strategies of customers etc. Observation can be participant observation or non-participant observation. In Participant Observation Method, the researcher joins in the daily life of informants or organisations, and observe show they be have. In the Non-participant Observation Method, the researcher will not join the informants or organisations but will watch from outside.

Merits

1) This is the most suitable method when the informants are unable or reluctant to provide information.
2) This method provides deeper insights in to the problem and generally the data is accurate and quicker to process. Therefore, this is useful for intensive study rather than extensive study.

Limitations

Despite of the above merits, this method suffers from the following limitations:

1) In many situations, the researcher cannot predict when the events will occur. So when an event occurs there may not be a ready observer to observe the event.
2) Participants may beaware of the observer and as a result may alter their behaviour.
3) Observer, because of personal biases and lack of training, may not records pecifically what he/she observes.
4) This method cannot beused extensively if the inquiry is large and spread over a wide area.

3.5.2 Interview Method

Inter view is one of the most powerful tools and most widely used method for primary data collection in business research. In our daily routine we see interviews on T.V. channels on various topics related to social, business, sports, budget etc. In the words of C. William Emory, 'personal interviewing is a two-way purposeful conversation initiated by an interviewer to obtain information that is relevant to some research purpose'. Thus an interview

is basically, a meeting between two persons to obtain the information related to the proposed study. The person who is interviewing is named as interviewer and the person who is being interviewed is named as informant. It is to be noted that, the research data/information collect through this method is not a simpleconversation between the investigator and the informant, but also the glances, gestures, facial expressions, level of speech etc., are all part of the process. Through this method, the researcher cancollectvariedtypesof dataintensively and extensively.

Interviewes can be classified as direct personal interviews and indirect personal interviews. Under the techniques of **direct personal interview**, the investigator meets the informants (who come under the study) personally, asks them questions pertaining to enquiry and collects the desired information. Thus if aresearcher intends to collect the data on spending habits of the students of Himachal Pradesh University, Shimla,he/she would go to the HPU, contact the students, interview them and collect the required information.

Indirect personal interview is another technique of interview method where it is not possible to collect data directly from the informants who come under the study. Under this method, the investigator contacts third parties or witnesses,who are closely associated with the persons/situations under study and are capable of providing necessary information. For example, an investigation regarding bribery pattern in an office. In such a case it is inevitable to get the desired information in directly from other people who may be knowing them. Similarly, clues about the crimes are gathered by the CBI. Utmost care must be exercised that these persons who are being questioned are fully aware of the facts of the problem understudy, and are not motivated to give a twist to the facts.

Another technique for data collection through this method can be structured and unstructured interviewing. In the **Structured interview** set questions are asked and the responses are recorded in a standardised form. This is useful in large scale interviews where a number of investigators are assigned the job of interviewing. The researcher can minimise the bias of the interviewer. This technique is also namedas formal interview. In **Un-structured interview**, the investigator may not have a set of questions but have only a number of key points around which to build the interview. Normally, such type of interviews are conducted in the case of an explorative survey where the researcher is not completely sure about the type of data he/she collects. It is also named as informal interview. Generally, this method is used as a supplementary method of data collection in conducting research in business are as.

Now-a-days, telephone or cellphone interviews are widely used to obtain thedesired information for small surveys. For instance, interviewing credit cardholders by banks about the level of services they are receiving. This techniqueis used in industrial surveys specially in developed regions.

Merits

The major merits of this method are as follows:

1) People are more willing to supply information if approached directly. Therefore, personal interviews tend to yield high response rates.
2) This method enables the interviewer to clarify any doubt that the interviewee might have while asking him/her questions. Therefore, interviews are helpful in getting reliable and valid responses.
3) The informant's reactions to questions can be properly studied.
4) The researcher can use the language of communication according to the standard of the information, so as to obtain personal information of informants which are helpful in interpreting the results.

Limitations

The limitations of this method are as follows:

1) The chance of the subjective factors or the views of the investigator may come in either consciously or unconsciously.
2) The interviewers must be properly trained, otherwise the entire work may be spoiled.
3) It is a relatively expensive and time-consuming method of data collection especially when the number of persons to be interviewed is large and they are spread over a wide area.
4) It cannot be used when the field of enquiry is large (large sample).

Precautions: While using this method, the following precautions should be taken:

1) Obtain thorough details of the theoretical aspects of the research problem.
2) Identify who is to be interviewed.
3) The questions should be simple, clear and limited in number.
4) The investigator should be sincere, efficient and polite while collecting data.
5) The investigator should be of the same area (field of study, district, state etc.).

3.5.3 Through Local Reporters and Correspondents

Under this method, local investigators/agents or correspondents are appointed in different parts of the area under investigation. This method is generally adopted by government departments in those cases where regular information is to be collected. This method is also useful for newspapers, magazines, radio and TV news channels. This method has been used when regular information is required and a high degree of accuracy is not of much importance.

Merits

1) This method is cheap and economical for extensive investigations.
2) It gives results easily and promptly.
3) It can cover a wide are a under investigation.

Limitations

1) The data obtained may not be reliable.
2) It gives approximate and rough results.
3) It is unsuited where a high degree of accuracy is desired.
4) Astheagent/reporter or correspondent uses his own judgement, his personal bias may affect the accuracy of the information sent.

3.5.4 QuestionnaireandScheduleMethods

Questionnaire and schedule methods are the popular and common methods forcollecting primary data in business research. Both the methods comprise a list of questions arranged in a sequence pertaining to the investigation. Let us study these methods in detail one after another.

i) Questionnaire Method

Under this method, questionnaires are sent personally or by post to various informants with a request to answer the questions and return the questionnaire. If the questionnaire is posted to informants, it is called a **Mail Questionnaire**. Sometimes questionnaires may also sent through E-mail depending upon the nature of study and availability of time and resources. After receiving thequestionnaires the informants read the questions and record their responses in the spacemeant for the purpose on the questionnaire. It is desirable to send the quetionnaire with self-addressed envelopes for quick and high rate ofresponse.

Merits

1) You can use this method in cases where informants are spread over a vast geographical area.
2) Respondents can take their own time to answer the questions. So the researcher can obtain original data by this method.
3) This is a cheap method because its mailing cost is less than the cost of personal visits.
4) This method is free from bias of the investigator as the information is given by the respondents themselves.
5) Large samples can be covered and thus the results can be more reliable and dependable.

Limitations

1) Respondents may not return filled in questionnaires, or they can delay in replying to the questionnaires.
2) This method is useful only when the respondents are educated and co-operative.
3) Once the questionnaire has been dispatched, the investigator can not modify the questionnaire.
4) It cannot been sured whether the respondents are truly representative.

ii) Schedule Method

As discussed above, a Schedule is also a list of questions, which is used to collect the data from the field. This is generally filled in by there searcher or the enumerators. If the scope of the study is wide, then the researcher appoints people who are called enumerators for the purpose of collecting the data. The enumerators go to the informants, ask them the questions from the schedule in the order they are listed and record the responses in the spacemeant for the answers in the schedule itself. For example, the population census all over theworld is conducted through this method. The difference between questionnaire and schedule is that the former is filled in by the informants, the latter is filled in by the researcher or enumerator.

Merits

1) It is a useful method in case the in formants are illiterates.
2) The researcher can overcome the problem of non-response as the enumerators go personally to obtain the information.
3) It is very useful in extensive studies and can obtain more reliable data.

Limitations

1) It is a very expensive and time-consuming method as enumerators are paid persons and also have to be trained.
2) Since the enumerator is present, the respondents may not respond to some personal questions.
3) Reliability depends upon the sincerity and commitment in data collection.

The success of data collection through the questionnaire method or schedule method depends on how the questionnaire has been designed.

3.6 Choice of Suitable Method

You have noticed that there are various methods and techniques for the collection of primary data. You should be careful while selecting the method which should be appropriate and effective. The selection of the methods depends upon various factors like scope and objectives of the inquiry, time, availability of funds, subject matter of the research, the kind of information required, degree of accuracy etc. As apprised, every method has its own merits and demerits. For example, the observation method is suitable for field surveys when the incident is really happening; the interview method is suitable where direct observation is not possible. Local reporter/correspondent method is suitable when information is required at regular intervals. The questionnaire method is appropriate in extensive enquiries where sample is large and scattered over large geographical areas and the respondents are able to express their responses in writing. The Schedule method is suitable in case respondents are illiterate.

3.7 Summary

In this chapter we elaborated on the meaning of data, methods of data collection, merits and limitations of data collection, precautions which are needed for the collection of data.

The information collected from various processes for a specific purpose is called data. Statistical data may be either primary data or secondary data. Data which is collected originally for a specific purpose is called primary data. The data which is already collected and processed by someone else and is being used now in the present study, is called secondary data. Secondary data can be obtained either from published sources or unpublished sources. It should be used if it is reliable, suitable and adequate, otherwise it may result in misleading conclusions. It has its own merits and demerits. There are several problems in the collection of primary data. These are: tools and techniques of data collection, degree of accuracy, designing the questionnaire, selection and training of enumerators, problem of tackling non-responses and other administrative aspects.

Several methods are used for collection of primary data. These are: observation, interview, questionnaire and schedule methods. Every method has its own merits and demerits. Hence, no method is suitable in all situations. The suitable method can be selected as per the needs of the investigator which depends on objective nature and scope of the enquiry, availability of funds and time.

3.8 Glossary

- Data: Quantitative or/and qualitative information, collected for study and analysis.
- Interview: A method of collecting primary data by meeting the informants and asking the questions.
- Observation: The process of observing individuals in controlled situations.
- Questionnaire: is a device for collection of primary data containing a list of questions pertaining to enquiry, sent to the informants, and the informant himself writes the answers.
- Primary Data: Data that is collected originally for the first time.
- Secondary Data: Data which were collected and processed by someone else but are being used in the present study.
- Published Sources: Sources which consist of published statistical information.
- Schedule: is a device for collection of primary data containing a list of questions to be filled in by the enumerators who are specially appointed for that purpose.

3.9 Answers to Self-Check Exercises

1. Distinguish between primary and secondary data.
2. How can data be collected through the Observation Method?
3. List out the methods of collecting primary data.

4. Distinguish between direct persona interview and indirect interview. Give suitable examples.
5. Distinguish between Internal and External Data

3.10 Suggested Readings

- Bhandarkar, P.L. and Wilkinson, T.S. (2016). Methodology and Techniques of Social Research. Himalaya Publishing House: New Delhi.
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3.11 Terminal Questions

1. What do you mean by data? Why it is needed for research.
2. Distinguish between primary and secondary data. Illustrate your answer with examples.
3. Explain the various methods of collecting primary data pointing out their merits and demerits?

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CHAPTER-4
CONSTRUCTION OF QUESTIONNAIRE

Structure

4.0 Learning Objectives

After going through this lesson you will be able to:

- Understand the meaning of Questionnaire and instruments
- Explain the characteristics of good questionnaire
- Understand the attributes of a well-designed questionnaire
- Explain the construction of instruments

4.1 Introduction

No survey can achieve success without a well-designed questionnaire. Unfortunately, questionnaire design has no theoretical base to guide the marketing researcher in developing a flawless questionnaire. All the researcher has to guide himself/herself for a lengthy list of do's and don'ts born out of the experience of other researchers past and present. Hence, questionnaire design is more of an art than a science.

4.2 Questionnaire

A questionnaire is a form containing a set of questions, which are filled by the respondents. According to Goode Hatt, "in general, the questionnaire refers to a device for securing answers to questions by using a form which the respondent fills in himself." The objective of a questionnaire is twofold:

i) To collect information from respondents scattered in a wide area.

ii) To achieve success in collecting reliable and dependable information in a short span of time.

4.2.1Characteristics of good Questionnaire

1. **Brief and Limited Questionnaire:**The number of questions in a schedule should be brief and limited as possible. Only relevant questions to the problem under investigation should be added.
2. **Simple and Clear:**The questions should be simple, clear and precise. Its language should be very simple so that informants may easily understand.
3. **Unambiguous Questions:**All unambiguous questions should be avoided at all, complicated and long-worded questions irritate the respondents which results in careless; replies.
4. **No Personal Questions:**No personal question should be asked from, respondents. Such questions should be avoided.
5. **Use of Proper Words:**Questions should be framed with right words. This ensures the validity.
6. **Avoidance of Calculations:**Questions should not be based on calculations. Only those questions should be asked which the respondents may reply immediately. Moreover, questions should avoid memories.
7. **Only Objective Questions:**The questions should be objective. It should be based on opinions of the individuals.
8. **Sequence of the Questions:**The arrangement of the questions should be such so that no question may slip back. It must involve a logical flow of questions.
9. **Pre-testing:**Before sending the questionnaire to the respondents, it must be properly tested.
10. **Instructions:**Precise and simple instructions of filling the questionnaire should be added in the foot note.
11. **Cross Examination:**The questionnaire should be set in such a way that there may be cross examination of the information supplied by the informants. In fact, it is a check on false or inaccurate answers.
12. **Secret Information:**Every respondent should be ensured that information given by them shall be kept secret.
13. **Attractive Questionnaire:**Proper care should be taken to make the questionnaire attractive. A well set questionnaire will certainly impress the recipient.

4.2.2 Questionnaire design

Perhaps the most important part of the survey process is the creation of questions that accurately measure the opinions, experiences and behaviors of the public. Accurate random sampling and high response rates will be wasted if the information gathered is built on a shaky foundation of ambiguous or biased questions. Creating good measures involves both writing good questions and organizing them to form the questionnaire.

Questionnaire design is a multiple-stage process that requires attention to many details at once. Designing the questionnaire is complicated because surveys can ask about topics in varying degrees of detail, questions can be asked in different ways, and questions asked earlier in a survey may influence how people respond to later questions. Researchers also are often interested in measuring change over time and therefore must be attentive to how opinions or behaviors have been measured in prior surveys.

Surveyors may conduct pilot tests or focus groups in the early stages of questionnaire development in order to better understand how people think about an issue or comprehend a question. Pretesting a survey is an essential step in the questionnaire design process to evaluate how people respond to the overall questionnaire and specific questions.

For many years, surveyors approached questionnaire design as an art, but substantial research over the past thirty years has demonstrated that there is a lot of science involved in crafting a good survey questionnaire. Here, we discuss the pitfalls and best practices of designing questionnaires.

4.3 Construction of Questionnaire

(i) Determine what information is needed- A questionnaire has two functions firs, it translates research objective into specific questions which the respondent can answer and second, it motivates the respondent to furnish the desired information correctly. Therefore, before a questionnaire can be formulated, a specific statement of the information needed must be made. The researcher has to first decide the topic of the study and then decide the type of information required such as awareness, facts, opinions, attitudes, reasons and future plans etc.

(ii) Type of Questionnaire-There are several types to ask a questions. Questionnaire can be directly given to the respondents or can be mailed. They can also be used for personal interview or on telephone. The choice of type of questionnaire to be used for the study depends upon the kind of the information to be gathered and the type of the respondents from whom it is to be obtained. It is necessary to determine the type of questionnaire because the questions asked, the way in which they are asked, and the sequence in which they are asked is all influenced by the type of questionnaire.

(iii) Decide on type of questions- After deciding the type of questionnaire the researcher has to decide what type of questions will be asked. The questions can be opened ended or close ended. Open ended questions are those in which respondents are free to answer in their own words. In closed ended questions respondents has to choose an alternative and cannot give his ownjudgment. Close ended questions may be dichotomous having only two answers “Yes” and “No” or multiple choice where respondent has to choose among alternatives or has to rate the alternatives.

(iv) Decide language of the questions- The language of the question and the kind of words used in the questionnaire are extremely important. Slight changes in language

and wording of particular question could have a large impact on how the respondent interprets them. Researchers strive for objectivity in surveys and therefore, he must be careful not to lead the respondent into giving a desired answer. The language of the questions should be simple as that they are unambiguous and easily understood.

(v) Decide on layout- The next step in constructing questionnaire is to decide the layout of the questionnaire. The researcher has to decide what will be the format and sequence of questions. Presentation of the questions should be simple and straightforward. It should facilitate analysis and interpretation. Always try to follow the funnel sequence and move from general to specific questions on the topic.

(vi) Pretest- A questionnaire must be pre tested before giving it a final shape. Questionnaire should be tested with a small number of respondents before conducting the main interview. Ideally, the questionnaire should be tested on the same kinds of people which will be included in the main study. The pretest is a preview of any possible inconsistency or ambiguity with question wording, instructions to skip questions, etc. It can help see the researcher if the interviewees understand questions and are giving the answers.

(vi) Revise and prepare final questionnaire- After the questionnaire has been subjected to a thorough pilot test it should be revised to correct spellings, to place the questions in correct order, to remove the unfamiliar words and to remove the insignificant questions. Now the final form of the questions and questionnaire will evolve and final questionnaire can be prepared. This will involve grouping and sequencing questions into an appropriate order, numbering questions, and inserting instructions.

4.4 Instruments

An instrument is a mechanism for measuring phenomena, which is used to gather and record information for assessment, decision making, and ultimately understanding. An instrument such as a questionnaire is typically used to obtain factual information, support observations, or assess attitudes and opinions. For example, a survey may ask respondents to list the type of soap they purchase (factual information), recall how often they purchased the item in the past year (an observation), and consider the factors that influenced their purchase, such as smell, touch, or appearance (attitudes toward the product). The term subjective describes information that originates within an individual and is reflected by items that measure attitudes, feelings, opinions, values, and beliefs. Information that is objective attempts to be free of personal interpretation and is typified by data that are observable.

Some instruments consist of all objective items, like the medical history questionnaire. Respondents are asked to provide demographic information such as their weight, height, and age as well as information about their physical health, such as allergies and previous illnesses. Conversely, some instruments are designed to obtain primarily subjective responses, such as information about political preferences. Although political polls include objective demographic questions, the body of the instrument consists of items that require the respondent to express an opinion or attitude.

In the social sciences most instruments are of the paper-and-pencil variety, meaning that the individual completing the instrument is expected to record information on a form. Even when other media are to be used, a paper-and-pencil instrument will probably need to be developed initially. For example, a marriage counselor might use videotape to record the interactions between a husband and wife. However, a written instrument might then be applied to count the number of times a particular word or phrase or body gesture is used or to rate a type of interaction. A marketing survey organization might collect information over the telephone but record responses with a paper-and-pencil instrument. More and more, instruments are being constructed that can be completed on a computer. This medium has the advantage of reaching many people quickly and the software often allows the user to tabulate results easily. However, even when the process of collecting or entering information varies—pen, pencil, keyboard, mouse, or verbal encoding—the basic construction of the instrument remains the same, regardless of the medium.

We can categorize instruments in several ways. One approach is based on a mode of administration:who is responsible for completing the instrument? Some instruments, such as polls or medical history questionnaires, rely on self-report, where the respondent supplies the information directly. For example, many interviews, telephone surveys, and some psychometric assessments are initiated by a second party; nonetheless, because the information is provided directly by the respondent, we classify these instruments as self-report.

Another mode of administration is observation,where information about an individual is obtained by someone external. Examples of observation instruments are employee performance appraisals, student assessments of faculty, and behavior checklists. These instruments collect data about characteristics intrinsic to anindividual even though the respondent is not queried directly. For example, as partof conducting a screening process for attention deficit disorder, a teacher mightuse a behavior checklist to record the number of times a student is off task.An external rater or observer is also used when information is needed aboutthings rather than people. For example, a medical records director might developa checklist to assess whether all the required documentation has been filed in aclinical chart. Similarly, when researchers need information from existing sources,such as medical, personnel, or student records, they may need an instrument designed specifically for data extraction. External raters usually require training to ensure that they obtain the data in the manner required by the instrument developer and are consistent with other observers or raters.

Some instruments use a combination of approaches and formats. The Achenbach questionnaires (Achenbach, 1991) consist of three instruments that provide information about a child’s behaviors and emotional state. The Youth Self-Report(YSR), which has various item formats, such as checklists, fill in the blanks, andrating scales, is completed directly by the youngster who is the focus of evaluation.

As its title implies, the mode of administration is self-report. The Child Behavior Checklist (CBCL) is completed by the child's parent or guardian and consistsessentially of the same items as the YSR, although worded slightly differently.The Teacher Report Form (TRF) attempts to measure the same attributes, but the questions are formulated to address the child's behaviors in an academic setting.Thus both the CBCL and the TRF are based on parent, guardian, or teacherobservation and assessment. The results from each of these three instruments canbe used, either individually or collectively, for assessment and diagnostic purposesby a mental health professional.

Both approaches provide the instrument designer with challenges. For example,one of the advantages of constructing an instrument for completion byexternal raters is the opportunity to interact with and train the observers. Thiscan produce very high levels of consistency between raters. However, this is alsotime consuming and costly. Conversely, self-report instruments are subject to eachrespondent's personal interpretation of an item, which may or may not be whatyou, as instrument designer, had intended. In either case it is important to test andrevise the instrument to minimize these potential problems.

We can also try to classify instruments by use or purpose. Although this approach provides a nomenclature for describing instruments, as we shall see, itis not easy to make distinctions based solely on intended use.The array of instruments used in the social sciences, ranges from academictests to survey questionnaires. It is perhaps better to think of them as a continuum(as in Figure 4.1), rather than as distinct categories, as these instruments may beput to use for more than one purpose and often share common elements. For example, results on an achievement test can be used as a measure of cognition in thesame manner as an intelligence test, although the latter would more likely be categorizedas a psychometric instrument than a test. Additionally, some instruments, such as tax forms, may not fit easily into a single grouping. The overlapping circlesin Figure 4.1 illustrate that these are not distinct or exclusive categories.

One major group of instruments listed in Figure 4.1 is tests. "A test is a collectionof items developed to measure some human educational or psychologicalattribute" (Worthen& Sanders, 1987, p. 302). One aspect of a test is that a correctanswer or level of performance is anticipated. Although tests and other instrumentsshare commonalities, the theories and properties underlying test development are sufficiently different from those underlying instruments as to excludetests from further discussion in this text.

Rating scale is a generic term describing instruments that are evaluative and thatmake use of an item format where response choices are ordered on a continuum.The system of judging athletic performances in such events as ice skating and divingis an example of a rating scale. A rating scale differs from a ranking in that the instrument designer predetermines the scale and the respondent selects one value,such as strongly agree on a scale that ranges from strongly disagree to strongly agree . Duringthe process of ranking, the respondent creates a hierarchy, placing all the values inorder, for example from strong to weak, or from most important toleast important.

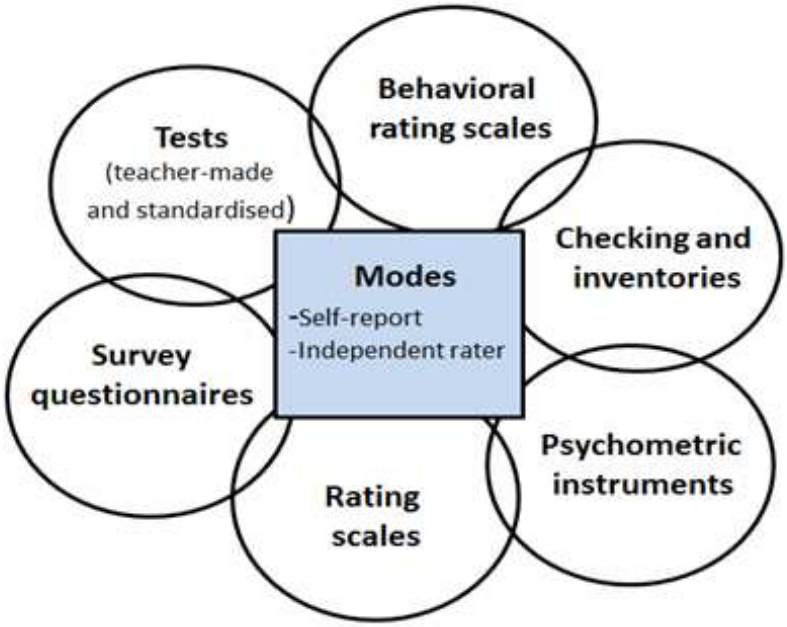

Figure 4.1: Categories of Social Science Instruments

Performance and behavior rating instruments use rating scales specificallydesigned to measure an individual's ability to complete a task or perform an activity.Examples of performance instruments are employee job evaluations and theassessment instruments used in rehabilitation and education. These instrumentsare typically completed by an external observer or rater. Behavior measures may be designed to be descriptive and not evaluative, that is, not judging the value ofwhat is observed but establishing whether it occurred. Such an instrument mightuse items with a response choice of present or not present. Behavior measures mayalso be primarily evaluative, as in a job performance appraisal where the task is tomake a qualitative assessment of performance. In that case the response choicesmight rate an aspect of job performance from satisfactory to unsatisfactory, or fromoccurring none of the time to all of the time.

Checklists are used to determine the presence or absence of an attribute andto count the prevalence of an item or event. These instruments may use a varietyof item formats, including scales, rank order, dichotomous choices (yesor no,present or not present), and open-ended questions. One example of a checklist is an instrument used to count the number of computers and computer accessories ina school building. The checklist might be used to indicate if the computer equipmentis located where it was originally assigned and to record the property number.The checklist might also include criteria for making qualitative assessments;for example, it might contain a rating scale for evaluating aspects of equipmentquality, such as working condition and need for hardware upgrades.

Checklists may be designed to be self-report instruments or to be completedby an independent observer or rater. Moreover, they may be completed for justone entity (such as

one individual) or for multiple entities, possibly chosen by samplingmethods. For example, if you are developing a checklist for auditing records(such as medical charts or personnel files) and there are hundreds or thousands ofthem, you could use random sampling to obtain a representative sample of therecords, rather than auditing all of them.

In the broadest terms, an inventory is simply a list of objects, goods, orattributes. The word is also used as a verb to describe the process of compiling thelist; one might inventory one's supplies, for example. In the social sciences the terminventory describes an instrument used to assess a person's interests, characteristics,or skills. One example is the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984), a developmental inventory that measures adaptive living skills,such as ability to dress oneself and manage a personal budget. An importantaspect of developmental inventories is that the items are usually listed sequentially where acquisition of basic skills is a precursor to demonstrating more complexskills; a child typically acquires the ability to hold a spoon, knife, or fork beforethe ability to cut up food without assistance.

As with other instruments, the mode of administration can be either selfreportor observer based. A patient recovering from a stroke might be asked tocomplete (self-report) an inventory of skills developed as a result of participatingin physical therapy. An external rater completing a developmental inventorymight observe the same person completing activities of daily living (toileting, personalhygiene, and so forth) and check off whether the individual can or cannotcomplete the task. An inventory may set a threshold at which observations stop,such as when the individual cannot complete five items in a row. The informationobtained can be weighed against normative data to provide a comparative level offunctioning. For example, an adaptive living inventory might indicate that, as theresult of a stroke, an elderly individual's physical functioning (gross motor skills tocarry out the activities of daily living) is significantly diminished in comparisonto the functioning of similarly aged adults.

Survey, poll, attitude scale, and questionnaire are terms used interchangeably to describe instruments designed to obtain factual information and to assess beliefs,opinions, and attitudes. Questionnaires typically make use of rating scales andopen-ended questions. Specific sampling methodologies may be used to obtain responses that are representative of the population of interest (see the following discussion). Questionnaires are typically designed as self-report instruments.

Psychometric instrument is a broad term used to describe an array of instruments designed to assess cognitive, affective, and physical functioning and personality traits. Consequently, some psychometric instruments can be just as easily categorizedas behavior rating instruments or inventories, such as the Vineland Adaptive Behavior Scales. Examples include instruments designed to assess depression or psychosis,intelligence, self-esteem, and hyperactivity. Psychometric instruments developedto assess vocational abilities and aptitudes are used to predict an individual's suitability for an occupation or a specific job.

Some psychometric instruments arevery specialized and make use of pictorial response sets. For example, the Children's Apperception Test (Bellak & Bellak, 1993) and the Rorschach inkblot test (Exner & Weiner, 1994) use drawings and abstract designs to solicit responses. Psychometric instruments can be completed through self-report or by an independent observer.

A unique subcategory of psychometric instruments consists of those designedfor behavior analysis. Behaviors are measured before, during, and after treatmentto determine if an intervention is producing the desired effect as evidenced bychanges in the frequency or duration, or both, of a targeted behavior. The numberof times the behavior occurs may be counted, or a behaviors may be classifiedinto discrete categories such as occurred or did not occur, or correct or incorrect (Kazdin, 1982). Frequency counts are typically tallied for predetermined blocks of time(such as fifteen-minute intervals) or by providing a list of frequency ranges foreach observation (such as "Number of Occurrences: 0 to 1, 2 to 4, 5 to 7, 8 or more"), or the observer may just count the occurrences.

4.4.1 Components of an Instrument

Typically, there are six parts to an instrument and all or most will be included regardless of the intended purpose or the process used to collect the data.Although we explain the purpose of each component individually, in reality the components function together to create an integrated document. The ability of arespondent or a rater to complete an instrument is based on the quality of each component as well as the instrument as a whole.

(i) **Title-** The title helps to convey the purpose of the instrument. It is placedat the top center (usually) of the instrument and is the first thing that someonewill see when handling the document. The title should be consistent with theinstrument's intended purpose.

(ii) **Introduction-** The purpose of an introduction is to explain why you constructedthe instrument, how you will use it, and the type of information youwant to obtain. It may also contain information about how the instrument andits contents will be managed—for example, how you will ensure the respondent's confidentiality as a participant. The introduction may be conveyed on a separatepage or as a separate section at the beginning of the instrument.

(iii) **Directions or instructions**- Directions should be given at the beginning of theinstrument and within the instrument where respondents need guidance to completeitems—for example, when there is a change in item format. External raters orobservers will also need comprehensive directions, to ensure interrater consistency. The purpose of directions is to guide the respondent through the instrumentand to assist in obtaining the type of information sought. They should be brief andclear; the directions on the workshop evaluation are concisely stated in onesentence.

(iv) Items- At the heart of the instrument are the items. Selection itemsprovide the respondent with potential choices (that is, choices given in advance)from which the respondent makes a selection. A rating item consists of a stem,which is a phrase, sentence, or question that elicits information, and the responseset,from which the respondent makes the selection. The response choices mayform a graded continuum, or scale, or they may be alternatives. An example ofa selection item with a scaled response set is being asked to rate your experiencewith a product as satisfactory, somewhat satisfactory, somewhat unsatisfactory, or unsatisfactory. An example of an item with alternative choices is being asked to select yourage from a list of age ranges. Another example of a selection item is being askedto rank your choices. In this case you must consider, compare, and order all theresponse alternatives, rather than selecting just one of them.

(v) Supply items- Such as open-ended questions; require respondents to provide theanswer themselves. Such responses tend to be more descriptive and provide opportunities for more elaboration. However, they may also measure more than the respondent's knowledge; for example, they may also reflect writing skills and language development. Consider the following question, written first as a selection item and then as a supply item:Supply items,such as open-ended questions, require respondents to provide the answer themselves. Such responses tend to be more descriptive and provide opportunities for more elaboration. However, they may also measure more thanthe respondent's knowledge; for example, they may also reflect writing skills and language development. Consider the following question, written first as a selection item and then as a supply item:

EXAMPLES

1. I would recommend this organization as a place of employment (circle one):

   Strongly Disagree, Disagree, Agree, Strongly Agree

2. What would you recommend about this organization as a place of employment?

In the first example, the selection item, the responses may be easier to score and categorize. This might be a factor if the question is to appear in an instrument administered to hundreds of people. However, the second example, the supply item,may elicit a better sample of the respondent's range of knowledge or attitudes, producing more information than the first example would provide. However, analysis of hundreds of lengthy narratives would be more labor intensive.

(vi) Demographics- The demographic section gathers such information about the respondent as age, gender, occupation, and marital status. It should solicit only information that is vital to the project. An instrument used to obtain information about an object will solicit descriptive information about that object.

(vii) Closing section- Depending on the purpose of the instrument, it may includea closing section. A survey, for example, might use this section to thank the individual for responding and also to repeat certain information, such as the return address.

4.4.2 The Process of Instrument Construction

As we discussed earlier, artists typically go through a number of steps in the creation of a painting. First, they may draft a number of preliminary sketches of their subject, drawing the subject from different angles, varying the lighting, and if painting the human figure, trying different poses. Some artists like to make color sketches in pastel chalks or water colors before committing to a final product in oil or acrylic paint. And even after they have begun applying paint to canvas, they may make changes during the process of actually completing the painting.

This process of constantly revising a composition is an iterative process, and instrument construction, like painting a picture, should be viewed as a systematic yet creative activity that requires continual refinement and revision (Figure 4.2). Although there are clearly steps that must be completed in this process, instrument construction may not always progress sequentially. For example, after you receive feedback from a friend, colleague, or potential user of the instrument, you may find you need to rewrite specific items or reorganize the instrument itself. Consequently, the following activities should be viewed as part of a creative cycle.

(i) Articulate the purpose and focus of the study- This is perhaps the most important activity, and yet it is often overlooked or minimized. Specifying the purpose helps you identify the themes or concepts you want to understand, the methodology you might use, the type of instrument to develop, and the questions or items that you might include in the instrument to obtain the information you seek. Part of this process involves reviewing literature (books, journal articles, and so on) relevant to the topic. Discussing your project with others who are familiar with its topic can help you identify aspects to focus on or exclude from the study. This is important if the study has been commissioned, as you may need to negotiate the purpose and content of the study. Additionally, you may want to speak with potential respondents, as they too can provide information and their personal perspective about the topic. In considering the approach to use to collect and analyze the data (that is, the methodology), ask whether the topic lends itself to qualitative approaches such as interviews or focus groups, to examination of archival data, to a survey, or to an experimental design. Failure to complete this activity could result in obtaining information that does not answer your question or that does not provide useful and accurate information for decision making. Drafting a purpose statement can also assist in specifying how the data will be collected and who will complete the instrument.

(ii) Activity review and check- It is important to share your purpose statement with others and to obtain feedback that can clarify and focus the project.

(iii) Formulate items- This is both a technical and creative process. It is based on your knowledge of the topic, the information you have described in your purpose statement, and your review of supportive information to help in the creation of specific items. For

example, if you are going to conduct an assessment of employee satisfaction, you will probably want to know, prior to designing the questionnaire, what the organization does and how it is organized. Additionally, you will want to understand some of the management theories and concepts that apply to the understanding of employee satisfaction. This information will assist you in brainstorming and writing out questions or items. This process may also involve examining similar instruments to see how others have carried out this measurement. (You may even decide that rather than create a new instrument you will use or adapt an existing instrument, being sure to cite the original source[s], respect copyright, and pay a fee if the instrument is proprietary.)

This creative process may be a solitary or a group endeavor. At this stage, items may be written as questions or statements, and no attempt is made to format them into, for example, open-ended questions or selected response items. Additionally, during this activity decisions can be made about the specific information to obtain. For example, if you have decided to create a survey that will be administered only to women, there is no need to include a demographic question asking for the respondent's gender.

(iv) Activity review and check- Obtain feedback from others on item validity: do the items appear to ask for information that will answer your question or obtain the information you need for decision making? Modify your items based on this feedback.

(v) Structure and format the items- The next activity is to decide on the item format or formats that will provide the information you need efficiently and effectively. This decision will depend in part on the purpose of your study. For example, an instrument designed to support observations of another's behaviors might suggest the use of a behavior rating scale, whereas an instrument with items that ask for opinions will likely suggest the use of a scale measuring the respondent's level of agreement with a statement. And depending on what you want to measure, you might incorporate a variety of item formats in the instrument.

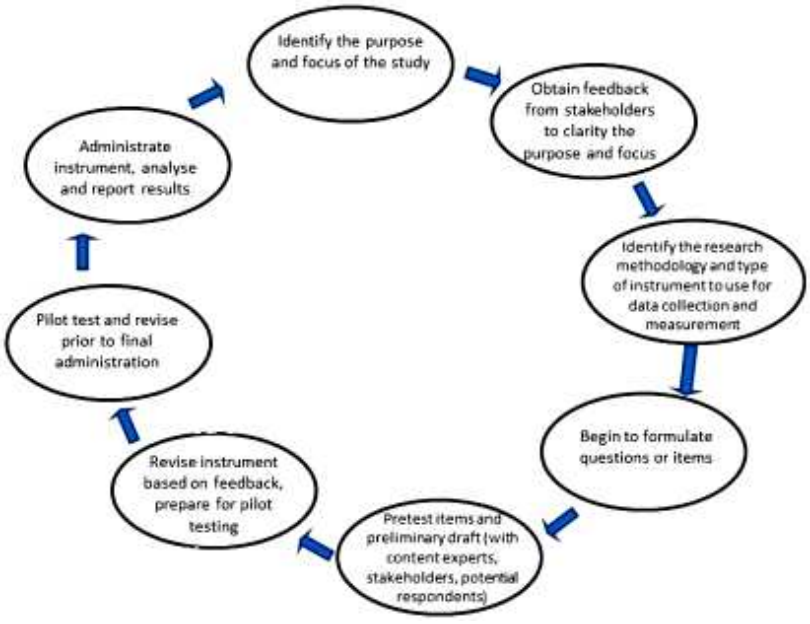

Figure 4.2: Steps in the Instrument Construction Process

(vi) Activity review and check- Obtain feedback from content experts (individuals knowledgeable in the subject you are studying) as well as from potential respondents. This feedback is used to determine whether the items make sense and are unambiguous and whether the information you obtain from the items will provide you with the information you want. This feedback can also assist in identifying problems with instrument administration. Do individuals who will use an observational instrument agree on the meaning of the items and what they are supposed to observe and report?

(vii) Organize and format the instrument- At this stage you are ready to organize items so that they flow in a logical order, and depending on the purpose of the instrument, you may need to consider the content of the instructions and the demographic section.

(viii) Activity review and check- Typically, you will want to pretest the instrument as a complete document rather than item by item. This pretest determines how long it takes to complete the instrument and identifies places where respondents or raters had difficulty completing the instrument due to bottlenecks or confusing items or instructions. This is an important activity, as an incomprehensible or awkwardly formatted instrument may result in a low response rate (for a survey questionnaire) or unreliable data (for a checklist or behavior rating instrument).

(ix) Administer and revise the instrument- Even though you have taken steps to correct problems during instrument design and construction, the responses from the first administration may suggest improvements, and you may find that the instrument requires further revision if you intend to use it again. Such revision is a common activity with instruments used to measure performance, as repeated administrations will certainly highlight shortcomings or portions of the instrument that need to be corrected. You may find problems in the administration of the instrument that can be improved as well.

4.5 Summary

In this chapter we have studied about questionnaire and the steps involved in the construction of a questionnaire. We also discussed about Instrument, and listed the steps in the instrument construction process. A questionnaire is a form containing a set of questions, which are filled by the respondents. Instrument construction is aniterative process— as you will find yourself repeatedly revising and refining theinstrument in response to feedback— and therefore it is an activity that is both technical and creative.

4.6 Glossary

- **Questionnaire-** A questionnaire is a form containing a set of questions, which are filled by the respondents. According to Goode Hatt, “in general, the questionnaire refers to a device for securing answers to questions by using a form which the

respondent fills in himself."

- **Questionnaire Design-** Questionnaire design is a multiple-stage process that requires attention to many details at once. Designing the questionnaire is complicated because surveys can ask about topics in varying degrees of detail, questions can be asked in different ways, and questions asked earlier in a survey may influence how people respond to later questions. Researchers also are often interested in measuring change over time and therefore must be attentive to how opinions or behaviors have been measured in prior surveys.
- **Instrument-** An instrument is a mechanism for measuring phenomena, which is used to gather and record information for assessment, decision making, and ultimately understanding. An instrument such as a questionnaire is typically used to obtain factual information, support observations, or assess attitudes and opinions.
- **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

4.7 Answers to Self-check Exercise

1. Define Questionnaire.
2. Explain the steps in the construction of a Questionnaire?
3. What do you understand by instrument in research?

4.8 Suggested Readings

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4.9 Terminal Questions

1. Explain the steps involved in constructing a questionnaire?
2. Explicate the procedure of constructing an instrument?

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CHAPTER-5
COLLECTION OF SECONDARY DATA

STRUCTURE

5.0 Learning Objectives

After reading this chapter, you will be able to:

- Understand the meaning of secondary data,
- Discuss the advantages and disadvantages of secondary data,
- Understand the different sources of secondary data,
- Examine precautions while using secondary data.

5.1 Introduction

We have discussed in chapter 3 the meaning of primary and secondary data. Sometimes, it is not possible to collect primary data due to time, cost and human resource constraints.

Therefore, researchers have to take the help of secondary data.Secondary data is the data that have been already collected by and readily available from other sources. Such data are cheaper and more quickly obtainable than the primary data and also may be available when primary data cannot be obtained at all.

5.2Meaning of Secondary Data

Secondary data is the data that has already been searched by the researchers for their purpose and people can access these gathered resources through different journals, books, websites, etc. These sources are available instantly as compared to primary data. The time and effort required to collect data are less. Secondary data by all means are an effective and efficient way to analyze data. But there are a lot of other factors that may lead to misrepresentation or misleading data as the data received may not be relevant for the study. Therefore there are many advantages and disadvantages of secondary data. Let us see the advantages and disadvantages.

5.2.1 Advantages of Secondary Data

Listed are a few advantages of secondary data.

i) **Easy to access**: Data is available anywhere and anytime it can be in the form of periodicals, magazines, or can be accessed anytime through the internet. People generally use secondary data maximum nowadays to evaluate their studies. A very small example is the students who depend on books, internet sites, and teachers to access information and prepare for exams.

ii) **Low cost or cost-effective**: The secondary data is of low cost as data are available at cheap rates, for example, the internet access, newspaper, or periodicals are available at cheaper rates and available in large quantities, so there is no non-availability of data to its users. Thus it is cost-effective.

iii) **Less time taking**: Data is available quickly and readily while primary data need to be collected first and then only after summarization data are used. Time taken to collect and analyze data is less than secondary data that is quickly available. Therefore it takes less time to take the source of data.

iv) **Various sources are available to collect data:** Secondary data is not only available through one source, but there are multiple sources like books, magazines, the internet, periodicals, and many more. Therefore various sources are available to collect data for analysis for its users. These sources are easily accessible and readily available to their users.

v) **Data can be collected by anyone**: Anyone can collect data whether he /she is specialized in collecting it or not, depending upon the use. Also, there is no ownership of data that can be claimed by its user as data has already been shared by its owner, who was a primary collector of data.

vi) **The study is based on longitudinal analysis:** Since the data has been collected over years, thus a longitudinal analysis is done by the researchers with the help of secondary data. The data collected is more reliable and valid for users.

5.2.2 Disadvantages of Secondary Data

i) **Inaccuracy**: It is a limitation of secondary data that the data collected over the past few years may be inaccurate. The basis of data collected may not be correct or the analysis or interpretation made may not be accurate or relevant.

ii) **Data may be sometimes outdated:** The data provided through different sources may also be outdated as it has been stored and managed for many years. Therefore it may also sometimes be outdated and may not be relevant for today's scenario.

iii) **Not compatible with the needs of the user:** Since data is related to past surveys and according to the needs of the researchers of that time. It may happen that the present user of this data may not need or not have topics relevant to his study or research. Therefore here instead of outdated data, the data becomes irrelevant for the user to be used in research.

iv) **Anyone can access data**: There is no privatization of data by its owner, data can be accessed by anyone willing to research on that topic. There is no secrecy of data but the user of data cannot appeal their possession or ownership of the data they accessed.

v) **Data quality cannot be controlled:** The researchers have no control over the quality of data. As data is already surveyed by researchers according to their relevant basis and there may be changes in the surroundings and other factors that may lead to the change in the data provided thus no proper quality can be controlled.

vi) **Data can be biased**: Since data collected by the researcher is based on his/her opinion, therefore data is biased. And it may also have an impact on the data collected by the user of the secondary data.

5.3 SOURCES OF SECONDARY DATA

In this unit we will discuss (a) various sources from where, one can get secondary data, (b) precautions while using secondary data, its merits and demerits and some documentary and electronic sources of data in India.

5.3.1 Documentary Sources of Data

This category of secondary data source may also be termed as Paper Source. The main sources of documentary data can be broadly classified into two categories:

a) Published sources, and

b) Unpublished sources.

Let us discuss these two categories in detail.

a) Published Sources

There are various national and international institutions, semi-official reports of various committees and commissions and private publications which collect and publish statistical data relating to industry, trade, commerce, health etc. These publications of various organisations are useful sources of secondary data. These are as follows:

1) **Government Publications:** Central and State Governments publish current information along with statistical data on various subjects, quarterly and annually. For example, Monthly Statistical Abstract, National Income Statistics, Economic Survey, Reports of National Council of Applied Economic Research (NCEAR), Federation of Indian Chambers of Commerce and Industry (FICCI), Indian Council of Agricultural Research (ICAR), Central Statistical Organisation (CSO), etc.
2) **International Publications:** The United Nations Organisation (UNO), International Labour Organisation (ILO), International Monetary Fund (IMF), World Bank, Asian Development Bank (ADB) etc., also publish relevant data and reports.
3) **Semi-official Publications:** Semi-official organisations like Corporations, District Boards, Panchayat etc. publish reports.
4) **Committees and Commissions:** Several committees and commissions appointed by State and Central Governments provide useful secondary data. For example, the report of the 10th Financial Commission or Fifth Pay Commissions etc.
5) **Private Publications:** Newspapers and journals publish the data on different fields of Economics, Commerce and Trade. For example, Economic Times, Financial Express etc. and Journals like Economist, Economic and Political Weekly, Indian Journal of Commerce, Journal of Industry and Trade, Business Today etc. Some of the research and financial institutions also publish their reports annually like Indian Institute of Finance. In addition to this, reports prepared by research scholars, universities etc. also provide secondary source of information.

b) Unpublished Sources

It is not necessary that all the information/data maintained by the institutions or individuals are available in published form. Certain research institutions, trade associations, universities, research scholars, private firms, business institutions etc., do collect data but they normally do not publish it. We can get this information from their registers, files etc.

5.3.2 Electronic Sources

The secondary data is also available through electronic media (through Internet). You can download data from such sources by entering web sites like google.com; yahoo.com; etc., and typing your subject for which the information is needed.You can also find secondary data on electronic sources like CDs, and the following online journals:

Electronic Journal	http://businessstandard.com
Electronic Journal	http://www.businessworldindia.com

Electronic Journal	http://www.business-today.com
Electronic Journal	http://www.india-invest.com
Census of India	http://www.censusindia.net
Union Budget and Economic Survey	http://www.indianbudget.nic.in
Directory of Government of India	http://goidirectory.nic.in
Indian Council of Agricultural Research	http://www.icar.org.in
Ministry of Commerce and Industry	http://www.commin.nic.in
Indian Institute of Foreign Trade	http://www.iift.edu
Department of Industrial Policy and Promotion, Ministry of Commerce andIndustry	http://www.dipp.nic.in
Ministry of Consumer Affairs, Food & Public Distribution	http://www.fccimin.in
Khadi and Village Industries	http://www.kvic.org.in
Board for Industrial & Financial Reconstruction	http://www.bifr.nic.in
Building Material & Technology Promotion Council	http://www.bmtpc.org
Central Food Technological Research	http://www.cftri.com
National Council for Traders Information	http://www.ncti-india.com
National Handloom Development Corporation Ltd.	http://www.nhdcltd.com
The Associated Chamber of Commerce and Industry	http://www.assochm.org
Federation of Indian Chambers ofCommerce and Industry	http://www.ficiofindia.com

Now you have learnt that the secondary data are available in documents, either published or unpublished, and electronic sources. However, you have to take precautions while using secondary data in research. Let us discuss them in detail.

5.4 PRECAUTION IN USING SECONDARY DATA

With the above discussion, we can understand that there is a lot of published and unpublished sources where researcher can gets secondary data. However, the researcher must be cautious in using this type of data. The reason is that such type of data may be full of errors because of bias, inadequate size of the sample, errors of definitions etc. Bowley expressed that it is never safe to take published or unpublished statistics at their face value without knowing their meaning and limitations. Hence, before using secondary data, you must examine the following points.

i) Suitability of Secondary Data

Before using secondary data, you must ensure that the data are suitable for the purpose of your enquiry. For this, you should compare the objectives, nature and scope of the given enquiry with the original investigation. For example, if the objective of our enquiry is to study the salary pattern of a firm including perks and allowances of employees. But, secondary data is available only on basic pay. Such type of data is not suitable for the purpose of the study.

ii) Reliability of Secondary Data

For the reliability of secondary data, these can be tested: i) unbiasedness of the collecting person, ii) proper check on the accuracy of field work, iii) the editing, tabulating and analysis done carefully, iv) the reliability of the source of information, v) the methods used for the collection and analysis of the data. If the data collecting organisations are government, semi-government and international, the secondary data are more reliable corresponding to data collected by individual and private organisations.

iii) Adequacy of Secondary Data

Adequacy of secondary data is to be judged in the light of the objectives of the research. For example, our objective is to study the growth of industrial production in India. But the published report provides information on only few states, then the data would not serve the purpose. Adequacy of the data may also be considered in the light of duration of time for which the data is available. For example, for studying the trends of per capita income of a country, we need data for the last 10 years, but the information available for the last 5 years only, which would not serve our objective.

5.5 Content Analysis

Content analysis is a research method used to analyze and interpret the characteristics of various forms of communication, such as text, images, or audio. It involves systematically analyzing the content of these materials, identifying patterns, themes, and other relevant features, and drawing inferences or conclusions based on the findings.Content analysis can be used to study a wide range of topics, including media coverage of social issues, political speeches, advertising messages, and online discussions, among others. It is often used in qualitative research and can be combined with other methods to provide a more comprehensive understanding of a particular phenomenon.

Types of Content Analysis

There are generally two types of content analysis:

1. Quantitative Content Analysis

This type of content analysis involves the systematic and objective counting and categorization of the content of a particular form of communication, such as text or video. The data obtained is then subjected to statistical analysis to identify patterns, trends, and relationships between different variables. Quantitative content analysis is often used to study media content, advertising, and political speeches.

2. Qualitative Content Analysis

This type of content analysis is concerned with the interpretation and understanding of the meaning and context of the content. It involves the systematic analysis of the content to identify themes, patterns, and other relevant features, and to interpret the underlying meanings and implications of these features. Qualitative content analysis is often used to study interviews, focus groups, and other forms of qualitative data, where the researcher is interested in understanding the subjective experiences and perceptions of the participants.

Methods of Content Analysis

There are several methods of content analysis, including:

1. Conceptual Analysis

This method involves analyzing the meanings of key concepts used in the content being analyzed. The researcher identifies key concepts and analyzes how they are used, defining them and categorizing them into broader themes.

2. Content Analysis by Frequency

This method involves counting and categorizing the frequency of specific words, phrases, or themes that appear in the content being analyzed. The researcher identifies relevant keywords or phrases and systematically counts their frequency.

3. Comparative Analysis

This method involves comparing the content of two or more sources to identify similarities, differences, and patterns. The researcher selects relevant sources, identifies key themes or concepts, and compares how they are represented in each source.

4. Discourse Analysis

This method involves analyzing the structure and language of the content being analyzed to identify how the content constructs and represents social reality. The researcher analyzes the language used and the underlying assumptions, beliefs, and values reflected in the content.

5. Narrative Analysis

This method involves analyzing the content as a narrative, identifying the plot, characters, and themes, and analyzing how they relate to the broader social context. The researcher identifies the underlying messages conveyed by the narrative and their implications for the broader social context.

5.6 Social mapping

Social mapping is a visual method of showing the relative location of households and the distribution of different people (such as male, female, adult, child, landed, landless, literate, and illiterate) together with the social structure, groups and organisations of an area. The useful of social mapping are as below:

- Exploring community structure, organisations and processes.
- Identifying who lives where in a community.
- Identifying different social groups using locally defined criteria and discussing social inequities.
- Identifying the location of different social groups in relation to key resources, including biodiversity and ecosystem services, and the community structures and processes that may be relevant in influencing the distribution of benefits.
- Identifying which community members may be most vulnerable to various hazards and risks, including those resulting from climate change, and discussing coping strategies and opportunities.
- Identifying the location, access and use of key resources, including biodiversity and ecosystem services, in relation to different social groups in order to inform ecosystem services valuation and equitable benefit sharing mechanisms.

5.7 Social Networking

Social networking refers to using internet-based social media sites to stay connected with friends, family, colleagues, or customers. Social networking can have a social purpose, a business purpose, or both through sites like Facebook, Twitter, Instagram, and Pinterest. Social networking is also a significant opportunity for marketers seeking to engage customers. Facebook remains the largest and most popular social network, with 2 billion people using the platform daily. Other popular platforms are Instagram, Twitter, WhatsApp, and Pinterest.

Characteristics of Social Networking

- Social networking uses internet-based social media platforms to connect with friends, family, or peers.
- Some of the most popular social networking sites in the U.S. include Facebook, Instagram, WhatsApp, and Twitter.
- Marketers use social networking to increase brand recognition and encourage brand loyalty.
- Social media can help connect people with businesses for various needs.
- There are disadvantages related to social media, including spreading misinformation, concerns posed by user anonymity, and the high cost of using and maintaining social network profiles.

Major Social Networking Platforms

5.7.1 Facebook:

Facebook is a social network that allows users to connect with people, businesses, and organizations. They can post updates and respond to the posts of others. They can share photographs and links to online content. Users can chat live and upload and share videos.Users can also communicate directly with each other via Facebook Messenger. They

can join groups with similar interests and be notified of friends' activities and pages they elect to follow.Facebook was designed to be open and social. However, while the platform encourages publicly available content, it also has privacy controls that can restrict access to, for instance, friends.Facebook was created in 2004 by Mark Zuckerberg while he went to Harvard University. Today, it is owned by Meta Platforms (of which Zuckerberg is CEO). Facebook is the world's largest social network, with about 2 billion daily active users.

5.7.2 Instagram

Instagram is a social network that focuses on sharing visual media like photos and videos. It's similar to Facebook in that users create a profile and have a news feed. It allows them to upload media that can be edited with filters and organized by hashtags and geographical tagging. Posts can be shared publicly or with followers. Users can browse other users' content, view trending content, and follow others. Additionally, they can add the content others upload to their personal feed. Over time, Instagram has added new features, such as Instagram Stories, Instagram Reels, and access to shopping. Like Facebook, Instagram encourages users to keep their content publicly accessible and lets them set access to approved followers only. Instagram has its own direct messaging feature. In addition, Facebook Messenger has been incorporated by Instagram so users can direct message Facebook contacts while on Instagram. Instagram was founded in 2010 by Kevin Systrom and Mike Krieger. In 2012, it was acquired by Meta (formerly Facebook). Instagram boasts 6.18 billion visits per month.

5.7.3 Twitter

Twitter is a social network that allows people to communicate with short messages called tweets. The social platform limits tweets to 280 characters. Users post tweets that may be useful, interesting, or even inflammatory for readers.*Many people use Twitter to find people and companies posting appealing, important, or newsworthy content and follow them to receive their stream of tweets for updates.*Tweeting is sometimes referred to as microblogging. It's distinguished by users' ability to scan and distribute content quickly, conveniently, and efficiently. This may account for its popularity with those who want (or need) to get lots of messages out to the world and those who want to follow these social or newsy types.Twitter is used by professional and citizen journalists, politicians, celebrities, marketers, and more. It was founded in 2006 by Jack Dorsey, Noah Glass, Biz Stone, and Evan Williams. It is owned by X Holdings, one of Elon Musk's holding companies.

5.7.4 Pinterest

Pinterest is a social networking site that promotes image saving and sharing using a virtual pinboard. It's an innovative platform that facilitates cataloging and organizing meaningful information for individuals. With Pinterest, account holders find images by browsing the web or Pinterest itself. They then pin (or save) those images to an online pinboard. Multiple pinboards can be set up and organized based on a topic. Once they've created and built their boards to catalog ideas and interests, users can access them whenever they want.

Clicking on the image reveals related information. Like other social networks, Pinterest users have a feed that exhibits images according to their interests. They can interact by "liking" images, following each other, and posting comments. There's also a feature that provides private messaging. Pinterest was created by Ben Silbermann, Paul Sciarra, and Evan Sharp in 2009. Pinterest, Inc. owns it, and its CEO is Bill Ready. Pinterest reported approximately 450 million monthly active users globally for 2022.

Advantages and Disadvantages of Social Networking

Social networking can affect individuals and corporations positively and negatively. That's why it's important to weigh the advantages and disadvantages of using these social media sites before getting too heavily involved.

Advantages

- Social networking allows individuals to make and stay in contact with family and friends that distance and lost connections would otherwise prohibit.
- People can also connect with unknown individuals who share the same interests and develop new relationships.
- Social networking also allows companies to connect with new and existing clients.
- Companies can create, promote, and increase brand awareness through social media.
- Companies can capitalize on customer reviews and comments promoting products, services, and brands. The more customers post about a company, the more valuable the brand authority can become. This can lead to greater sales and a higher ranking by search engines.
- Social networking can help establish a brand as legitimate, credible, and trustworthy.
- Companies may use social networking to demonstrate the quality of their customer service and enrich their relationships with consumers. For example, if a customer complains about a product or service on Twitter, the company may address the issue immediately, apologize, and take action to make it right.

Disadvantages

- Social networking can facilitate the spread of misinformation about individuals and companies.
- Due to its online nature, falsehoods can spread like wildfire. This became increasingly prevalent after 2012. One study found that misinformation is 70% more likely than factual information to be shared on Twitter.4
- The detrimental impact of misinformation can create a virtual headache for a company's public relations (PR) department.
- The anonymous aspect of newfound personal relationships requires caution.
- Building and maintaining a company profile takes hours each week. Costs add up quickly.

- Businesses need many followers before a social media marketing campaign starts generating a positive return on investment (ROI). For example, submitting a post to 15 followers does not have the same effect as submitting the post to 15,000 followers.

5.8 Summary

In this chapter we have studied about the meaning of secondary data, its advantages and disadvantages, various sources from where we can get secondary data and the precautions while using secondary data. Secondary data is the data that has already been searched by the researchers for their purpose and people can access these gathered resources through different journals, books, websites, etc. the various sources of secondary data can be classified in to a) Published Sources, and b) Unpublished Sources. But, we should use the secondary data if it is reliable, suitable and adequate.

5.9 Glossary

- **Data:** Quantitative or/ and qualitative information, collected for study and analysis.
- **Primary Data:** Data that is collected originally for the first time.
- **Secondary Data:** Data which were collected and processed by someone else but are being used in the present study.
- **Published Sources:** Sources which consist of published statistical information.

5.10 Answers to Self-Check Exercises

1. What is meant by secondary data?
2. What are the advantages of secondary data?
3. What are disadvantages of secondary data?
4. What are main sources of secondary data?
5. What is meant by content analysis?
6. What is Social Mapping?

5.11 Suggested Readings

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5.12 Terminal Questions

1. Explain the advantages and disadvantages of using secondary data in research?
2. Explain in details the various sources of secondary data?
3. What precautions must a researcher take before using the secondary data?
4. What is social networking? Explain the major social networking platforms. Also explain the advantages and disadvantages of social networking.

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CHAPTER-6
POPULATION AND SAMPLING

STRUCTURE

6.0 Learning Objectives

After reading this chapter, you will be able to:

- understand the meaning of population and sampling,
- discuss the merits and demerits of population and sampling,
- explain the differences between population and sampling.

6.1 Introduction

In statistics as well as in quantitative methodology, the set of data are collected and selected from a statistical population with the help of some defined procedures. There are two different types of data sets namely, population and sample. So basically when we calculate the mean deviation, variance and standard deviation, it is necessary for us to know if we are referring to the entire population or to only sample data. Let us take a look of population data sets and sample data sets in detail.

6.2 Meaning of Population

A population refers to any collection of specified group of human beings or of non-human entities such as objects, educational institutions, time units, geographical areas, prices of wheat or salaries drawn by individuals. Some statisticians call it universe. A population containing a finite number of individuals, members or units is a class. A population with infinite number of members is known as infinite population. The population of pressures at various points in the atmosphere is an example of infinite population. The population of

concrete individuals is called as existent population, while as the collection of all possible ways in which an event can materialize as the hypothetical population. All the 400 students of 10th class of particular school is an example of existent type of population and the population of heads and tails obtained by tossing a coin on infinite number of times is an example of hypothetical population.

The population is properly defined so that there is no ambiguity as to whether a given unit belongs to the population. For example, in a survey of achievement in mathematics, a researcher will have to define the population of students by age or by grade and, if necessary, he will also specify the type of schools, the geographical area and the academic year for which the data will be collected. Inferences concerning a population cannot be drawn until the nature of the units that comprise it is clearly identified. If a population is not properly defined, a researcher does not know what units to consider when selecting the sample.

6.3 Types of Population

There are different types of population. They are:

a) Finite Population
b) Infinite Population
c) Existent Population
d) Hypothetical Population

a) Finite Population:

The finite population is also known as a countable population in which the population can be counted. In other words, it is defined as the population of all the individuals or objects that are finite. For statistical analysis, the finite population is more advantageous than the infinite population. Examples of finite populations are employees of a company, potential consumer in a market.

b) Infinite Population

The infinite population is also known as an uncountable population in which the counting of units in the population is not possible. Example of an infinite population is the number of germs in the patient's body is uncountable.

c) Existent Population

The existing population is defined as the population of concrete individuals. In other words, the population whose unit is available in solid form is known as existent population. Examples are books, students etc.

d) Hypothetical Population

The population in which whose unit is not available in solid form is known as the hypothetical population. A population consists of sets of observations, objects etc that are all something in common. In some situations, the populations are only hypothetical. Examples are an outcome of rolling the dice, the outcome of tossing a coin.

6.4 Merits and demerits of Population Investigation

Merits: The merits of population investigation are as below:

- ***Intensive Study*** – Under population investigation, you must obtain data from each and every unit of the population. Further, it enables the statistician to study more than one aspect of all items of the population. To give you an example, the Indian Government conducts a census investigation once every 10 years. The authorities collect the data regarding the population size, males, and females, education levels, sources of income, religion, etc.
- ***Reliable Data*** – The data that a statistician collects through population investigation is more reliable, representative, and accurate. This is because, in population investigation, the statistician observes every item personally.
- ***Suitable Choice*** – It is a great choice in situations where the different items of the population are not homogeneous.
- ***The basis of various surveys*** – Data from a population investigation is used as a basis in various surveys.

Demerits: A population investigation also has certain demerits. Some of these demerits are:

- ***Costs*** – Since the statistician closely observes each and every item of the population before collecting the data, which makes it a very costly method of investigation. Usually, government organizations adopt this method to collect detailed data like the population census or agricultural census or the census of industrial protection, etc.
- ***Time-consuming*** – population investigation is time-consuming and also requires manpower to collect original data.
- ***Possibilities of Errors*** – There are many possibilities of errors in the population investigation method due to non-response, measurement, lack of preciseness of the definition of statistical units or even the personal bias of the investigators.

6.5Sample

A selected group of some elements from the totality of the population is known as the sample. It is from the study of this sample that something is known and said about the whole population. The assumption is that what is revealed about the sample will be true about the population as a whole. But it may not be true always as it depends on the way the sample is drawn. If the sample is a replica of the population, the foregoing assumption is true. But, if it is biased, such inferences about the population cannot be true.

A biased sample is one that is selected in such a way that it yields a sample value which is much different from the true or population value. Hence it is basic requirement for inferential research that the sample should be free from bias. In other words, it should be representative of the population. A representative sample is a sample which has all those

characteristics present in the same amount or intensity in which they are found in the population. Bias in selecting a sample can be avoided and it can be made representative of the population by selecting it randomly. A random sample involves small errors in predicting population value and this error can be estimated also. Thus the objective should always be to draw an unbiased random and representative sample.

In order to draw such a representative sample, a sample plan has to be prepared. It means a plan which, if properly executed can guarantee that if we were to repeat a study on a number of different samples each of a particular size drawn from a given population, our findings would not differ from the findings that we would get if the given population as a whole was studied by more than specified proportions of sample. For example, not more than 5 points in 90 per cent of the samples, that is, out of 100 samples the sample value (estimate of value) will be correct within 5 points in 90 out of 100 samples. If the plan guarantees sufficiently well that the chances are great enough that the selected sample is representative of the population, it is known as a representative sampling plan. It ensures selecting diverse elements and making sure that these diverse elements are adequately represented in the sample.

6.6 Merits and Demerits of Sampling Method of Data Collection

The merits and demerits of the sampling methods of data collection are as below:

Merits:

1. **Economical:** It is economical, because we have not to collect all data. We collect data from a small size of group selected from the population.
2. **Less Time Consuming:** As number of units is only a fraction of the total universe, time consumed is also a fraction of total time. Number of units is considerably small, hence the time.
3. **Reliable:** If sample is taken judiciously, the results are very reliable and accurate.
4. **Organisational Convenience:** As samples are taken and the number of units is smaller, the better (Trained) enumerators can be employed by the organisation.
5. **More Scientific:** According to Prof R.A. Fisher, “The sample technique has four important advantages over census technique of data collection. They are Speed, Economy, Adaptability and Scientific approach.” It is based on certain laws such as:

   (a) Law of Statistical Regularity

   (b) Law of Inertia of Large numbers

   (c) Law of Persistence

   (d) Law of Validity.

6. **Detailed Enquiry:** A detailed study can be undertaken in case of the units included in the sample. Size of sample can be taken according to time and money available with the investigator.
7. **Indispensable Method:** If universe is bigger, there remains no option but to proceed for this method. It is specially used for infinite, hypothetical and perishable universes.

Demerits:

1. **Absence of Being Representative:** Methods, such as purposive sampling may not provide a sample that is representative.
2. **Wrong Conclusion:** If the sample is not representative, the results will not be correct. These will lead to the wrong conclusions.
3. **Small Universe:** Sometimes universe is so small that proper samples cannot be taken not of it. Number of units are so less.
4. **Specialised Knowledge:** It is a scientific method. Therefore, to get a good and representative sample, one should have special knowledge to get good sample and to perform proper analysis so that reliable result may be achieved.
5. **Inherent Defects:** The results which are achieved though the analysis of sampling data may not be accurate as this method have inherent defects. There is not even a single method of sampling which has no demerit.
6. **Sampling Error:** This method of sampling has many errors.
7. **Personal Bias:** As in many cases the investigator, chooses samples, such as convenience method, chances of personal bias creep in.

6.7 Difference between Population and Sample

The difference between population and sample can be drawn clearly on the following grounds:

1. The collection of all elements possessing common characteristics that comprise universe is known as the population. A subgroup of the members of population chosen for participation in the study is called sample.
2. The population consists of each and every element of the entire group. On the other hand, only a handful of items of the population is included in a sample.
3. The characteristic of population based on all units is called parameter while the measure of sample observation is called statistic.
4. When information is collected from all units of population, the process is known as census or complete enumeration. Conversely, the sample survey is conducted to gather information from the sample using sampling method.
5. With population, the focus is to identify the characteristics of the elements whereas in the case of the sample; the focus is made on making the generalisation about the characteristics of the population, from which the sample came from.

Some of the key differences between population and sample are clearly given below:

Comparison	Population	Sample
Meaning	Collection of all the units or elements that possess common characteristics	A subgroup of the members of the population
Includes	Each and every element of a group	Only includes a handful of units of population
Characteristics	Parameter	Statistic
Data Collection	Complete enumeration or census	Sampling or sample survey
Focus on	Identification of the characteristics	Making inferences about the population

6.8 Summary

In spite of the above differences, it is also true that sample and population are related to each other, i.e. sample is drawn from the population, so without population sample may not exist. Further, the primary objective of the sample is to make statistical inferences about the population, and that too would be as accurate as possible. The greater the size of the sample, the higher is the level of accuracy of generalisation.

6.9 Glossary

- **Population:** The collection of all elements possessing common characteristics that comprise universe is known as the population. It consists of each and every element of the entire group.
- **Sampling:** A subgroup of the members of population chosen for participation in the study is called sample.
- **Finite Population:** defines as the population of all the individuals or objects that are finite.
- **Infinite Population:** defines as the population in which the counting of units in the population is not possible
- **Existent Population:** defines as the population of concrete individuals.
- **Hypothetical Population:** The population in which whose unit is not available in solid form is known as the hypothetical population.

6.10 Answers to Self-Check Exercises

1. Define population
2. Explain various types of population.
3. Define sample
4. What are merits and demerits of sampling
5. What are difference between population and sampling

6.11 Suggested Readings

- Bhandarkar, P.L. and Wilkinson, T.S. (2016). Methodology and Techniques of Social Research. Himalaya Publishing House: New Delhi.
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6.12 Terminal Questions

1. What is meant by population? Explain its types, merits and demerits.
2. Explain, in detail, the differences between population and sampling.

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CHAPTER-7
SAMPLING DESIGN AND METHODS

Structure

7.0 Learning Objectives

After studying this lesson, the students will be able to:

- know the meaning of sampling,
- know the need of sampling and essentials of good sampling,
- learn about the various steps involved in sampling process,
- understand the various methods of sampling,
- know about the merits and limitations of sampling method, and
- know the meaning of sampling and non-sampling errors.

7.1 Introduction

In statistics, data plays an essential role in deciding the validity of the outcome. The data being used must be relevant, correct, and representative of all classes. While more data is good to get impartial results, it is crucial to make sure that the data collected is suitable for the problem at hand. You can do this using population vs. sample. Population refers to the entire group of individuals about whom you wish to draw conclusions. The sample refers to the group of people from which you will be collecting data. The population is said to be completely defined if at least the element, sampling units, extent and time are specified.

A complete enumeration of all items in the 'population' is known as a census inquiry. It is the process of obtaining responses from/about each of the members of the population. It can be presumed that in such an inquiry when all items are covered, no element of chance is left and highest accuracy is obtained. A sample is a subset of a population that is used to represent the entire group as a whole. Sample is the selection of a part of the universe for the purpose of drawing conclusion or inference about the entire universe from the study of these parts. In certain circumstances the sampling may represent the only possible or practicable method to obtain desired information. For example if the universe is infinite or very large or complex then the sample is only way to study. It is said that a carefully designed sample may better than a poorly planned and executed census. In case of sampling, the cost of data collection is much less than census.

7.2 Essentials of Good Sampling

An ideal sample contains the following essentials:

- **Representation:** A perfect sample is where the whole data can be represented adequately. It must be ensured that units with same characteristics are selected as represented in the data.
- **Independent:** The other aspect of a sample is it being independent which means the units should be interchangeable. There should be a freedom for every unit has a chance to be included in the sample.
- **Adequate:** The size of the sample should be adequate in order to infer any results and apply the conclusions to the entire data.
- **Homogenous:** The sampling units must have the same characteristics as other units or else the sample will be rendered unscientific.

7.3 Need of Sampling

Sampling is necessary because of the following reasons

1. It is not technically or economically feasible to take the entire population into consideration.
2. Due to dynamic changes in business, industrial and social environment, it is necessary to make quick decision, so sample is necessary to save time.
3. If data collection takes a long time, then value of some characteristics may change over the period of time thus, defeating the very purpose of data analysis. Thus, due to importance of time element sample is required.
4. Sample, if representative, may yield more accurate results than the total census because sample can be more accurately supervised.
5. Quality of some product is tested by destroying the products.

7.4 Steps in Sampling Process

An operational sampling process can be divided into seven steps as given below:

1. Defining the target population.
2. Specifying the sampling frame.
3. Specifying the sampling unit.
4. Selection of the sampling method.
5. Determination of sample size.
6. Specifying the sampling plan.
7. Selecting the sample.

1. Defining the Target Population:

Defining the population of interest, for business research, is the first step in sampling process. In general, target population is defined in terms of element, sampling unit, extent, and time frame. The definition should be in line with the objectives of the research study. A well-defined population reduces the probability of including the respondents who do not fit the research objective of the company.

2. Specifying the Sampling Frame:

Once the definition of the population is clear, a researcher should decide on the sampling frame. The sampling frame is the group of individuals or objects from which the researcher will draw the sample. It is the actual list of all units in a target population from which the sample is taken.

3. Specifying the Sampling Unit

A sampling unit is a basic unit that contains a single element or a group of elements of the population to be sampled.

4. Selection of the Sampling Method

The sampling method outlines the way in which the sample units are to be selected. The choice of the sampling method is influenced by the objectives of the business research, availability of financial resources, time constraints, and the nature of the problem to be investigated. All sampling methods can be grouped under two distinct heads, that is, probability and non-probability sampling.

5. Determination of Sample Size

In order to generalize from a random sample and avoid sampling errors or biases, a random sample needs to be of adequate size. What is adequate depends on several issues which often confuse people doing surveys for the first time. This is because what is important here is not the proportion of the research population that gets sampled, but the absolute size of the sample selected relative to the complexity of the population, the aims of the researcher and the kinds of statistical manipulation that will be used in data analysis. While the larger the sample the lesser the likelihood that findings will be biased does hold, diminishing returns can quickly set in when samples get over a specific size which need to be balanced against the researcher's resources. To put it bluntly, larger sample sizes reduce sampling error but at a decreasing rate. Several statistical formulas are available for determining sample size.

There are numerous approaches, incorporating a number of different formulas, for calculating the sample size for categorical data.

$$n = \frac{P(100 - p)\, z^2}{E^2}$$

where, n = the required sample size

P = the percentage occurrence of a state or condition

E = the percentage maximum error required

Z = the value corresponding to level of confidence required

There are two key factors to this formula. First, there are considerations relating to the estimation of the levels of precision and risk that the researcher is willing to accept:

E is the margin of error (the level of precision) or the risk the researcher is willing to accept (for example, the plus or minus figure reported in newspaper poll results). In the social research a 5 per cent margin of error is acceptable. So, for example, if in a survey on job satisfaction 40 per cent of respondents indicated they were dissatisfied would lie between 35 per cent and 45 per cent. The smaller the value of E the greater the sample size required as technically speaking sample error is inversely proportional to the square root of n, however, a large sample cannot guarantee precision.

Z concerns the level of confidence that the results revealed by the survey findings are accurate. What this means is the degree to which it can be ensured the characteristics of the population have been accurately estimated by the sample survey. Z is the statistical value corresponding to level of confidence required. The key idea behind this is that if a population were to be sampled repeatedly the average value of a variable or question obtained would be equal to the true population value. In management research the typical levels of confidence used are 95 per cent (0.05: a Z value equal to 1.96) or 99 per cent (0.01: Z=2.57). A 95 percent level of confidence implies that 95 out of 100 samples will have the true population value within the margin of error (E) specified.

The second key component of a sample size formula concerns the estimation of the variance or heterogeneity of the population (P). The researchers are commonly concerned with determining sample size for issues involving the estimation of population percentages or proportions. In the formula the variance of a proportion or the percentage occurrence of how a particular question, for example, will be answered is P(100-P). Where, P= the percentage of a sample having a characteristic , for example, the 40 per cent of the respondents who were dissatisfied with pay, and (100-P) is the percentage (60 per cent) who lack the characteristic or belief.

6. Specifying the Sampling Plan

Once population, sampling frame, sampling technique, and sample size are identified, the researcher can use all that information to execute the sampling plan and collect the data required for the research.

7. Selecting the Sample

This is the final step in the sampling process, where the actual selection of the sample elements is carried out. At this stage, it is necessary that the interviewers stick to the rules outlined for the smooth implementation of the business research. This step involves implementing the sampling plan to select the sampling plan to select a sample required for the survey.

7.5 Methods of Sampling

When a sample is required to be reflected from a population, it is necessary to decide which method should be applied. Basically, there are two different types of sample designs, namely, probability sampling and non-probability sampling. Each of the two is described below.

7.5.1 Random or Probability Sampling

This type of sampling is also known as random sampling or chance sampling. This sampling procedure gives each element in the population an equal chance of getting selected for the sample; besides, all choices are independent of one another. The obtained results of probability sampling can be assured in terms of probability. In other words, we can measure the errors of estimation or the significance of obtained results from a random sample. In fact, due to this very reason probability sampling design is superior to the deliberate sampling design. Probability sampling ensures the law of Statistical Regularity, which states that if the sample chosen is a random one, the sample will have the same composition and characteristics as the universe. Hence, probability sampling is more or less the best technique to select a representative sample

7.5.2 Non-Random or Non-Probability Sampling

This type of sampling is also known as deliberate sampling, purposive sampling, or judgment sampling. In this sampling procedure, the organizers of the inquiry deliberately choose the particular units of the universe to compose a sample on the basis that the small mass selected out of a large one would represent the whole. For example, suppose the economic conditions of the population living in a state are to be studied, a few cities and towns can be deliberately selected for intensive study on the principle that they can represent the entire state. Besides, the investigator may select a sample yielding results favourable to his point of view. In case that happens, the entire inquiry may get vitiated. Thus, there exists the danger of bias entering into this type of sampling technique. However, if the investigators are impartial, work without bias and have the necessary experience so as to take sound judgment, the obtained results of an analysis of deliberately selected sample may be tolerably reliable.

We shall now discuss some of the various sampling methods under two separate headings as follows:

7.5.1 Random or Probability Sampling

1. Simple Random Sampling

A simple random sample is one in which every member of the target population has the same probability of being included in the sample. The selection is thus free from personal bias because the investigator does not exercise his discretion of preference in the choice of items. Since selection of items in the sample depends entirely on chance, this method is also known as the method of chance selection. Random sampling is done through the following methods:

i) **Lottery Method:** It is the easiest way of choosing the sample. Each unit is assigned a particular number and these numbers are then written on a piece of paper and put in a box. Then a neutral person, who is blindfolded, is made to pullout the required number of units for the sample from the box. Here the sample is being chosen by simple chance and there is no favor or partiality involved. It is also important to ensure that the sheets of paper that are used should be of equal size and quality.

ii) **Using the Rotating Drum:** This process is similar to the lottery method but with a slight modification. Here the units are itemized into lists and divided into categories from say 0 to 5. Then the same categories 0-5 are printed on pieces of wood or tin etc (of same size) and placed in a drum. This drum is then rotated and the required number of the pieces is drawn. Now if we draw 5 zeroes 10 fives and 20 twos then we pick 5 units from the zero list 10 units from five list and 20 units from the twos list respectively.

iii) **Selection based on a Sequential List:** This process involves maintaining the units in alphabetical, numerical or geographical sequence. In this procedure units are broken up into numerical, alphabetical or geographical Sequence. So for a numerical selection one can choose units that fall in multiples of 3, for alphabetical selection we can choose all the names that begin with vowels, etc.

Precautions to be considered while choosing sample:

While conducting a random sample, the researcher must consider that the sample represents the entire population and the number of units selected are sufficient. Following should be considered while choosing a random sample:

- The researcher should be aware of the entire variation of population from which she/he wants to select his/her then sample. She/he should be aware of the main features of the field and its scope with the number of units in the population, so as to make a fair selection.
- The various items of a population must be similar and have common characteristics (homogeneous). If they differ too much then the sample will not be representative.
- The units of the field should not be dependent or linked otherwise it will not be possible for a random selection to take place.

2. Stratified Sampling

When the population is divided into subgroups called strata which refers to a way in which the units within the group share common characteristics with each other but are heterogeneous with other subgroups, after which units are randomly chosen from each stratum, it is called stratified sampling. The researcher needs to have knowledge of the population beforehand so that she/he can form subgroups. This technique uses both deliberate and random sampling. Firstly, we divide the entire population into subsets based on their homogeneous character, then by using random sampling we choose elements from these subsets. Thus, this is a mixed sampling technique. This technique can be applied when the population can be divided into subgroups based on common characteristics. This stratification is made in accordance to the special qualities of a group and from these strata, units are randomly selected. For example, if a researcher wants to collect the data of the distribution of expenses of all residents in a city, she/he can divide the population on the basis of their profession and then choose some individuals or units randomly from these subgroups.

Process of Stratifying:

The stratification of the total population or division of data must be done with utmost care as the success of this technique is based on successful stratification. Below mentioned points should be considered for the same:

i) The researcher should have in-depth information about all units in the data and should be able to identify the common characteristics to bunch them into subgroups that are different from each other.

ii) Each stratum should be large enough to conduct random sampling.

iii) While dividing them into subgroups it must be considered that each stratum is related to the domain in a similar way though being homogeneous themselves.

iv) The number of units chosen from each subgroup for the survey, through random sampling, must be in the same proportion as the subgroup is to the entire population. For example if the total population is 10,000 out of which the businessmen are 30per cent then the number of units chosen from the subgroup of businessmen should be 30 per cent of all the units picked by random sampling.

If the researcher observes the above mentioned precautions then she/he can achieve goals from this method as it has the qualities of both deliberate and random sampling.

3. Systematic Sampling

Systematic sampling is a probability sampling technique in which the sample members are chosen from a larger population using a fixed, periodic interval but a random starting point. This interval called the sampling interval, is calculated by dividing the population by the desired sample size. Each group member is regularly chosen to create a sample in this extended application of probability sampling. Systematic sampling, when done correctly on a large population of a defined size, can assist researchers, including marketing and sales professionals, in obtaining representative findings on a sizeable group of individuals without getting in touch with every single one.

In this type of sampling, we choose the elements systematically and not randomly with the exception of the first element. There is a regular interval in the population at which these elements are chosen. All these elements are sequenced first wherein each of them gets an equal probability of being chosen. To calculate the interval required to select the sample data, we calculate the population size divided by the sample size.

$$\text{Interval} = \frac{Population\,Size}{Sample\,Size}$$

If the population size is 1200 and the desired sample size is 400 items of data, we divide 1200 by 400 to get an interval of 3. This means that every 3rd item of data in the ordered list is selected for the sample. For example, a factory that manufactures cars must regularly assess the quality of production. In one month, 5 per cent of cars are selected using a systematic sample to be rigorously tested for quality purposes. The first car is chosen at random then every 10th car that follows. This systematic sample helps the company to ensure the quality of their car manufacture is maintained. Testing each vehicle would be costly and take too much time.

4. Cluster Sampling

Cluster sampling is another type of random statistical measure. In cluster sampling, the population is divided into well-defined groups or clusters. Then, few of these clusters are selected based on the assumptions that they represent the entire universe. All the units of selected cluster are studied to arrive at a conclusion. The selection of these clusters is done by using anyone of the above discussed sampling methods. Cluster sampling is used primarily because it allows for great economies in data collection costs.

Cluster sampling is a two-step procedure. First, the entire population is selected and separated into different clusters. Random samples are then chosen from these sub-groups. For example, a researcher may find it challenging to interview the entire population of a grocery store's customers. However, they may be able to create a subset of stores in clusters; this represents the first step in the process. The second step would be to interview random customers of those stores. Third, data would be collected from the interviews and samples selected.

Types of Cluster Sampling

There are two types of cluster sampling, one-stage cluster sampling, and two-stage cluster sampling:

- **One-stage cluster sampling**: Involves choosing a random sample of clusters and gathering data from every subject within that cluster.
- **Two-stage cluster sampling**: Involves randomly selecting multiple clusters and choosing certain subjects randomly within each cluster to form the final sample.

5. Multistage Sampling

As the name implies, this method refers to a sampling procedure which is carried out in several stages. The material is regarded as made up of a number of first stage sampling units, each of which is made of a number of second stage units, etc. At first, the first stage units are sampled by some suitable method, such as random sampling. Then, a sample of second stage unit is selected from each of the selected first stage units again by some suitable method which may be the same or different from the method employed for the first stage units. Further stages may be added as required.

7.5.2 Non-Random Sampling Methods

1. Judgment or Purposive Sampling

In judgment sampling, the selection of the sample is based on the judgment of the investigator, who is studying a situation. In other word, the investigator exercises his judgment in the choice of sample items and includes those items in the sample which he thinks are most typical of the population with regard to the characteristics under investigation. This method is also known as 'purposive sampling' or 'deliberate sampling'. This sampling method should be carried out by an expert in the field as his judgment will influence the final outcome of the study.

This simple technique of sampling is used by the investigator when the data is not diverse and she/he has knowledge of various facets of the problem. This method does not point to a random choice even though it is deliberate; on the contrary it signifies that only the elements that represent the entire population will be selected. It is determined by the purpose or intent of the study and selection is done on the suitability of elements for the purpose of study.

2. Quota Sampling

Quota sampling is the non-probabilistic version of stratified random sampling. The target population is spill into appropriate strata based on known sub-groups (e.g. sex, educational achievement, company size, etc.). Each stratum is sampled (using convenience or snowball techniques) so that number of respondents in each sub-group is proportional to the proportion in the population.

This sampling method is seldom used. This method is dependent on the honesty and proficiency of the investigator for its success. Since the proficiency of the investigators is subjective and varied, the results of the study tend to be erroneous or inaccurate, thus this method is seldom used.There is a need of a predefined standard to conduct this sampling technique. The sample thus selected represents the population and the proportion of traits should be similar to that of the population.

3. Convenience Sampling

In this sampling technique, the elements or items of the study are selected as perthe convenience of the investigator. There is no endeavor to collect informationas per a plan or process. This is a technique which is frequently used by touristswhile travelling. They interact

with a few people whom they meet, transact withthem and based on this they generate a perception and generalize this to the entirepopulation of the country or state. This approach has zero scientific credibilityand is termed as a “hit or miss method”. Convenience selection chooses its samples on the basis of availability and usedwhen this availability turns out to be costly and rare.

4. Referral/Snowball Sampling

This method of sampling is used by the researcher when he/she is completely unaware about the population, she/he then picks one element or individual and asks him/her for reference or recommendation of other individuals whose characteristics she/he may describe to suit the need of the sample. This is called as a snowball technique because the size of the sample constantly grows as new referrals keep pouring in.

7.6 Sampling and Non-sampling Errors

Sampling error is the deviation of the selected sample from the true characteristics, traits, behaviours, qualities or figures of the entire population. Various forces combine to produce deviations of sample statistic from population parameters, and errors, in accordance with the different cause, are classified into sampling and non-sampling error.

a) Sampling Errors

The sampling errors arise due to drawing faulty interference about the population based upon the results of the samples. The sampling error would be less, if the sample size is large relative to the population and vice-versa. The reason is that the estimate is based on a part and not on the whole.Even if utmost care has been taken in selecting a sample, the results derived from the sample may not be representative of the population from which it is drawn, because samples are seldom, if ever, perfect miniatures of the population. This gives rise to sampling errors. Sampling error are of two types- biased and unbiased.

1. Biased Errors

These errors arise from any bias in selection, estimation etc. For example if in place of simple random sampling, deliberate sampling has been used in particular case some bias isintroduced in the result and hence, such errors are called biased sampling errors.

2. Unbiased Sampling Errors

These errors arise due to chance differences between the members of population included in the sample and those not included. An error in statistics is the difference between the value of a statistic and that of the corresponding parameter.

Causes of Sampling Errors: Some of the causes of sampling errors are:

1. Error in the selection of the sample.
2. Bias in reporting of data.
3. Diversity of population.
4. Substitution of sample units for convenience.
5. Faulty demarcation of sampling universe.

b) Non-sampling Errors

Non-sampling error occurs at the time of observation, approximation and processing of data. This error is common to both the sampling and census survey. Non-sampling error can arise at any stage of the planning and execution of complete enumeration or sample survey.

As regards non-sampling errors, they are likely to be more in case of complete enumeration survey than in the case of a sample survey, since it is possible to reduce the non- sampling errors to a great extent by using better organisation and suitably trained personnel at the field and tabulation stages. The behaviour of non-sampling errors with increase in sample size is likely to be opposite of that of sampling error, that is, non-sampling error is likely to increase with increase in sample size. Non-sampling errors can occur at every stage of planning and execution of the census or survey. Such errors can arise due to a number of causes such as defective methods of data collection and tabulation, faulty definition, incomplete coverage of the population or sample etc.

Causes of Non- sampling Errors: Non -sampling errors may arise from one or more of the following factors:

1. Data specification being inadequate and inconsistent with respect to the objectives of the census or survey.
2. Lack of trained and experienced investigators**.**
3. Lack of adequate inspection and supervision of primary staff.
4. Errors due to non-response, i.e. incomplete coverage in respect of unit.
5. Errors in data processing operations such as coding, punching, certification, tabulation etc.
6. Omission or duplication of units due to imprecise definition or boundaries of area units, incomplete or wrong identification of units or faulty method of enumerations.
7. Inaccurate or inappropriate methods of interview, observation or measurement with inadequate or ambiguous schedules, definitions or instructions.

7.7 Summary

A complete enumeration of all items in the population is known as census inquiry. A sample is a subset of a population that is used to represent the entire group as a whole. Thus, sample is the selection of part of the universe for the purpose of drawing conclusion or inference about the entire universe from the study of these parts. In order to reach at right conclusions, a sample must possess the essential characteristics such as representativeness, adequacy, homogeneity, and independentability. Sampling can be done either by probability sampling method or by non-probability sampling method. Probability sampling means where each and every unit of the population has equal chance to be selected in the sample. Non-probability sampling is that when the organisation of the inquiry deliberately chooses the particular units of the universe to compose a sample on the basis that the small mass selected out of a large would represent the whole.

Probability sampling methods include simple random sampling, stratified sampling, systematic sampling, cluster sampling and multistage sampling. On the other hand, non–probability sampling methods include judgment sampling,convenience sampling,quota sampling. In the data collection process, some scope for errors still remains inspite of taking all the precautions. These errors can be sampling and non-sampling errors. Sampling error is the deviation of the selected sample from the true characteristics, traits, behaviors and qualities of the entire population. Non-sampling errors occurs at the time of observation approximation and processing of data.

7.8 Glossary

- **Sample**: The sample is a part or a small section of the population selected for study.
- **Sampling**: It is the procedure of selecting a sample from the population.
- **Sampling Frame**: A set of informationused to identify a samplepopulationfor statistical treatment. A sampling frame includes a numerical identifier for each individual, plusother identifying information about characteristicsof the individuals, to aid in analysisand allow for divisioninto further framesfor more in-depth analysis.

7.9 Answers to self-check Exercise

1. What is meant by sampling
2. Write the essential of good sampling
3. Distinguish between Random Sampling and Non-random Sampling
4. What is meant by Sampling Errors and Non-sampling Errors

7.10 Suggested Readings

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7.11 Terminal Questions

1. Define the term sampling? What should be the qualities of good sampling?
2. Discuss the various steps involved in sampling?
3. Discuss in brief Probability and Non-probability Methods of Sampling?
4. Explain various Sampling and Non-sampling Errors?

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CHAPTER-8
RELIABILITY AND VALIDITY OF MEASUREMENT

STRUCTURE

8.0 Learning Objectives

After reading this chapter, you will be able to:

- Define reliability and validity,
- Describe the various methods of calculating reliability and validity,
- Identify the problems that constitute threats to internal and external validity; and
- Differentiate between internal and external validity.

8.1 Introduction

Most research is designed to draw the conclusion about the cause and effect relationship among the variables. The goal of the research remains to develop a theory that explains the relationship found among variables. This chapter mainly concerns about various problems that can threaten the reliability and validity of conclusions drawn by the researcher.Reliability and validity are central issues in all measurement. Reliability and validity are salient because they are often ambiguous, diffused and not directly observable. Perfect reliability and validity are virtually very difficult to achieve. These two very important aspects of research design will be discussed in this chapter.

8.2 Meaning of Reliability

The idea behind reliability is that any significant results must be repeatable. Other researchers must be able to perform exactly the same experiment, under same conditions and generate the same results. This will support the findings and ensure that all researchers will accept the hypothesis. Without this replication of statistically significant results, experiment and research have not fulfilled all of the requirements of testability. This prerequisite is essential to a hypothesis establishing itself as an accepted scientific truth. For example, if you are performing a time critical experiment, you will be using some type of stopwatch. Generally, it is reasonable to assume that the instruments are reliable and will keep true and accurate time. However, scientists take measurements many times, to minimize the chances of malfunction and maintain validity and reliability. At the other extreme, any experiment that uses human judgment is always going to come under question. Human judgment can vary as individual observer may rate things differently depending upon time of day and current mood. This means that such experiments are more difficult to repeat and are inherently less reliable. Reliability is a necessary ingredient for determining the overall validity of a scientific experiment and enhancing the strength of the results.

Reliability is the consistency of your measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with the same subjects. In short, it is the repeatability of measurement. A measure is considered reliable if a person's score on the same test given twice is similar. It is important to remember that reliability is not measured, it is estimated. For instance, if a test is constructed to measure a particular trait; say, neuroticism, then each time it is administered, it should yield same results. A test is considered reliable if we get same result repeatedly.

According to Anastasi, the reliability of test refers to the consistency of scores obtained by the individual on different occasions or with different sets of equivalent items.

According to Stodola and Stordahl, the reliability of a test can be defined as the correlation between two or more sets of scores of equivalent tests from the same group of individuals.

According to Guilford, reliability is the proportion of the true variance in obtained test scores.

8.3 Methods of Estimating Reliability

There are number of ways of estimating reliability of an instrument. Various procedures can be classified into two groups:

8.3.1 External consistency procedures

8.3.2 Internal consistency procedures

8.3.1 External Consistency Procedures

External consistency procedures compare findings from two independent process of data collection with each other as a means of verifying the reliability of the measure. Two methods are as below:

8.3.1.1 Test- Retest Reliability

The most frequently used method to find the reliability of a test is by repeating the same test on same sample, on two different time periods. The reliability coefficient in this case would be the correlation between the score obtained by the same person on two administrations of the test.Test-Retest reliability is estimated, when same test is administered on same sample. The assumption behind this approach is that there will be no substantial changes in the measurement of the construct in question, upon administration on separate occasions. The time gap that is given between measures is of critical value, the shorter the time gap, higher the correlation value and vice versa. If the test is reliable, the scores that are attained on first administration should be more or less equal to those obtained on second time also. The relationship between the two administrations should be highly positive.

Limitations of this approach

There are a few limitations which include the following:

i) **Memory effect /carry over effect:** One of the common problems with test- retest reliability is that of memory effect. This argument particularly holds true when, the two administrations takes place within short span of time, for example, when a memory related experiment including nonsense syllables is conducted whereby, the subjects are asked to remember a list in a serial wise order, and the next experiment is conducted within 15 minutes, most of the times, subject is bound to remember his/her responses, as a result of which there can be prevalence of artificial reliability coefficient since subjects give response from memory instead of the test. Same is the condition when pre-test and post-test for a particular experiment is being conducted.

ii) **Practice effect:** This happens when repeated tests are being taken for the improvement of test scores, as is typically seen in the case of classical IQ where there is improvement in the scores as we repeat these tests.

iii) **Absence:** People remaining absent for re-tests.

8.3.1.2 Parallel Forms Reliability

Parallel-Forms Reliability is known by the various names such as Alternate forms reliability, equivalent form reliability and comparable form reliability. Parallel forms reliability compares two equivalent forms of a test that measure the same attribute. The two forms use different items. However, the rules used to select items of a particular difficulty level are the same. When two forms of the test are available, one can compare performance on one form versus the other. Sometimes the two forms are administered to the same group of people on the same day.

The Pearson product moment correlation coefficient is used as an estimate of the reliability. When both forms of the test are given on the same day, the only sources of variation are random error and the difference between the forms of the test. Sometimes the two forms of the test are given at different times. In these cases, error associated with time sampling is also included in the estimate of reliability.

The method of parallel forms provides one of the most rigorous assessments of reliability commonly in use. Unfortunately the use of parallel forms occurs in practice less often than is desirable. Often test developers find it burdensome to develop two forms of the same test, and practical constraints make it difficult to retest the same group of individuals. Instead many test developers prefer to base their estimate or reliability on a single form of a test.

In practice, psychologists do not always have two forms of a test. More often they have only one test form and must estimate the reliability for this single group of items. You can assess the different sources of variation within a single test in many ways. One method is to evaluate the internal consistency of the test by dividing it into subcomponents.

8.3.2 Internal Consistency Procedures

The idea behind internal consistency procedures is that items measuring same phenomena should produce similar results. Following internal consistency procedures are commonly used for estimating reliability-

8.3.2.1 Split Half Reliability

In this method, as the name implies, we randomly divide all items that intends to measure same construct into two sets .The complete instrument is administered on sample of people and total scores are calculated for each randomly divided half; the split half reliability is then, the simply the correlation between these two scores.

8.3.2.2 Kudar-Richardson Estimate of Reliability

The coefficient of internal consistency could also be obtained with the help of Kudar-Richardson formula. One of the techniques for item analysis is item difficulty index. Item difficulty is the proportion or percentage of those answering correctly to an item. For example, symbol ‘p’ is used to represent the difficulty index. Suppose an item ‘X’ has p=0.74.this means item ’X’ was answered correctly by 74 per cent of those who answered the item. To compute reliability with the help of Kuder-Richardson formula, the following formula is used:

$$KR = \frac{N}{N-1}\left[-\frac{pq}{\sigma^2}\right]$$

Where,

N = the number of items on the test,

ó² = the variance of scores on the total test,

p = the proportion of examinees getting each item correct,

q = the proportion of examinees getting each item wrong.

Kuder-Richardson is an index of reliability that is relevant to the special case where each test item is scored 0 or 1 (e.g., right or wrong).

8.3.2.3 Cronbach's Alpha

Cronbach's alpha coefficient measures the internal consistency, or reliability, of a set of survey items. Use this statistic to help determine whether a collection of items consistently measures the same characteristic. Higher values indicate higher agreement between items. The formula for coefficient alpha is

$$r_{\sigma} = \left[\frac{N}{N-1}\right]\left[1-\frac{\sigma_j^2}{\sigma^2}\right]$$

Where,

r = coefficient alpha,

N = the number of items,

$ó_j^2$ = the variance of one item,

ó² = the sum of variances of all items,

As with all reliability estimates, coefficient alpha can vary between 0.00 and 1.00. Coefficient alpha extends the Kuder-Richardson method to types of tests with items that are not scored as 0 or 1. For example, coefficient alpha could be used with an attitude scale in which examinees indicate on each item whether they strongly agree, agree, disagree, or strongly disagree.

High Cronbach's alpha values indicate that response values for each participant across a set of questions are consistent. For example, when participants give a high response for one of the items, they are also likely to provide high responses for the other items. This consistency indicates the measurements are reliable and the items might measure the same characteristic.

Conversely, low values indicate the set of items do not reliably measure the same construct. High responses for one question do not suggest that participants rated the other items highly. Consequently, the questions are unlikely to measure the same property because the measurements are unreliable.

8.4 Validity

Validity is the extent to which differences found with measuring instruments reflect true differences among those being tested. It refers to the degree to which a test measures, what it claims to measure. It is very necessary for a test to be valid for its proper administration and interpretation.

According to Cronbach, validity is the extent to which a test measures what it purports to measure.

According to Freeman, an index of validity shows the degree to which a test measures what it purports to measure when compared with accepted criteria.

According to Anastasi, the validity of a test concerns what the test measures and how well it does so.

The above definitions pointed out that for determining the validity of the test, the test must be compared with some ideal independent measures or criteria. The correlation coefficients computed between the test and an ideal criterion is known as the validity coefficients. Independent criteria refer to some measure of the trait or group of the traits (outside the test) that the test itself claims to measure.

8.5 Types of Validity

There are six types of validity which are being discussed below:

8.5.1 Content Validity

Content validity is the notion that a test should sample range of behaviour that is represented by the theoretical conceptbeing measured.It is a non-statistical type of validity with involvement of assessment of the content of the test to ascertain whether it includes the sample representative of the behaviour that is intended to be measured. When a test has content validity, the items on the test represent the entire range of possible items the test should cover. For instance, if researcher wants to develop an achievement test of spelling for the third grade children then a researcher could identify nearly all the possible words that third grade children should know. Individual test items may be taken from a huge group of items that include a broad range of items.

A test has content validity inbuilt in it. Items are selected in accordance with their compliance with the requirements of the test after a careful examination of the subject area.In certain cases, where a test measures a trait which is difficult to define, an expert can rate the relevance of items. Since, each judge have their own opinion on their rating, two independent judges will rate the test separately. Items which are rated as highly relevant by both judges would be included in the final test.

8.5.2 Criterion-related Validity

Criterion related validity is the idea that a valid test should relate closely to other measure of the same theoretical concept. A valid test of intelligence should correlate highly with other intelligence test. If a test demonstrates effective predicting criterion or indicators of the construct, it is said to possess criterion-related validity. There are two different types of criterion validity.

a) Concurrent Validity

Its occurrence is found when criterion measures are achieved at the same time as the test scores. It reflects the degree to which the test scores estimate the individual's present status with regards to criterion. For instance, if a test measures anxiety, it would be said to have concurrent validity if it rightly reflects the current level of anxiety experienced by an individual. Concurrent evidence of test validity is usually desirable for achievement tests and diagnostic clinical test.

b) Predictive Validity

Predictive validity occurs when criterion measures are obtained at a time after the test. For example, aptitude tests are useful in identifying who will be more likely to succeed or fail in a particular subject. Predictive validity is part curly relevant for entrance examination and occupational test.

8.5.3 Construct Validity

Construct validity approach is complex than other forms of validity. Mc Burney and White (2007) defined construct validity as the property of a test that the measurement actually measures the constructs they are designed to measure. There are several ways to determine whether a test generate data that have construct validity.

i) The test should actually measure whatever theoretical construct it supposedly tests, and not something else. For example a test of leadership ability should not actually test extraversion.

ii) A test that has construct validity should measure what it intends to measure but not measure theoretically unrelated constructs. For example, a test of musical aptitude should not require too much reading ability.

iii) A test should prove useful in predicting results related to the theoretical concepts it is measuring. For example, a test of musical ability should predict who will benefit from taking music lessons, should differentiate groups who have chosen music as a career from those who haven't should relate to other tests of musical ability and so on.

There are two types of construct validity— 'convergent validity' and 'divergent validity' (or discriminant validity).

a) Convergent Validity: It means the extent to which a measure is correlated with other measure which is theoretically predicted to correlate with.

b) Divergent/Discriminant Validity: This explains the extent to which the operationalisation is not correlated with other operationalisations that it theoretically should not be correlated with.

8.5.4 Face Validity

Face validity refers to what appears to measure superficially. It depends on the judgment of the researcher. Each question is scrutinised and modified until the researcher is satisfied that it is an accurate measure of the desired construct. The determination of face validity is based on the subjective opinion of the researcher.

8.5.5 Internal Validity

Internal validity is the most fundamental type of validity because it concerns the logic of the relationships between the independent variable and dependent variable. This type of validity is an estimate of the degree to which inferences about causal relationship can be drawn, based on the measures employed and research design. Properly suited experimental techniques, where the effect of an independent variable upon the dependent one is observed under highly controlled conditions makes possible higher degree of internal validity.

Threats to Internal Validity

i) **Confounding:**Confounding error that occurs when the effects of two variables in an experiment cannot be separated, resulting in a confused interpretation of the results. Confounding is one of the biggest threat to validity in experimentation. The problem of confounding is particularly acute in research in which the experimenter cannot control the independent variable. When participants are selected according to presence or absence of a condition, subject variable can affect the results. Where a false relationship cannot be avoided, a rival hypothesis may be developed to the original cause and inference hypotheses.

ii) **Selection bias:**Any bias in selecting a group can undermine internal validity. Selection bias indicates the problem that occurs as a result of its existence at the pre-test differences between groups, may interact with the independent variable and thus influence the observed outcome and creates problems; examples would be gender, personality, mental capabilities, and physical abilities, motivation level and willingness to participate.

iii) **History:** Events outside the experiment or between repeated measures of dependent variables may influence participants' responses, attitudes and behaviour during process of experiment, like; natural disasters, political changes etc. In this condition, it becomes impossible to determine whether change in dependent variable is caused by independent variable or historical event.

iv) **Maturation:**Usually, it happens that subjects change during the course of an experiment or between measurements. For instance, in longitudinal studies young kids might grow up as a result of their experience, abilities or attitudes which are intended to be measured. Permanent changes [such as physical growth] and temporary changes [like fatigue and illness] may alter the way a subject would react to the independent variable. Thus, researcher may have trouble in ascertaining if the difference is caused by time or other variables.

v) **Repeated testing**: Participants may be driven to bias owing to repeated testing. Participants may remember correct answers or may be conditioned as a result of incessant administration of the test. Moreover, it also causes possibility of threat to internal validity.

vi) **Instrument change**: If any instrument is replaced/changed during process of experiment, then it may affect the internal validity as alternative explanation easily available.

vii) **Regression toward the mean**: During the experiment, if subjects are selected on the basis of extreme scores, then there are chances of occurrence of such an error. For example, when subjects with minimum mathematical abilities are chosen, at the end of the study if there is any improvement chances are that it would be due to regression towards the mean and not due to effectiveness of the course.

viii) **Mortality:** It should be kept in mind that there may be some participants who may have dropped out of the study before its completion. If dropping out of participants leads to relevant bias between groups, alternative explanation is possible that account for the observed differences.

ix) **Diffusion:** It might be observed that there will be a lack of differences between experimental and control groups if treatment effects spread from treatment groups to control groups. This, however, does not mean that, independent variable will have no effect or that there would not be no relationship between dependent and independent variable.

x) **Compensatory rivalry/resentful demoralisation:** There will be a change in the behaviour of the subject if the control groups alter as a result of the study. For instance, control group participants may work extra hard to see that expected superiority of the experimental group is not demonstrated. Again, this does not imply that the independent variable created no effect or that there would be no relationship between dependent and independent variable. Vice-versa, changes in the dependent variable may only be effected due to a demoralised control group, working less hard or demotivated.

xi) **Experimenter bias:**Experimenter bias happens while experimenters, without any intention or reluctance, behave differently to the participants of control and experimental groups, that in turn, affect the results of the experiment. Experimental bias can be reduced by keeping the experimenter from knowing the condition in the experiment or its purpose and by standardising the procedure as much as possible.

8.5.6 External Validity

External validity concerns whether results of the research can be generalised to another situation, different subjects, settings, times and so on.External validity lacks from the fact that experiments using human participants often employ small samples collected from a particular geographic location or with idiosyncratic features (e.g. volunteers). Because of this, it cannot be made sure that the conclusions drawn about cause-effect-relationships are actually applicable to the people in other geographic locations or in the absence of these features.

Threat to External Validity

How one may go wrong in making generalisations, is one of the major threats to external validity. Usually, generalisations are limited when the cause (i.e. independent variable) is dependent upon other factors; as a result, all the threats to external validity interact with the independent variable

a) **Aptitude-Treatment-Interaction**: The sample might have some features that may interact with the independent variable causing to limit generalisability, for instance, conclusions drawn from comparative psychotherapy studies mostly use specific samples (example; volunteers, highly depressed, hardcore criminals).

b) **Situations**: All the situational factors, for example, treatment conditions, light, noise, location, experimenter, timing, scope and degree of measurement etc may limit generalisations.

c) **Pre-Test Effects**: When the cause-effect relationships can only be found out after the pre-tests are carried out, then, this also tends to limit the generality of the findings.

d) **Post-Test Effects:** When cause-effect relationships can only be explored after the post-tests are carried out, then this can also be a cause for limiting the generalisationsof the findings.

e) **Rosenthal Effects:** When derivations drawn from the cause-consequence relationships cannot be generalised to other investigators or researchers.

8.6 Summary

In psychological testing, reliability refers to the attribute of consistency of measurement. There are various types of reliability. The Pearson product-moment correlation coefficient can be used to gauge the consistency of psychological test scores. This form of reliability is referred to as test-retest reliability. Alternate- forms reliability is computed by correlating scores on two equivalent forms, administered in counterbalanced fashion to a large group of heterogeneous subjects. Internal consistency approaches to reliability include split-half reliability, in which scores on half tests are correlated with each other, and coefficient alpha, which can be thought of as the mean of all possible split-half coefficients. For tests that require examiner judgment for assignment of scores, inter scorer reliability is needed. Computing inters corer reliability is straightforward: A sample of tests is independently score by two or more examiners and scores for pairs of examiners are then correlated.

The validity of a test is the degree to which it measures what it claims to measure. A test is valid to the extent that inferences made from it are appropriate, meaningful, and useful. There are various kinds of validity – content validitydetermine by the degree to which the question, task or items on a test are representative of the universe of behaviour the test was designed to sample. A test has face validity if it looks valid to test users, examiners, and especially the examinees. Criterion-related validity is demonstrated when a test is effective in predicting performance on an appropriate outcome measure. An investigation has internal

validity is a cause-effect relationship actually exists between the independent and dependent variables. Confounding occurs when the effects of two independent variables in an experiment cannot be separately evaluated. External validity concerns whether the results of the research can be generalised to another situation: different subjects, settings, times, and so forth. Treats to the internal validity of an experiment include events outside the laboratory, maturation, effects of testing, regression effect, selection and mortality. Threats to external validity include problems arising from generalising to other subjects, other times, or other settings. Experimenter bias can be reduced by keeping the experiment from knowing he conditions in the experiment or its purpose and by standardising procedure as much as possible.

8.7 Glossary

- **Concurrent validity:** a type of criterion-related validity in which thecriterion measures are obtained at approximately the same time as the test scores.
- **Confounding:** error that occurs when the effects of two variablesin an experiment cannot be separated, resulting in a confused interpretation of the results.
- **Construct:** a theoretical, tangible quality or trait in which individuals differ.
- **Construct validity:** the property of a test that the measurementsactually measure the constructs they are designed to measure, but no others.
- **Content validity:**idea that a test should sample the range ofbehaviour represented by the theoretical concept being tested.
- **Criterion validity:** idea that a test should correlate with othermeasures of the same theoretical construct.
- **External validity:** how well the findings of an experiment generalize to other situations or populations.
- **Internal consistency**: the degree to which the various items on a test are measures of the same thing.
- **Internal validity:** extent to which a study provides evidence of acause-effect relationship between the independent and dependent variables.
- **Maturation:**a source of error in an experiment related to theamount of time between measurements.
- **Regression effect:** regression effect tendency of subjects withextreme score on a first measure to score closer to the mean on a second testing.
- **Reliability:** the property of consistency of a measurement thatgives the same result on different occasions.
- **Split-half reliability:** a form of reliability in which scores from the twohalves of a test (e.g. even items versus odd items) are correlated with one another; the correlation is then adjusted for test length.

- **Test- retest reliability:** the degree to which the same test score would beobtained on another occasion.
- **Validity:** of a measurement the property of a measurement that tests what it is supposed to test.

8.8 Answers to Self-Check Exercises

1. Define reliability and validity.
2. What is meant by internal consistency reliability.
3. Explain construct validity. How does it differ from content validity.
4. What is internal and external validity?
5. Write short notes on :
   a) Parallel Forms Reliability.
   b) Kudar-Richardson Estimate of Reliability (KR formula 20)
   c) Cronbach's Alfa
   d) Convergent and Divergent Validity
   e) Concurrent and Predictive Validity

8.9 Suggested Readings

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8.10 Terminal Questions

1. Define reliability. Discuss any two methods of estimating reliability of test scores.
2. Define validity and distinguish between reliability and validity.
3. Define validity and also explain its various types.
4. What is meant by internal consistency reliability? Discuss any two methods of assessing internal consistency reliability.

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CHAPTER-9
SCALING TECHNIQUES

STRUCTURE

9.1 Introduction

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

9.2 Meaning of Scaling

Scaling describes the procedures of assigning numbers to various degrees of opinion, attitude and other concepts. This can be done in two ways viz., (i) making a judgment about

some characteristic of an individual and then placing him directly on a scale that has been defined in terms of that characteristic and (ii) constructing questionnaire in such a way that the score of individual's responses assigns him a place on a scale. It may be stated here that a scale is a continuum, consisting of the highest point (in terms of some characteristic e.g., preference, favourableness, etc.) and the lowest point along with several intermediate points between these two extreme points. These scale-point positions are so related to each other that when the first point happens to be the highest point, the second point indicates a higher degree in terms of a given characteristic as compared to the third point and the third point indicates a higher degree as compared to the fourth and so on.

Numbers for measuring the distinctions of degree in the attitudes/opinions are, thus, assigned to individuals corresponding to their scale-positions. All this is better understood when we talk about scaling technique(s). Hence the term 'scaling' is applied to the procedures for attempting to determine quantitative measures of subjective abstract concepts. Scaling has been defined as a "procedure for the assignment of numbers (or other symbols) to a property of objects in order to impart some of the characteristics of numbers to the properties in question."

Bases of Scale Classification

The number assigning procedures or the scaling procedures may be broadly classified on one or more of the following bases:

(a) Subject orientation;

(b) Response form;

(c) Degree of subjectivity;

(d) Scale properties;

(e) Number of dimensions; and

(f) Scale construction techniques.

(a) **Subject orientation**: Under it a scale may be designed to measure characteristics of the respondent who completes it or to judge the stimulus object which is presented to the respondent. In respect of the former, we presume that the stimuli presented are sufficiently homogeneous so that the between stimuli variation is small as compared to the variation among respondents. In the latter approach, we ask the respondent to judge some specific object in terms of one or more dimensions and we presume that the between-respondent variation will be small as compared to the variation among the different stimuli presented to respondents for judging.

(b) **Response form:** Under this we may classify the scales as categorical and comparative. Categorical scales are also known as rating scales. These scales are used when a respondent scores some object without direct reference to other objects. Under comparative scales, which are also known as ranking scales, the respondent is asked to compare two or more objects. In this sense the respondent

may state that one object is superior to the other or that three models of pen rank in order 1, 2 and 3. The essence of ranking is, in fact, a relative comparison of a certain property of two or more objects.

(c) **Degree of subjectivity**: With this basis the scale data may be based on whether we measure subjective personal preferences or simply make non-preference judgements. In the former case, the respondent is asked to choose which person he favours or which solution he would like to see employed, whereas in the latter case he is simply asked to judge which person is more effective in some aspect or which solution will take fewer resources without reflecting any personal preference.

(d) **Scale properties:** Considering scale properties, one may classify the scales as nominal, ordinal, interval and ratio scales. Nominal scales merely classify without indicating order, distance or unique origin. Ordinal scales indicate magnitude relationships of 'more than' or 'less than', but indicate no distance or unique origin. Interval scales have both order and distance values, but no unique origin. Ratio scales possess all these features.

(e) **Number of dimensions:** In respect of this basis, scales can be classified as 'unidimensional' and 'multidimensional' scales. Under the former we measure only one attribute of the respondent or object, whereas multidimensional scaling recognizes that an object might be described better by using the concept of an attribute space of 'n' dimensions, rather than a single-dimension continuum.

(f) **Scale construction techniques:** Following are the five main techniques by which scales can be developed.

(i) **Arbitrary approach:** It is an approach where scale is developed on ad hoc basis. This is the most widely used approach. It is presumed that such scales measure the concepts for which they have been designed, although there is little evidence to support such an assumption.

(ii) **Consensus approach:** Here a panel of judges evaluate the items chosen for inclusion in the instrument in terms of whether they are relevant to the topic area and unambiguous in implication.

(iii) **Item analysis approach:** Under it a number of individual items are developed into a test which is given to a group of respondents. After administering the test, the total scores are calculated for everyone. Individual items are then analysed to determine which items discriminate between persons or objects with high total scores and those with low scores.

(iv) **Cumulative:** scales are chosen on the basis of their conforming to some ranking of items with ascending and descending discriminating power. For instance, in such a scale the endorsement of an item representing an extreme position should also result in the endorsement of all items indicating a less extreme position.

(v) Factor scales may be constructed on the basis of inter-correlations of items which indicate that a common factor accounts for the relationship

9.4 Important Scaling Techniques

We now take up some of the important scaling techniques often used in the context of research specially in context of social or business research.

9.4.1 Attitude Scales

Researchers are interested in people's attitudes. An attitude is a psychological construct. It is a person's predisposition to respond favorably or unfavorably to activities, people, events, and objects. Attitudes are often considered precursors to behavior.Attitudes have three components:

1) **Affective**, which deals with a person's feelings and emotions
2) **Cognitive**, which deals with a person's awareness and knowledge
3) **Behavioral**, which deals with a person's actions

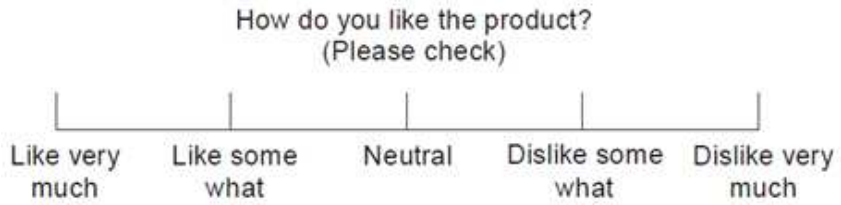
Researchers have developed a variety of attitude rating scales to measure the intensity of an attitude's affective, cognitive, and behavioral components. These scales may require a respondent to rank, rate, sort, and choose when we assess an attitude.**Scaling** refers to the process of assigning numbers or symbols to measure the intensity of abstract attitudes. Scales can be **uni-dimensional** or **multi-dimensional**. **Uni-dimensiona**l scales measure a single aspect or dimension of an attitude. **Multi-dimensional** scales measure more than one dimension of an attitude.

9.4.2 Rating Scales:

The rating scale involves qualitative description of a limited number of aspects of a thing or of traits of a person. When we use rating scales (or categorical scales), we judge an object in absolute terms against some specified criteria i.e., we judge properties of objects without reference to other similar objects. These ratings may be in such forms as "like-dislike", "above average, average, below average", or other classifications with more categories such as "like very much—like somewhat—neutral—dislike somewhat—dislike very much"; "excellent—good—average—below average—poor", "always—often—occasionally—rarely—never", and so on. There is no specific rule whether to use a two-points scale, three-points scale or scale with still more points. In practice, three to seven points scales are generally used for the simple reason that more points on a scale provide an opportunity for greater sensitivity of measurement.

Rating scale may be either a graphic rating scale or an itemized rating scale.

(i) The graphic rating scale is quite simple and is commonly used in practice. Under it the various points are usually put along the line to form a continuum and the rater indicates his rating by simply making a mark (such as ü) at the appropriate point on a line that runs from one extreme to the other. Scale-points with brief descriptions may be indicated along the line, their function being to assist the rater in performing his job. The following is an example of five-points graphic rating scale when we wish to ascertain people's liking or disliking any product:



This type of scale has several limitations. The respondents may check at almost any position along the line which fact may increase the difficulty of analysis. The meanings of the terms like "very much" and "somewhat" may depend upon respondent's frame of reference so much so that the statement might be challenged in terms of its equivalency. Several other rating scale variants (e.g., boxes replacing line) may also be used.

(ii) The itemized rating scale (also known as numerical scale) presents a series of statements from which a respondent selects one as best reflecting his evaluation. These statements are ordered progressively in terms of more or less of some property. An example of itemized scale can be given to illustrate it.

Suppose we wish to inquire as to how well does a worker get along with his fellow workers? In such a situation we may ask the respondent to select one, to express his opinion, from the following:

- He is almost always involved in some friction with a fellow worker.
- He is often at odds with one or more of his fellow workers.
- He sometimes gets involved in friction.
- He infrequently becomes involved in friction with others.
- He almost never gets involved in friction with fellow workers.

The chief merit of this type of scale is that it provides more information and meaning to the rater, and thereby increases reliability. This form is relatively difficult to develop and the statements may not say exactly what the respondent would like to express.

Rating scales have certain good points. The results obtained from their use compare favourably with alternative methods. They require less time, are interesting to use and have a wide range of applications. Besides, they may also be used with a large number of properties or variables. But their value for measurement purposes depends upon the assumption that the respondents can and do make good judgements. If the respondents are not very careful while rating, errors may occur. Three types of errors are common viz., the error of leniency, the error of central tendency and the error of hallo effect. The error of leniency occurs when certain respondents are either easy raters or hard raters. When raters are reluctant to give extreme judgements, the result is the error of central tendency. The error of hallo effect or the systematic bias occurs when the rater carries over a generalised impression of the subject from one rating to another. This sort of error takes place when we conclude for example, that a particular report is good because we like its form or that someone is intelligent because he agrees with us or has a pleasing personality. In other words, hallo effect is likely to appear when the rater is asked to rate many factors, on a number of which he has no evidence for judgement.

9.4.3 Ranking Scales:

Under ranking scales (or comparative scales) we make relative judgements against other similar objects. The respondents under this method directly compare two or more objects and make choices among them. There are two generally used approaches of ranking scales:

(a) **Method of paired comparisons**: Under it the respondent can express his attitude by making a choice between two objects, say between a new flavour of soft drink and an established brand of drink. But when there are more than two stimuli to judge, the number of judgements required in a paired comparison is given by the formula:

$$N = \frac{n(n-1)}{2}$$

Where,

N = number of judgements

n = number of stimuli or objects to be judged.

For instance, if there are ten suggestions for bargaining proposals available to a workers union, there are 45 paired comparisons that can be made with them. When N happens to be a big figure, there is the risk of respondents giving ill-considered answers or they may even refuse to answer. We can reduce the number of comparisons per respondent either by presenting to each one of them only a sample of stimuli or by choosing a few objects which cover the range of attractiveness at about equal intervals and then comparing all other stimuli to these few standard objects. Thus, paired-comparison data may be treated in several ways. If there is substantial consistency, we will find that if X is preferred to Y, and Y to Z, then X will consistently be preferred to Z. If this is true, we may take the total number of preferences among the comparisons as the score for that stimulus.

It should be remembered that paired comparison provides ordinal data, but the same may be converted into an interval scale by the method of the Law of Comparative Judgement developed by L.L. Thurstone. This technique involves the conversion of frequencies of preferences into a table of proportions which are then transformed into Z matrix by referring to the table of area under the normal curve. J.P. Guilford in his book “Psychometric Methods” has given a procedure which is relatively easier. The method is known as the Composite Standard Method and can be illustrated as under:

Suppose there are four proposals which some union bargaining committee is considering. The committee wants to know how the union membership ranks these proposals. For this purpose a sample of 100 members might express the views as shown in the following table:

Response Patterns of 100 Members' Paired Comparisons of 4 Suggestions for Union Bargaining Proposal Priorities

	Suggestion			
	A	*B*	*C*	*D*
A	–	65*	32	20
B	40	–	38	42
C	45	50	–	70
D	80	20	98	–
TOTAL:	165	135	168	132
Rank order	2	3	1	4
M_p	0.5375	0.4625	0.5450	0.4550
Z_j	0.09	(–).09	0.11	(–).11
R_j	0.20	0.02	0.22	0.00

*Read as 65 members preferred suggestion *B* to suggestion *A*.

Comparing the total number of preferences for each of the four proposals, we find that C is the most popular, followed by A, B and D respectively in popularity. The rank order shown in the above table explains all this.

By following the composite standard method, we can develop an interval scale from the paired comparison ordinal data given in the above table for which purpose we have to adopt the following steps in order:

(i) Using the data in the above table, we work out the column mean with the help of the formula given below:

$$\text{Mp} = \frac{C + 0.5N}{nN} = \frac{165 + 0.5(100)}{4(100)} = 0.5375$$

Where,

Mp = the mean proportion of the columns

C = the total number of choices for a given suggestion

n = number of stimuli (proposals in the given problem)

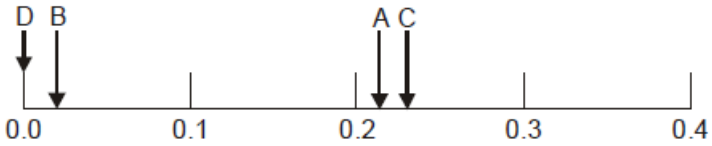
N = number of items in the sample.

The column means have been shown in the Mprow in the above table.

(ii) The Z values for the Mpare secured from the table giving the area under the normal curve. When the Mpvalue is less than 0.5, the Z value is negative and for all Mpvalues higher than 0.5, the Z values are positive. These Z values are shown in Zjrow in the above table.

(iii) As the Zjvalues represent an interval scale, zero is an arbitrary value. Hence we can eliminate negative scale values by giving the value of zero to the lowest scale value (this being (–).11 in our example which we shall take equal to zero) and then adding the absolute value of this lowest scale value to all other scale items. This scale has been shown in Rjrow in the above table.

Graphically we can show this interval scale that we have derived from the paired-comparison data using the composite standard method as follows:



(b) Method of rank order: Under this method of comparative scaling, the respondents are asked to rank their choices. This method is easier and faster than the method of paired comparisons stated above. For example, with 10 items it takes 45 pair comparisons to complete the task, whereas the method of rank order simply requires ranking of 10 items only. The problem of transitivity (such as A prefers to B, B to C, but C prefers to A) is also not there in case we adopt method of rank order. Moreover, a complete ranking at times is not needed in which case the respondents may be asked to rank only their first, say, four choices while the number of overall items involved may be more than four, say, it may be 15 or 20 or more. To secure a simple ranking of all items involved we simply total rank values received by each item. There are methods through which we can as well develop an interval scale of these data. But then there are limitations of this method. The first one is that data obtained through this method are ordinal data and hence rank ordering is an ordinal scale with all its limitations. Then there may be the problem of respondents becoming careless in assigning ranks particularly when there are many (usually more than 10) items.

9.5 Scale Construction Techniques

In social science studies, while measuring attitudes of the people we generally follow the technique of preparing the opinionnaire (An information form that attempts to measure the attitude or belief of an individual is known as opinionnaire) in such a way that the score of the individual responses assigns him a place on a scale. Under this approach, the respondent expresses his agreement or disagreement with a number of statements relevant to the issue. While developing such statements, the researcher must note the following two points:

(i) That the statements must elicit responses which are psychologically related to the attitude being measured;

(ii) That the statements need be such that they discriminate not merely between extremes of attitude but also among individuals who differ slightly.

Researchers must as well be aware that inferring attitude from what has been recorded in opinionnaires has several limitations. People may conceal their attitudes and express socially acceptable opinions. They may not really know how they feel about a social issue. People may be unaware of their attitude about an abstract situation; until confronted with a real situation, they may be unable to predict their reaction. Even behaviour itself is at times not a true indication of attitude. For instance, when politicians kiss babies, their behaviour may not be a true expression of affection toward infants. Thus, there is no sure method of measuring attitude; we only try to measure the expressed opinion and then draw inferences from it about people's real feelings or attitudes.

With all these limitations in mind, psychologists and sociologists have developed several scale construction techniques for the purpose. The researcher should know these techniques so as to develop an appropriate scale for his own study. Some of the important approaches, along with the corresponding scales developed under each approach to measure attitude are as follows:

Different Scales for Measuring Attitudes of People

S. No.	Name of the scale construction approach	Name of the scale developed
1.	Arbitrary approach	Arbitrary scales
2.	Consensus scale approach	Differential scale (such as Thurstone differential scale)
3.	Item analysis approach	Summated scales (Such as Likert Scale)
4.	Cumulative scale approach	Cumulative scale (Such as Guttman's Scalogram)
5.	Factor analysis approach	Factor scales (Such as Osgood's Semantic Differential, Multi-dimensional scaling etc.)

A brief description of each of the above listed scales will be helpful.

9.5.1 Arbitrary Scales

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

The chief merit of such scales is that they can be developed very easily, quickly and with relatively less expense. They can also be designed to be highly specific and adequate. Because of these benefits, such scales are widely used in practice.

At the same time there are some limitations of these scales. The most important one is that we do not have objective evidence that such scales measure the concepts for which they have been developed. We have simply to rely on researcher's insight and competence.

9.5.2 Differential Scales (or Thurstone-type Scales)

The name of L.L. Thurstone is associated with differential scales which have been developed using consensus scale approach. Under such an approach the selection of items is made by a panel of judges who evaluate the items in terms of whether they are relevant to the topic area and unambiguous in implication. The detailed procedure is as under:

(a) The researcher gathers a large number of statements, usually twenty or more, that express various points of view toward a group, institution, idea, or practice (i.e., statements belonging to the topic area).

(b) These statements are then submitted to a panel of judges, each of whom arranges them in eleven groups or piles ranging from one extreme to another in position. Each of the judges is requested to place generally in the first pile the statements which he thinks are most unfavourable to the issue, in the second pile to place those statements which he thinks are next most unfavourable and he goes on doing so in this manner till in the eleventh pile he puts the statements which he considers to be the most favourable.

(c) This sorting by each judge yields a composite position for each of the items. In case of marked disagreement between the judges in assigning a position to an item, that item is discarded.

(d) For items that are retained, each is given its median scale value between one and eleven as established by the panel. In other words, the scale value of any one statement is computed as the 'median' position to which it is assigned by the group of judges.

(e) A final selection of statements is then made. For this purpose a sample of statements, whose median scores are spread evenly from one extreme to the other is taken. The statements so selected, constitute the final scale to be administered to respondents. The position of each statement on the scale is the same as determined by the judges.

After developing the scale as stated above, the respondents are asked during the administration of the scale to check the statements with which they agree. The median value of the statements that they check is worked out and this establishes their score or quantifies their opinion. It may be noted that in the actual instrument the statements are arranged in random order of scale value. If the values are valid and if the opinionnaire deals with only one attitude dimension, the typical respondent will choose one or several contiguous items (in terms of scale values) to reflect his views. However, at times divergence may occur when a statement appears to tap a different attitude dimension.

The Thurstone method has been widely used for developing differential scales which are utilized to measure attitudes towards varied issues like war, religion, etc. Such scales are considered most appropriate and reliable when used for measuring a single attitude. But an important deterrent to their use is the cost and effort required to develop them. Another weakness of such scales is that the values assigned to various statements by the judges may reflect their own attitudes. The method is not completely objective; it involves ultimately subjective decision process. Critics of this method also opine that some other scale designs give more information about the respondent's attitude in comparison to differential scales.

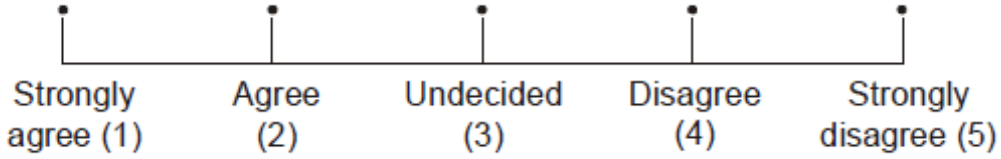
9.5.3 Summated Scales (or Likert-type Scales)

Summated scales (or Likert-type scales) are developed by utilizing the item analysis approach wherein a particular item is evaluated on the basis of how well it discriminates between those persons whose total score is high and those whose score is low. Those items or statements that best meet this sort ofdiscrimination test are included in the final instrument.

Thus, summated scales consist of a number of statements which express either a favourable or unfavourable attitude towards the given object to which the respondent is asked to react. The respondentindicates his agreement or disagreement with each statement in the instrument. Each response isgiven a numerical score, indicating its favourableness or unfavourableness, and the scores are totaled to measure the respondent's attitude. In other words, the overall score represents the respondent'sposition on the continuum of favourable-unfavourableness towards an issue.

Most frequently used summated scales in the study of social attitudes follow the pattern devised by Likert. For this reason they are often referred to as Likert-type scales. In a Likert scale, the respondent is asked to respond to each of the statements in terms of several degrees, usually fivedegrees (but at times 3 or 7 may also be used) of agreement or disagreement. For example, whenasked to express opinion whether one considers his job quite pleasant, the respondent may respond inany one of the following ways: (i) strongly agree, (ii) agree, (iii) undecided, (iv) disagree, (v) stronglydisagree.

We find that these five points constitute the scale. At one extreme of the scale there is strong agreement with the given statement and at the other, strong disagreement, and between them lie intermediate points. We may illustrate this as under:



Each point on the scale carries a score. Response indicating the least favourable degree of job satisfaction is given the least score (say 1) and the most favourable is given the highest score (say 5). These score-values are normally not printed on the instrument but

are shown here just to indicate the scoring pattern. The Likert scaling technique, thus, assigns a scale value to each of the five responses. The same thing is done in respect of each and every statement in the instrument. This way the instrument yields a total score for each respondent, which would then measure the respondent's favourableness toward the given point of view. If the instrument consists of, say 30 statements, the following score values would be revealed:

30 × 5 = 150 Most favourable response possible

30 × 3 = 90 A neutral attitude

30 × 1 = 30 Most unfavourable attitude.

The scores for any individual would fall between 30 and 150. If the score happens to be above 90, it shows favourable opinion to the given point of view, a score of below 90 would mean unfavourable opinion and a score of exactly 90 would be suggestive of a neutral attitude.

Procedure: The procedure for developing a Likert-type scale is as follows:

(i) As a first step, the researcher collects a large number of statements which are relevant to the attitude being studied and each of the statements expresses definite favourableness or unfavourableness to a particular point of view or the attitude and that the number of favourable and unfavourable statements is approximately equal.

(ii) After the statements have been gathered, a trial test should be administered to a number of subjects. In other words, a small group of people, from those who are going to be studied finally, are asked to indicate their response to each statement by checking one of the categories of agreement or disagreement using a five point scale as stated above.

(iii) The response to various statements are scored in such a way that a response indicative of the most favourable attitude is given the highest score of 5 and that with the most unfavourable attitude is given the lowest score, say, of 1.

(iv) Then the total score of each respondent is obtained by adding his scores that he received for separate statements.

(v) The next step is to array these total scores and find out those statements which have a high discriminatory power. For this purpose, the researcher may select some part of the highest and the lowest total scores, say the top 25 per cent and the bottom 25 per cent. These two extreme groups are interpreted to represent the most favourable and the least favourable attitudes and are used as criterion groups by which to evaluate individual statements. This way we determine which statements consistently correlate with low favourability and which with high favourability.

(vi) Only those statements that correlate with the total test should be retained in the final instrument and all others must be discarded from it.

Advantages: The Likert-type scale has several advantages. Mention may be made of the important ones.

(a) It is relatively easy to construct the Likert-type scale in comparison to Thurstone-type scale because Likert-type scale can be performed without a panel of judges.

(b) Likert-type scale is considered more reliable because under it respondents answer each statement included in the instrument. As such it also provides more information and data than does the Thurstone-type scale.

(c) Each statement, included in the Likert-type scale, is given an empirical test for discriminating ability and as such, unlike Thurstone-type scale, the Likert-type scale permits the use of statements that are not manifestly related (to have a direct relationship) to the attitude being studied.

(d) Likert-type scale can easily be used in respondent-centred and stimulus-centred studies i.e., through it we can study how responses differ between people and how responses differ between stimuli.

(e) Likert-type scale takes much less time to construct, it is frequently used by the students of opinion research. Moreover, it has been reported in various research studies* that there is high degree of correlation between Likert-type scale and Thurstone-type scale.

Limitations: There are several limitations of the Likert-type scale as well. One important limitation is that, with this scale, we can simply examine whether respondents are more or less favourable to a topic, but we cannot tell how much more or less they are. There is no basis for belief that the five positions indicated on the scale are equally spaced. The interval between 'strongly agree' and 'agree', may not be equal to the interval between "agree" and "undecided". This means that Likert scale does not rise to a stature more than that of an ordinal scale, whereas the designers of Thurstone scale claim the Thurstone scale to be an interval scale. One further disadvantage is that often the total score of an individual respondent has little clear meaning since a given total score can be secured by a variety of answer patterns. It is unlikely that the respondent can validly react to a short statement on a printed form in the absence of real-life qualifying situations. Moreover, there "remains a possibility that people may answer according to what they think they should feel rather than how they do feel.".

In spite of all the limitations, the Likert-type summated scales are regarded as the most useful in a situation wherein it is possible to compare the respondent's score with a distribution of scores from some well defined group. They are equally useful when we are concerned with a programme of change or improvement in which case we can use the scales to measure attitudes before and after the programme of change or improvement in order to assess whether our efforts have had the desired effects. We can as well correlate scores on the scale to other measures without any concern for the absolute value of what is favourable and what is unfavourable. All this accounts for the popularity of Likert-type scales in social studies relating to measuring of attitudes.

9.5.4 Cumulative scales or Guttman's Scalogram Analysis:

Cumulative scales or Louis Guttman's scalogram analysis, like other scales,consist of series of statements to which a respondent expresses his agreement or disagreement. Thespecial feature of this type of scale is that statements in it form a cumulative series. This, in otherwords, means that the statements are related to one another in such a way that an individual, who replies favourably to say item No. 3, also replies favourably to items No. 2 and 1, and one who repliesfavourably to item No. 4 also replies favourably to items No. 3, 2 and 1, and so on. This being so anindividual whose attitude is at a certain point in a cumulative scale will answer favourably all the items on one side of this point, and answer unfavourably all the items on the other side of this point.The individual's score is worked out by counting the number of points concerning the number of statements he answers favourably. If one knows this total score, one can estimate as to how arespondent has answered individual statements constituting cumulative scales. The major scale ofthis type of cumulative scales is the Guttman's scalogram. We attempt a brief description of thesame below.

The technique developed by Louis Guttman is known as scalogram analysis, or at times simply'scale analysis'. Scalogram analysis refers to the procedure for determining whether a set of items forms a uni-dimensional scale. A scale is said to be uni-dimensional if the responses fall into a patternin which endorsement of the item reflecting the extreme position results also in endorsing all itemswhich are less extreme. Under this technique, the respondents are asked to indicate in respect ofeach item whether they agree or disagree with it, and if these items form a uni-dimensional scale, the response pattern will be as under:

Responses pattern in scalogram analysis

Item Number				Respondent score
4	**3**	**2**	**1**	
X	X	X	X	4
-	X	X	X	3
-	-	X	X	2
-	-	-	X	1
-	-	-	-	0

X = Agree; - (minus) = Disagree

A score of 4 means that the respondent is in agreement with all the statements which indicate the most favourable attitude. But a score of 3 would mean that the respondent is not agreeable to item 4, but he agrees with all others. In the same way one can interpret other values of the respondents' scores. This pattern reveals that the universe of content is scalable.

Procedure:

The procedure for developing a scalogram can be outlined as under:

(a) The universe of content must be defined first of all. In other words, we must lay down in clear terms the issue we want to deal within our study.

(b) The next step is to develop a number of items relating the issue and to eliminate by inspection the items that are ambiguous, irrelevant or those that happen to be too extreme items.

(c) The third step consists in pre-testing the items to determine whether the issue at hand is scalable (The pretest, as suggested by Guttman, should include 12 or more items, while the final scale may have only 4 to 6 items. Similarly, the number of respondents in a pretest may be small, say 20 or 25 but final scale should involve relatively more respondents, say 100 or more).

In a pretest the respondents are asked to record their opinions on all selected items using a Likert-type 5-point scale, ranging from 'strongly agree' to 'strongly disagree'. The strongest favourable response is scored as 5, whereas the strongest unfavourable response as 1. The total score can thus range, if there are 15 items in all, from 75 for most favourable to 15 for the least favourable.

Respondent opinionnaires are then arrayed according to total score for analysis and evaluation. If the responses of an item form a cumulative scale, its response category scores should decrease in an orderly fashion as indicated in the above table. Failure to show the said decreasing pattern means that there is overlapping which shows that the item concerned is not a good cumulative scale item i.e., the item has more than one meaning. Sometimes the overlapping in category responses can be reduced by combining categories. After analysing the pretest results, a few items, say 5 items, may be chosen.

(d) The next step is again to total the scores for the various opinionnaires, and to re-array them to reflect any shift in order, resulting from reducing the items, say, from 15 in pretest to, say, 5 for the final scale. The final pretest results may be tabulated in the form of a table given in Table given below:

Table showing the final pretest results in a Scalogram Analysis

Scale type	Item					Errors per case	Number of case	Number of errors
	5	**12**	**3**	**10**	**7**			
5 (perfect)	X	X	X	X	X	0	7	0
4 (perfect)	-	X	X	X	X	0	3	0
(non-scale)	-	X	-	X	X	1	1	1
(non-scale)	-	X	X	-	X	1	2	2
3 (perfect)	-	-	X	X	X	0	5	0

2 (perfect)	-	-	-	X	X	0	2	0
1 (perfect)	-	-	-	-	X	0	1	0
(non-scale)	-	-	X	-	-	2	1	2
(non-scale)	-	-	X	-	-	2	1	2
0 (perfect)	-	-	-	-	-	0	2	0
	n = 5						N= 25	e=7

The table shows that five items (numbering 5, 12, 3, 10 and 7) have been selected for the final scale. The number of respondents is 25 whose responses to various items have been tabulated along with the number of errors. Perfect scale types are those in which the respondent's answers fit the pattern that would be reproduced by using the person's total score as a guide. Non-scale types are those in which the category pattern differs from that expected from the respondent's total score i.e., non-scale cases have deviations from uni-dimensionality or errors. Whether the items (or series of statements) selected for final scale may be regarded a perfect cumulative (or a uni-dimensional scale), we have to examine on the basis of the coefficient of reproducibility. Guttman has set 0.9 as the level of minimum reproducibility in order to say that the scale meets the test of uni-dimensionality. He has given the following formula for measuring the level of reproducibility:

$$\text{Guttman's Coefficient of Reproducibility} = 1 - \frac{e}{n}(N)$$

where

e = number of errors

n = number of items

N = number of cases

For the above table figures,

$$\text{Coefficient of Reproducibility} = 1 - \frac{7}{5}(25) = 0.94$$

This shows that items number 5, 12, 3, 10 and 7 in this order constitute the cumulative or uni-dimensional scale, and with this we can reproduce the responses to each item, knowing only the total score of the respondent concerned.

Scalogram, analysis, like any other scaling technique, has several advantages as well as limitations. One advantage is that it assures that only a single dimension of attitude is being measured. Researcher's subjective judgement is not allowed to creep in the development of scale since the scale is determined by the replies of respondents. Then, we require only a small number of items that make such a scale easy to administer. Scalogram analysis can appropriately be used for personal, telephone or mail surveys. The main difficulty

in using this scaling technique is that in practice perfect cumulative or uni-dimensional scales are very rarely found and we have only to use its approximation testing it through coefficient of reproducibility or examining it on the basis of some other criteria. This method is not a frequently used method for the simple reason that its development procedure is tedious and complex. Such scales hardly constitute a reliable basis for assessing attitudes of persons towards complex objects for predicting the behavioural responses of individuals towards such objects. Conceptually, this analysis is a bit more difficult in comparison to other scaling methods.

9.5.5 Factor Scales

Factor scales are developed through factor analysis or on the basis of inter-correlations of itemswhich indicate that a common factor accounts for the relationships between items. Factor scales areparticularly "useful in uncovering latent attitude dimensions and approach scaling through the conceptof multiple-dimension attribute space." More specifically the two problems, viz., how to dealappropriately with the universe of content which is multi-dimensional and how to uncover underlying(latent) dimensions which have not been identified, are dealt with through factor scales. An importantfactor scale based on factor analysis is Semantic Differential (S.D.) and the other one isMultidimensional Scaling. We give below a brief account of these factor scales.

9.5.6 Semantic Differential Scale:

Semantic differential scale or the S.D. scale developed by CharlesE. Osgood, G.J. Suci and P.H. Tannenbaum (1957), is an attempt to measure the psychologicalmeanings of an object to an individual. This scale is based on the presumption that an object can havedifferent dimensions of connotative meanings which can be located in multidimensional propertyspace, or what can be called the semantic space in the context of S.D. scale. This scaling consists ofa set of bipolar rating scales, usually of 7 points, by which one or more respondents' rate one or moreconcepts on each scale item. For instance, the S.D. scale items for analysing candidates for leadership position may be shown as under:

(E) Successful								**Unsuccessful**
(P) Severe								**Lenient**
(P) Heavy								**Light**
(A) Hot								**Cold**
(E) Progressive								**Regressive**
(P) Strong								**Weak**
(A) Active								**Passive**
(A) Fast								**Slow**
(E) True								**False**
(E) Sociable								**Unsociable**
	3	**2**	**1**	**0**	**-1**	**-2**	**-3**	

Candidates for leadership position (along with the concept—the 'ideal' candidate) may becompared and we may score them from +3 to –3 on the basis of the above stated scales. (Theletters, E, P, A showing the relevant factor viz., evaluation, potency and activity respectively, writtenalong the left side are not written in actual scale. Similarly the numeric values shown are also notwritten in actual scale.)

Osgood and others did produce a list of some adjective pairs for attitude research purposes andconcluded that semantic space is multidimensional rather than uni-dimensional. They made sincereefforts and ultimately found that three factors, viz., evaluation, potency and activity, contributed mostto meaningful judgements by respondents. The evaluation dimension generally accounts for 1/2 and3/4 of the extractable variance and the other two factors account for the balance.

Procedure: Various steps involved in developing S.D. scale are as follows:

(a) First of all the concepts to be studied are selected. The concepts are usually chosen bypersonal judgement, keeping in view the nature of the problem.

(b) The next step is to select the scales bearing in mind the criterion of factor composition andthe criterion of scale's relevance to the concepts being judged (it is common practice to useat least three scales for each factor with the help of which an average factor score has tobe worked out). One more criterion to be kept in view is that scales should be stable acrosssubjects and concepts.

(c) Then a panel of judges are used to rate the various stimuli (or objects) on the variousselected scales and the responses of all judges would then be combined to determine thecomposite scaling.

To conclude, the S.D. has a number of specific advantages. It is an efficient and easy way to secure attitudes from a large sample. These attitudes may be measured in both direction and intensity. The total set of responses provides a comprehensive picture of themeaning of an object, as well as a measure of the subject doing the rating. It is a standardized technique that is easily repeated, but escapes many of the problems of response distortion found with more direct methods.

9.5.7 Multidimensional Scaling:

Multidimensional scaling (MDS) is relatively more complicated scalingdevice, but with this sort of scaling one can scale objects, individuals or both with a minimum of information. Multidimensional scaling (or MDS) can be characterized as a set of procedures forportraying perceptual or affective dimensions of substantive interest. It "provides useful methodology for portraying subjective judgements of diverse kinds." MDS is used when all the variables (whether metric or non-metric) in a study are to be analyzed simultaneously and all such variables happen to beindependent. The underlying assumption in MDS is that people (respondents) "perceive a set ofobjects as being more or less similar to one another on a number of dimensions (usually uncorrelated with one another) instead of only one." Through MDS techniques one can represent geometrically the locations and interrelationships among

a set of points. In fact, these techniques attempt to locatethe points, given the information about a set of interpoint distances, in space of one or more dimensionssuch as to best summarise the information contained in the interpoint distances. The distances in thesolution space then optimally reflect the distances contained in the input data. For instance, if objects,say X and Y, are thought of by the respondent as being most similar as compared to all other possiblepairs of objects, MDS techniques will position objects X and Y in such a way that the distancebetween them in multidimensional space is shorter than that between any two other objects.

Two approaches, viz., the metric approach and the non-metric approach, are usually talked about in the context of MDS, while attempting to construct a space containing m points such that m(m – 1)/2 interpoint distances reflect the input data. The metric approach to MDS treats the input data as interval scale data and solves applying statistical methods for the additive constant* which minimises the dimensionality of the solution space. This approach utilises all the information in the data in obtaining a solution. The data (i.e., the metric similarities of the objects) are often obtained on a bipolar similarity scale on which pairs of objects are rated one at a time. If the data reflect exact distances between real objects in an r-dimensional space, their solution will reproduce the set of interpoint distances. But as the true and real data are rarely available, we require random and systematic procedures for obtaining a solution. Generally, the judged similarities among a set of objects are statistically transformed into distances by placing those objects in a multidimensional space of some dimensionality.

The non-metric approach first gathers the non-metric similarities by asking respondents to rank order all possible pairs that can be obtained from a set of objects. Such non-metric data is then transformed into some arbitrary metric space and then the solution is obtained by reducing the dimensionality. In other words, this non-metric approach seeks “a representation of points in a space of minimum dimensionality such that the rank order of the interpoint distances in the solution space maximally corresponds to that of the data. This is achieved by requiring only that the distances in the solution be monotone with the input data.” The non-metric approach has come into prominence during the sixties with the coming into existence of high speed computers to generate metric solutions for ordinal input data.

The significance of MDS lies in the fact that it enables the researcher to study “the perceptual structure of a set of stimuli and the cognitive processes underlying the development of this structure. Psychologists, for example, employ multidimensional scaling techniques in an effort to scale psychophysical stimuli and to determine appropriate labels for the dimensions along which these stimuli vary.”10 The MDS techniques, in fact, do away with the need in the data collection process to specify the attribute(s) along which the several brands, say of a particular product, may be compared as ultimately.

9.6 Summary

Scaling techniques in social research are essential tools that enable researchers to quantify and measure subjective concepts, such as attitudes, opinions, and perceptions. These techniques provide a structured framework for converting abstract notions into tangible numerical values, facilitating a more systematic analysis of complex human behaviors and attitudes. Various scaling methods, such as Likert scales, semantic differentials, and visual analogue scales, allow researchers to capture the multidimensional nature of social phenomena. By employing scaling techniques, researchers can not only enhance the reliability and validity of their findings but also gain insights into patterns and trends that might otherwise remain obscured within qualitative analyses. The choice of an appropriate scaling technique depends on the research objectives, the characteristics of the variables under investigation, and the desired level of precision, ensuring that the resulting quantitative data effectively captures the richness of human experiences and perspectives.

9.7 Glossary

- **Scaling** refers to the process of assigning numbers or symbols to measure the intensity of abstract attitudes.
- **Ranking:** Ranking is a measurement that asks respondents to rank a small number of items on some characteristic. Respondents might be asked to rank their favorite hot breakfast beverage: Hot Chocolate, Tea, Coffee, or Herbal Tea. Ranking delivers an ordinal score.
- **Rating:** Rating asks respondents the extent to which an item of interest possesses a characteristic. Scales that requires respondents to rank an item result in a quantitative score.
- **Category Scales**: Category scales are the simplest type of rating scale. They contain only two choices: yes/no or agree/disagree.
- **Constant Sum Scales:** Constant sum scales require respondents to divide a set number of points, usually 100, to rate two or more attributes. The problem with constant sum scales is that respondents find it difficult to allocate points especially if there are a lot of attributes to be measured.
- **Semantic Differential Scales:** Semantic differential scales measure respondents' attitudes about the strengths and weaknesses of a concept or construct. With this scale, researchers select a pair of dichotomous adjectives to describe the concept under investigation. Typically researchers use a scale from 1 through 7.
- **Likert Scale:** The Likert scale allows respondents to state how strongly they agree or disagree with an attitude.

9.8 Answers to Self-Check Exercises

1. Discuss in brief

    (a) Rating vs. Ranking scales.

    (b) Summated vs. Cumulative scales.

    (c) Scalogram analysis vs. Factor analysis.

2. Write short notes on:

    (a) Semantic differential scale;

    (b) Scalogram analysis;

    (c) Likert-type scale;

    (d) Arbitrary scales;

    (e) Multidimensional scaling (MDS).

9.9 Suggested Readings

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9.10 Terminal Questions

1. Describe the different methods of scale construction, pointing out the merits and demerits of each.
2. "Scaling describes the procedures by which numbers are assigned to various degrees of opinion, attitudeand other concepts." Discuss. Also point out the bases for scale classification.

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CHAPTER-10
PROCESSING OF DATA

Structure

10.0 Learning Objectives

After going through this lesson you will be able to:

- Evaluate the steps involved in processing of data,
- Define the terms: Editing, Coding, Data Entry, and Tabulation
- Describe various types of Tables and illustrate how to present the data through appropriate tables.

10.1 Introduction

The data collection stage is followed by the processing of data. 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 comparison and analysis. The data collected from the field has to be processed as laid down in the research plan. This ispossible only through systematic processing of data. Data processing involvesediting, coding, classification and tabulation of the data collected so that theyare amenable to analysis. This is an intermediary stage between the collectionof data and their analysis and interpretation. In this chapter, therefore, we will learnabout different stages of processing of data in detail.

10.2 Processing of data

Processing of data refers to the task of consolidation, editing, and regrouping of data. Details regarding data processing should be included in the research design itself so that chances of encountering problems in data analysis are reduced to a considerable extent. While planning for data processing, the researcher should try to correlate the techniques of data processing with the nature of data. During this stage there is a need for the researcher to be continuously in touch with the codes and staffers responsible for the data processing. Data processing is done in four distinct stages: (i) Editing (ii) Coding (iii) Data entryand (iv)Tabulation. We discuss the three of them one by one in detail in the following paragraphs.

10.2.1 Editing

After collection of filled in questionnaires, editing of entries therein is not only necessary but also useful in making subsequent steps simpler. Editing is the process of examining the data collected in questionnaires/schedules to detect errors and omissions and to see that they are corrected and the schedules prepared for tabulation. In other words editing of data is a process of examining the collected raw data(specially in surveys) to detect errors and omissions and to correct these when possible. As a matter of fact, editing involves a careful scrutiny of the completed questionnaires and/or schedules. Editing is done to assure that the data are accurate, consistent with other facts gathered, uniformly entered, as complete as possible and have been well arranged to facilitate coding and tabulation.

Many atimes, a researcher or the assistants either miss entries in the questionnaires or enter responses, which are not legible.This sortofdiscrepancies can be resolved by editing the schedule meticulously. Another problem comes up at thetimeoftabulation of data when researcher asks for tabulation of responses from consecutive questions. In cases where data are not cleaned there has tobeinconsistency in the tabulations. The researcher has to be very particular about consecutive questions where category ‘not applicable’ exists.

Editing is done with the objective of achieving the following:

i) **Completeness-** It ensures that there is no answer left incomplete, no section left unattempted. In case of any blank question, it is important to understand the reason for this i.e., is it to due oversight on the researcher’s part or is it due to unwillingness of the respondent to answer the question. In some situation the response to the blank questions can be deduced from other data on the questionnaire. In this case of interview schedule, the interviewer may be able to fill it from the memory.

ii) **Comprehensibility-** An answer may not convey anything specific or the researcher may not be able to comprehend it. In such a situation the researcher should immediately get in touch with the concerned field.

(iii) **Consistency-** If the answers show too much inconsistency between themselves it is a cause for concern. Editing looks out for such inconsistencies so that they can be corrected. If the level of inconsistency is too high, then it indicates carelessness in administration of the instrument or ambiguity in the instrument.

(iv) **Regularity-** It refers to uniformity in asking the questions and recording the answers. Regularity ensures that there is no basis in the data collected. Generally if the interviewer sticks to the exact wording of the questions, chances of irregularity is reduced. Similarly in certain situations respondents may not be able to give factually correct answers e. g., illiterate people may not know their exact age however they may be able to quote their birth in terms of major event e.g., a war that happened in the year they were born. In such a situation the interviewer should record the answer as given by the respondent and leave the interpretations for the later date.

Editing is done in two stages (i) Field Editing and (ii) Central editing

(i) **Field Editing**- It is done immediately after the instrument has been administered. Field editing removes any glaring errors and omissions in the questionnaire form. Common problems like use of adhoc abbreviations, special symbols should be interpreted into complete answers immediately so that their true meaning is not lost. Incase the context of the answer cannot be recollected then the alternative is to make an immediate callback. Through field editing, the objectives mentioned above i.e., completeness, comprehensibility, consistency and regularity are established in the data. If the survey is a small one, the field editing is done by the researcher himself and in case of large projects the field editing is done by the field supervisor.

(ii) **Central editing-**The field editing is followed by central editing, which is a more complete and exacting scrutiny and correction of the completed returns. Central editing is more thorough in nature and is generally conducted by a single editor, so that high level of consistency is maintained. In case of large projects, more than one editor may be employed; however each editor is assigned a section of the instrument. This way there will be no inconsistency within each section. However inconsistency in answers between different sections will not be spotted, hence one editor can be appointed specifically for looking into such a problem.

10.2.2 Coding of Data

Coding is a process/operation by which data/responses are organized into classes/ categories and numerals or other symbols are given to each item according to the class in which it falls. In other words, coding involves two important operations (i) deciding the categories to be used and, (ii) allocating individual answers to them. These categories should be appropriate to the research problem, exhaustive of the data, mutually exclusive and undimensional. Since coding eliminates much of information in raw data, it is important that the researcher design category set carefully in order to utilize the available data more fully.

In case of pre coded questions, coding begins at the preparation of interview schedules. Secondly, coding frame is developed by listing the possible answers to each questions and assigning code numbers or symbols to each of them which are the indicators used for coding. The coding frame is an outline of what is coded and how it is to be coded. That is, a coding frame is a set of explicit rules and conventions that are used to base classification of observations variables into values which are transformed into numbers. Thirdly, after preparing the sample frame the gradual process of fitting the answers to the questions must be begun. Lastly, transcription sheet is large. Transcription may not be necessary when only simple tables are required and the numbers of respondents are few.

Rules of Coding

(i) Give code numbers for each respondent for identification. Generally while giving identification number, different digits are used to identify the area, institution and the department also.

(ii) Give code numbers for each question.

(iii) Give code numbers for each response. In this context categorization assumes significance.

(iv) Give numbers for qualitative responses also.

(v) Do not delegate the work of categorization to others. The researcher himself should undertake the work, because categorization is not a routine work.

(vi) Prepare the coding frame.

(vii) Decide on the instructions to coders.

(viii) Prepare and supply coders, instruction manual.

(ix) May take the services of trained coders with close supervision.

(x) Carefully scrutinize every coded item in the initial stages of coding.

(xi) Afterwards have a random checking of the coded names.

(xii) The researcher himself should decide on any change in coding due to change in the nature of data or importance of data after collection.

Coding of Different Types of Questions: Coding of the responses to open questions is always difficult task. Sometimes, the responses are recorded verbatim. In such cases, note the basic or essential aspect of the possible responses. Give a number to each aspect. Clarify each response according to the basic content and code them accordingly. Coding of Don't Know/No Opinion Responses: In some cases, these answers themselves become significant meaning something. For instance, in a study to measure the knowledge of the respondent of the work of the institution, no knowledge is significant. Similarly, in opinion surveys, no opinion may mean neutrality. In such cases, give a number for such response and accordingly proceed with the analysis.

In other cases, where no answer does not mean anything if the number of responses is too small, ignore them. On the other hand, if the responses to many questions are such, the researcher may not get adequate data. In such cases, examine the reasons for no answer. If it is due to unwillingness on the part of the respondent, change the wordings carefully so as to extract the response. It is due to the inefficiency of the interviewer, change the interviewer. Pilot study and pre-testing help this. In order to demonstrate the points discussed above a section of the code-book is reproduced in Table below.

Table 10.1: Code Book

Q No.	Information Sought	Response	Code	Column No.	Remarks
	Respondents Number			1-3	
2.	Age	Actual	-	4-5	
3.	Designation	Worker Supervisor Manager	1 2 3	6	
4.	Type of Job	Public Private	1 2	7	
5.	Level of Education	Graduate Intermediate High School Middle School Primary Illiterate Other	1 2 3 4 5 6 7	8	
6.	Marital Status	Married Unmarried Widow Divorce	1 2 3 4	9	
12.	Nature of work	Manual Mental	1 2	16	
16.	Duration of work	6hrs 7hrs 8hrs 9hrs	1 2 3 4	20	
17.	Wages	Cash Bank Kind	1 2 3	22	
18	Promotion	Yes No	1 2	23	

Codes can be recorded on the questionnaire/schedules themselves. In such cases record the code numbers in the margin with colour pencils. Transcription sheets can also be used for recording the codes. Though it amounts to duplication, it will facilitate further analysis. However, pre coding will avoid the use of transcription sheets.

Distinction between Editing of Data and Coding of Data

Editing of Data	Coding of Data
1. Process of error elimination. Preparatory process for classification and tabulation.	1. Respondent's replies are assigned a code. It helps computerized processing.
2. Editing in post survey work.	2. Coding can be done before survey (pre coding)
3. Editing checks accuracy and consistency.	3. It helps quick processing of data.
4. Editing is done at field survey stage or post survey stage.	4. It can be done at time.

10.2.3 Data Entry

After the collection, editing and coding of data, the next step is data entry. It is the process of transcribing information into an electronic medium such as a computer or other electronic device. It can either be performed manually or automatically by using a machine or computer. Most data entry tasks are time consuming in nature, however data entry is considered a basic, necessary task for most organizations.

Data entry is considered a non–core process for most organizations and is usually performed on data forms such as spreadsheets, handwritten or scanned documents, audio or video. Addition, modification and deletion are the three modes of operation in data entry.

Manual data entry often requires good concentration and focus over a long duration of time, and this can prove physically and mentally challenging for data entry workers. After a code book is prepared, the data can be transferred either to a master chart or directly to computer through a statistical package. Going through master chart to computer is much more advantageous than entering data directly to computers because one can check the wrong entries in the computer by comparing 'data listing' as a computer output and master chart. Entering data directly to computer is disadvantageous, as there is no way to check wrong entries, which will show inconsistencies in tabulated data at the later stages of tabulation. A sample of master chart prepared in accordance with the code book is presented in Table.

Table 10.2: Master Chart

Questionnaire no.	Respondents Name	Age	Designation	Type of Job	Level of Education	Marital Status	Nature of work	Duration of work	Wages	Promotion
1	XXX	40	2	1	1	1	2	2	2	2
2	XXX	30	3	2	2	2	2	3	3	1
3	XXX	32	1	2	5	4	2	4	1	1
4	XXX	45	2	1	3	3	1	3	2	2
5	XXX	55	1	2	2	2	2	2	1	1
6	XXX	51	3	2	2	4	2	4	3	2
7	XXX	25	3	2	2	1	2	2	3	2
8	XXX	23	2	1	4	2	1	1	2	2
9	XXX	26	1	1	2	3	1	3	1	1
10	XXX	38	1	1	1	4	1	4	1	1
11	XXX	46	2	2	1	3	2	3	2	2
12	XXX	52	3	2	7	2	2	3	3	2
13	XXX	32	2	2	6	2	2	2	2	2
14	XXX	26	1	2	5	1	2	1	1	1
15	XXX	23	3	1	6	1	1	3	3	2

10.2.4 Tabulation

Presentation of collected data in the tabular form is one of the techniques of data presentation. The two other techniques are diagrammatic and graphic presentation. Arranging the data in an orderly manner in rows and columns is called tabulation of data. Sometimes data collected by survey or even from publications of official bodies are so numerous that it is difficult to understand the important features of the data. Therefore it becomes necessary to summarize data through tabulation toan easily intelligible form. It may be noted that there may be loss of some minor information in certain cases, but the essential underlying features come out more clearly. Quite frequently, data presented in tabular form is much easier to read and understand than the data presented in the text.

Tables can be divided into: (i) Frequency tables, (ii) Response tables, (iii)Contingency tables, (iv) Univariate tables, (v) Bivariate tables, (vi) Statistical tables, and (vii) Time series tables.

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

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

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

(ii) **Columns and Rows-** Each table should be prepared in just adequate number of columns and rows.

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

(iv) **Ruling-** Columns and rows should be divided by means of tin or thick rulings

(v) **Arrangement-** Comparable figures should be arranged side by side.

(vi) **Derivations-** These should be arranged in the columnner the original data so that their presence may easily be noted.

(vii) **Size of Columns-** This should be according to the requirement.

(viii) **Arrangement of items-** This should be according to the problem.

(ix) **Special Emphasis-** This can be done by writing important data in bold or special letters.

(x) **Unit of measurement-** This unit should be noted below the line.

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

(xii) **Foot-notes-** These may be given below the table.

(xiii) **Total-** Totals of each column and grand total should be one line.

It is not always necessary to present facts in form if they can be presented more simply in the body of the text. Tabular presentation enables the reader to follow quickly than textual presentation. A table should not merely repeat information covered in the text. The same information should not, of course, be presented in tabular form and graphical form. Smaller and simpler tables may be presented in the text while the large and complex tables may be placed at the end of the chapter or report.

Types of Tabulation

Evaluation can be simple one way tabulation or it can be complex cross tabulation.

(a) Simple Table- One way tables are best used to depict the frequency of a variable than with studying its correlates. Other than frequency, the one way tabulation may also depict percentages e.g. a table showing the number of workers across wage groups in a firm can be depicted as:

Table 10.3: Frequency Distribution of Daily Wages of 65 Labourers

Daily Wages of Labourers (Rs)	No. of Labourers
20-30	2
30-40	5
40-50	21
50-60	19
60-70	11
70-80	5
80-90	2
Total	**65**

Table 10.3 shows the wage group in column 1, number of labourers in column 2.

Simple table's offers number of uses:

(i) It helps in communicating the results of the study. The frequency associated with each class of the variable can be studied through one-way table.

(ii) The degree of item non-response can be determined. The number of survey instruments having the problem of non-response can be determined.

(iii) One way tabulation also locates blunders. Blunders refer to errors made in the process of editing, coding or tabulating the data. E.g. if the number of workers in a particular category has been read as '3' instead of '8' then such an error will be revealed by the one-way table since the workers total will not sum up to the total surveyed.

(iv) It is possible to locate outliers in the data. Outliers refer to observing those values which are entirely different in magnitude from the rest of the observations that the researcher treats them as special case. In tabulation such observations can easily be spotted and then they can either be eliminated or they may demand a deeper analysis with the cause of such observations.

(b) **Complex Table –** This is formed on the basis of more than one quality or characteristics, e.g., distribution of students on the basis of sex and marks obtained, etc. If complex table is based on two qualities it is called two-way table and if it is based on three qualities, it is named as three-way table. If there are more than three qualities, it is called manifold-table.

Table 10.4: Wages and Number of Workers in Different Plants

Wages	Number of Workers		Total Number of workers
	Plant A	Plant B	
0-1000	07	01	08
1000-2000	10	09	19
2000-3000	11	16	27
3000-4000	05	10	15
4000-5000	02	09	11
Total	**35**	**45**	**80**

Table 10.4 gives a more detailed comparison showing that there are more workers (45) employed in plant b than in plant A. Further workers in plant A are primarily working on wages less than Rs. three thousand whereas there are very few workers in the wage group of Rs. 0-2000 in Plant B. This helps is in answering questions like; Does the number of workers in each plant differ on wage distribution? Thus data is represented across two variables i.e., wages and plant. The table can further be made in a greater detail to introduce a third variable e.g. gender, as shown in Table 10.5.

Table 10.5: Wages distribution in workers across gender and plant in a firm

Number of Workers

Wages	Plant A			Plant B			Total		
Rupees	**M**	**F**	**Total**	**M**	**F**	**Total**	**M**	**F**	**Total**
0-1000	04	03	07	01	00	01	05	03	08
1000-2000	05	05	19	06	03	09	11	08	19
2000-3000	08	03	11	11	05	16	19	08	27
3000-4000	02	03	05	06	04	10	08	07	15
4000-5000	00	02	02	05	04	09	05	06	11
Total	**19**	**16**	**35**	**29**	**16**	**45**	**48**	**32**	**80**

Thus complex table makes it possible to represent large number of variables and express relationship among the variables as well as between the variables.

Methods of Tabulation

(i) Hand Tabulation- When the survey is a small survey and a few questionnaires are filled in, it is simple to sort them out manually. Generally cards are used in collecting information. A card is a thick paper in which collected information is recorded as it

is or in a coded manner. The questionnaire or cards are put in different lots, for example, we can sort them out (i) male workers and (ii) female workers. We can count them out and get the desired information.

(ii) Mechanical Tabulation- It is used when there are a large number of questionnaires involved in a survey. Mechanical sorting and tabulation help us to organize the work speedily and accurately. But the system is pretty costly and can be used only when the study is very extensive.

10.3 Summary

Once data collection is over, the next important steps are editing, coding, and tabulation.Editing helps in maintaining consistency in quality of data. Editing is the firststage in data processing. It is the process of examining the data collected todetect errors and omissions and correct them for further analysis. Codingmakes further computation easier and necessary for efficient analysis of data.Coding is the process of assigning some symbols to the answers. A codingframe is developed by listing the answers and by assigning the codes to them, data may besummarized by means of tabulations and frequency distributions. Complextabulation is particularly useful as it provides some clue about relationship andits direction between two variables.

Statistical data not only requires a careful analysis but also make sure an attractiveand communicative display. The work of the researcher is to understand thefacts of the data himself/herself and also to present them in such a form thattheir significance may be understandable to a common reader. In order toachieve this objective, we have, in this chapter, discussed the techniques of diagrammatic and graphic presentation of statistical data. Besides, presenting thedata in the form of tables, data can also be presented in the form of diagrams and graphs. Such presentation of data allows relation between numbers tobe exhibited clearly and attractively, makes quick comparison between two ormore data sets easier, brings out hidden facts and the nature of relationship,saves time and effort, facilitates the determination of various statistical measures.

10.4 Glossary

- **Processing of Data:** refers to the task of consolidation, editing, and regrouping of data.
- **Editing of Data:** is the process of examining the data collected in questionnaires/ schedules to detect errors and omissions and to correct these when possible.
- **Data Entry**: is the process of transcribing information into an electronic medium such as a computer or other electronic device. It can either be performed manually or automatically by using a machine or computer
- **Coding of Data-**A method to categorize data into groups and assign numerical valuesor symbols to represent them.

10.5 Answers to Self-Check Exercises

1. Define data processing?
2. What do you mean by editing of data?
3. What are the objectives of data editing?
4. What is coding of data?
5. Distinguish between coding of data and editing of data.
6. What are essential parts of a table.

10.6 Suggested Readings

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10.7 Terminal Questions

1. Describe the major operations involved in data processing.
2. What is the objective of editing and coding of data?

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Chapter-11
ANALYSIS OF DATA

Structure:

11.0 Learning objectives

After studying this lesson, students will be able to:

- understand the importance of data analysis,
- acquire knowledge regarding the consideration to be taken into account while analyzing data,
- understanding the meaning and procedure to be adopted in testing hypothesis,
- know about the two tailed and one tailed test of hypothesis, and
- apply Z- test, t-test and chi-square-test in their research.

11.1 Introduction

The data, after collection, has to be analysed in accordance with the outline laid down for the purpose at the time of developing the research plan. This is essential for a scientific study and for ensuring that we have all relevant data for making contemplated comparisons and analysis. The term analysis refers to the computation of certain measures along with searching for patterns of relationship that exists 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.

11.2 Importance of Data Analysis

Data analysis is a process used to transform, remodel and revise certain data with a view to reach to a certain conclusion for a given situation or problem. Data analysis can be done by different methods as according to the needs and requirements of different domains like science, business, social science etc. Data analysis, in a research supports the researcher to reach to a conclusion. Therefore, simply stating that data analysis is important for a research will be an understatement rather no research can survive without data analysis. There are many benefits of data analysis however; the most important ones are as follows:

Data analysis helps in structuring the findings from different sources of data collection like survey research. It is again very helpful in breaking a macro problem into micro parts. Data analysis acts like a filter when it comes to acquiring meaningful in sights out of huge data-set. Every researcher has sort-out huge pile of data that he/she has collected, before reaching to a conclusion of the research question. Mere data collection is of no use to the researcher. Data analysis proves to be crucial in this process. It provides a meaningful base to critical decisions.

One of the most important uses of data analysis is that it helps in keeping human bias away from research conclusion with the help of proper statistical treatment. With the help of data analysis a researcher can filter both qualitative and quantitative data for an assignment writing projects. Thus, it can be said that data analysis is of utmost importance for both the research and the researcher. Or to put in another words data analysis is as important to a research as it is important for a doctor to diagnose the problem of the patient before giving him any treatment.

11.3 Considerations/Issues in Data Analysis

1. Having Necessary Skills to Analyze

A tacit assumption of investigators is that they have received training sufficient to demonstrate a high standard of research practice. Unintentional ‘scientific misconduct’ is likely the result of poor instruction and follow-up. A common practice of investigators is to

defer the selection of analytic procedure to a research team 'statistician'. Ideally, investigators should have substantially more than a basic understanding of the rationale for selecting one method of analysis over another. This can allow investigators to better supervise staff who conduct the data analyses process and make informed decisions.

2. Concurrently Selecting Data Collection Methods and Appropriate Analysis

While methods of analysis may differ by scientific discipline, the optimal stage for determining appropriate analytic procedures occurs early in the research process and should not be an afterthought. Statistical advice should be obtained at the stage of initial planning of an investigation so that, for example, the method of sampling and design of questionnaire are appropriate.

3. Drawing Unbiased Inference

The chief aim of analysis is to distinguish between an event occurring as either reflecting a true effect versus a false one. Any bias occurring in the collection of the data, or selection of method of analysis, will increase the likelihood of drawing a biased inference. Bias can occur when recruitment of study participants falls below minimum number required to demonstrate statistical power or failure to maintain a sufficient follow-up period needed to demonstrate an effect.

4. Inappropriate Sub group Analysis

When failing to demonstrate statistically different levels between treatment groups, investigators may resort to breaking down the analysis to smaller and smaller sub groups in order to find a difference. Although this practice may not inherently be unethical, these analyses should be proposed before beginning the study even if the intent is exploratory in nature. If the study is exploratory in nature, the investigator should make this explicit so that readers understand that the research is more of a hunting expedition rather than being primarily theory driven. Although a researcher may not have a theory-based hypothesis for testing relationships between previously untested variables, a theory will have to be developed to explain an unanticipated finding.

5. Environmental/Contextual issues

The integrity of data analysis can be compromised by the environment or context in which data was collected i.e., face-to-face interviews vs. focused group. The interaction occurring within dyadic relationship (interviewer-interviewee) differs from the group dynamic occurring within a focus group because of the number of participants, and how they react to each other's responses. Since the data collection process could be influenced by the environment/context, researchers should take this into account when conducting data analysis.

6. Reliability and Validity

Researchers performing analysis on either quantitative or qualitative analyses should be aware of challenges to reliability and validity. The potential for compromising data integrity arises when researchers cannot consistently demonstrate stability, reproducibility, or accuracy of data analysis.

11.4 Types of Analysis

As stated earlier, by analysis we mean the computation of certain indices or measures along with searching for patterns of relationship that exist among the data groups. Analysis, particularly in case of survey or experimental data, involves estimating the values of unknown parameters of the population and testing of hypotheses for drawing inferences. Analysis may, therefore be categorized as descriptive analysis and inferential analysis. “Descriptive analysis is largely the study of distributions of one variable. This study provides us with profiles of companies, work groups, persons and other subjects on any of a multiple of characteristics such as size, composition, efficiency, preferences etc.” this sort of analysis may be in respect of one variables (described as univariate analysis), or in respect of two variables (described as bivariate analysis) or in respect of more than two variables (described as multivariate analysis).

Univariate analysis explores each variable in a data set. It looks at the range of values, as well as the central tendency of the value. It describes the pattern of response to the variable. It describes each variable on its own. Descriptive statistics describe and summarize data. Univariate descriptive statistics describe individual variables.

11.4.1 Central Tendency

In statistics, the central tendency is the descriptive summary of a data set. Through the single value from the dataset, it reflects the centre of the data distribution. Moreover, it does not provide information regarding individual data from the dataset, where it gives a summary of the dataset. Generally, the central tendency of a dataset can be defined using some of the measures in statistics.

Definition

The central tendency is stated as the statistical measure that represents the single value of the entire distribution or a dataset. It aims to provide an accurate description of the entire data in the distribution.

Measures of Central Tendency

The central tendency of the dataset can be found out using the three important measures namely mean, median and mode.

a) Mean

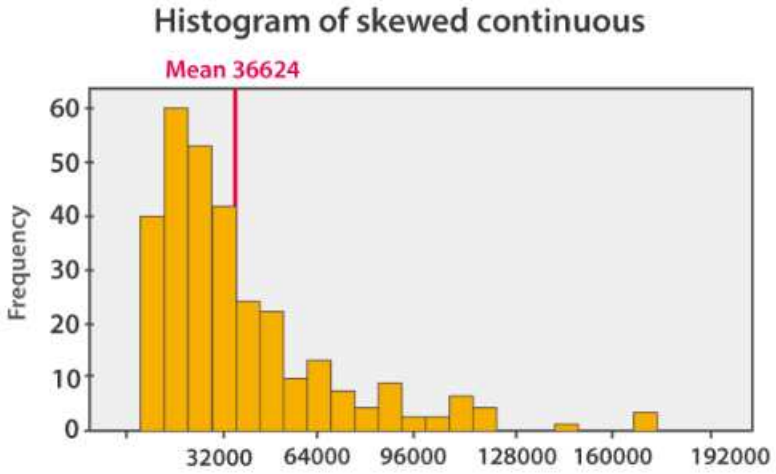
The mean represents the average value of the dataset. It can be calculated as the sum of all the values in the dataset divided by the number of values. In general, it is considered as the arithmetic mean. Some other measures of mean used to find the central tendency are as follows:

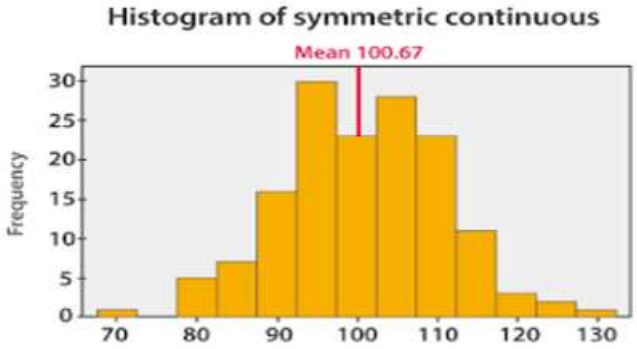
- Geometric Mean
- Harmonic Mean
- Weighted Mean

It is observed that if all the values in the dataset are the same, then all geometric, arithmetic and harmonic mean values are the same. If there is variability in the data, then the mean value differs. Calculating the mean value is completely easy. The formula to calculate the mean value is given by:

$$\text{Mean} = \frac{x1 + x2 + x3 + x4 + ... xn}{n}$$

The histogram given below shows that the mean value of symmetric continuous data and the skewed continuous data.



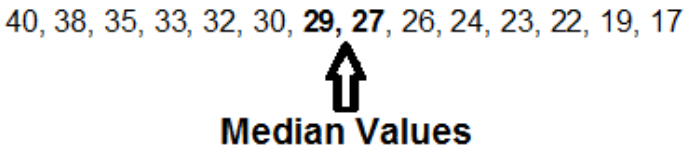


In symmetric data distribution, the mean value is located accurately at the centre. But in the skewed continuous data distribution, the extreme values in the extended tail pull the mean value away from the centre. So it is recommended that the mean can be used for the symmetric distributions.

b) Median

Median is the middle value of the dataset in which the dataset is arranged in the ascending order or in descending order. When the dataset contains an even number of values, then the median value of the dataset can be found by taking the mean of the middle two values. Consider the given dataset with the odd number of observations arranged in descending order – 23, 21, 18, 16, 15, 13, 12, 10, 9, 7, 6, 5, and 2.

Here 12 is the middle or median number that has 6 values above it and 6 values below it.Now, consider another example with an even number of observations that are arranged in descending order – 40, 38, 35, 33, 32, 30, 29, 27, 26, 24, 23, 22, 19, and 17



When you look at the given dataset, the two middle values obtained are 27 and 29.

Now, find out the mean value for these two numbers.

i.e., , Therefore, the median for the given data distribution is 28.

c) Mode

The mode represents the frequently occurring value in the dataset. Sometimes the dataset may contain multiple modes and in some cases, it does not contain any mode at all. Consider the given dataset 5, 4, 2, 3, 2, 1, 5, 4, 5. Since the mode represents the most common value. Hence, the most frequently repeated value in the given dataset is 5.

Based on the properties of the data, the measures of central tendency are selected.

- If you have a symmetrical distribution of continuous data, all the three measures of central tendency hold good. But most of the times, the analyst uses the mean because it involves all the values in the distribution or dataset.

- If you have skewed distribution, the best measure of finding the central tendency is the median.
- If you have the original data, then both the median and mode are the best choice of measuring the central tendency.
- If you have categorical data, the mode is the best choice to find the central tendency.

11.4.2 Dispersion

An average can represent a series only as best as a single figure can, but it certainly cannot reveal the entire story of any phenomenon under study. Specially, the averages cannot alone describe adequately a set of observations, unless all the observations are the same. It is necessary to describe the variability or dispersion of the observation. In two or more distributions the central value may be the same but still there can be wide disparities in the formation of the distribution. Measures of the dispersion help us in studying this important characteristics' of a distribution.

Measures of Dispersion

a) Range- it is the simplest method of measuring dispersion and is defined as the difference between the values of the smallest item and the value of the largest item included in the distribution. It is calculated as under:

Range = L-S

Where, L = Largest item

S = Smallest item

$$\frac{L-S}{L+S}$$

The relative measure corresponding to range, called the co-efficient of range, is obtained by applying the following formula:

Co-efficient of Range =

b) Inter-quartile Range or Quartile Deviation – the inter-quartile range is the difference between the 75^{th} and 25^{th} percentile or 3^{rd} quartile and 1^{st} quartile. Thus, the range which includes the middle 50 percent of the distribution is called the inter-quartile range. This is one quarter of the item at the lower end and another quarter of the item at the upper end of the distribution is excluded in computing the inter-quartile range. It is obtained as under

c) Mean deviation– the method discussed earlier, namely range and quartile deviation, are not measures of dispersion in the strict sense of the term because they do not show the scatterness around as average. Mean deviation is the average of difference of the values of items from some average of the series. Such a difference is technically called deviation.

M.D. = $\frac{|D|}{N}$

Where, M.D = Mean Deviation

|D| = the absolute value of the deviation ignoring plus and minus signs.

N = the total number of items.

The relative measure corresponding to the mean deviation, called the co-efficient of mean deviation, is obtained by dividing mean deviation by particular average used in computing mean deviation.

Coefficient of M.D. = $\frac{M.D.}{Mean}$

d) Standard Deviation–it is the most widely used measure of dispersion of a series and is denoted by the 'ó' symbol pronounced as sigma. Its significant lies in the fact that it is free from those defects from which the earlier method suffer and satisfies most of the properties of a good measure of dispersion. Standard deviation for the values of individual items in a series is obtained from the arithmetic average.

$$\sigma = \sqrt{\frac{\sum(\chi_i - \mu)^2}{N}}$$

Where, ó = population standard deviation

N = size of the population

x_i= each value from the population

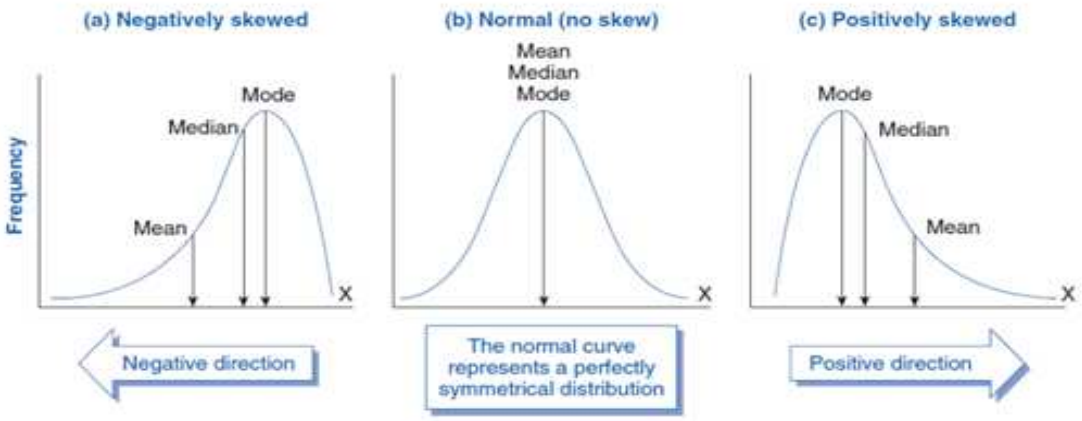
ì = the population mean

11.4.3 Skewness

Skewness means lack of symmetry in a frequency distribution. Skewness denotes the degree of departure of a distribution from symmetry and reveals the direction of scatterness of the items. It gives us an idea about the shape of frequency distribution is not symmetrical, it is called skewed distribution. Skewness tells us about the asymmetry of the frequency distribution. Skewness can be positive or negative. The measures of skewness can either be relative or absolute. The measures which expresses the values of the series are expressed are called absolute measures of skewness. The measures which express skewness in the form of ratios or percentage are called relative measures of skewness. Relative measures of skewnessare also known as coefficient of skewness and are useful to compare the skewness of two or more of a series.

Skewness tells the direction and extent of skewness/ asymmetry in a series. Mean, median and mode are identical in a symmetrical distribution. Asymmetry or skewness is larger if mean moves away from the mode. In the present study, skewness will be calculated

by means of Karl Pearson's Coefficient of Skewness as it is an important characteristic for defining the precise pattern of a distribution. Skewness is defined as a measure of a symmetry. In a symmetrical distribution, the values of mean, median and mode coincide. If skewness is positive than mode < median < mean and in case of negative skewness mean <median <mode. It has been used to study the direction (either towards the lower side or mean score or towards the higher side of the mean score).



Measures of Skewness

The followings are the important measures of skewness.

1. Karl pearson's co-efficient of skewness.
2. Bowley's coefficient of skewness. $\frac{Q_3 + Q_1 - 2\,Median}{Q_3 - Q_1}$
3. Kelly's coefficient of skewness.

1. **Karl pearson's co-efficient of skewness –** This is method of measuring skewness is based upon the difference between mean and mode. The difference is divided by standard deviation to give a relative measure. Symbolically,

   Absolue S_k = Mean –Mode

   Coefficient of S_k = $\frac{\text{Mean} - \text{Mode}}{\text{Standard Deviation}}$

2. **Bowley's coefficient of skewness–**Bowley's measures is based on quartiles. In a symmetrical distribution first and third quartiles are equidistant from the median whereas in a asymmetrical distribution first and third quartiles are not equidistant from the median.

   Absolute S_K= Q3+Q1– 2Median

   Coefficient of S_k=

3. **Kelly's coefficient of skewness –** Kelly's measure is based on deciles or percentiles. In a symmetrical distribution first and ninth deciles or 10^{th} and 90^{th} percentiles are equidistant from median. On the other hand, in an asymmetrical distribution first and ninth or 10^{th} and 90^{th} percentiles are not equidistant from median.

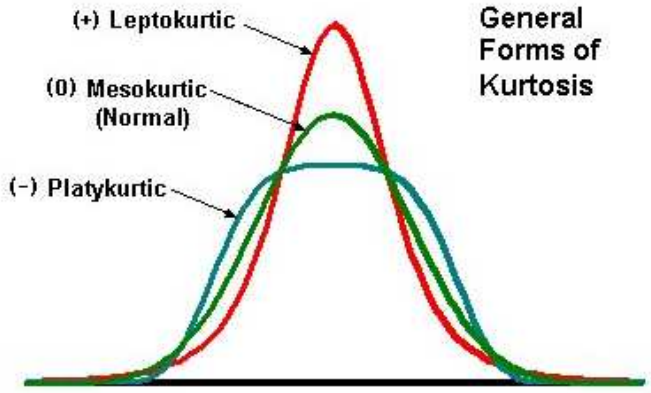
Absolute SK = P10+ P90– 2 MedianOr

Absolute SK = D1+D9– 2Median

Coefficient of S_k=

11.4.4 Kurtosis

Kurtosis is also a characteristic of a frequency distribution which tells about the shape of the frequency distribution. In statistics Kurtosis refers, whether a frequency distribution is more flat-topped or more peaked than the normal distribution. Kurtosis is a measure of weather the data are heavy-tailed or light-tailed relative to a normal distribution.



$$\frac{D_9 - 2\,Median}{D_9 - D_1}$$

The value of the coefficient β_2 is the most important measure of kurtosis. It is calculatedas:

For a normal curve, the value of $\beta_2 = 3$. The curve is more peaked than the normal curve when the value of β_2 is greater than 3, i.e., leptokurtic. When the value of β_2 is less than 3 then the curve is less pleaded than the normal curve i.e., platykutic. And if $\beta_3 = 3$, then it called mesokurtic.

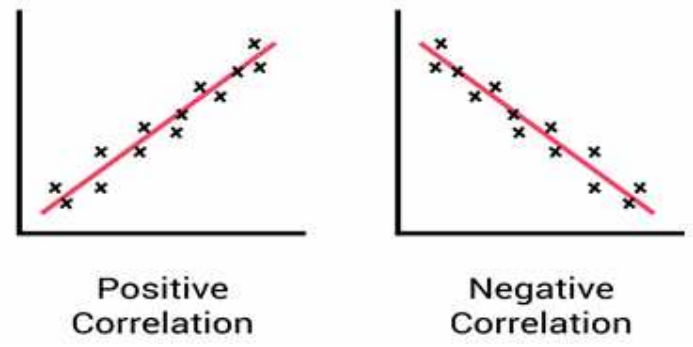
11.4.5 Correlation

Correlation is measure of association between two variables. The variables are not designed as dependents or in dependent. The most popular correlation coefficients are: Spearman's correlation coefficient and Pearson's product moment correlation coefficient. When calculating a correlation coefficient for ordinal data, select Spearman's techniques.

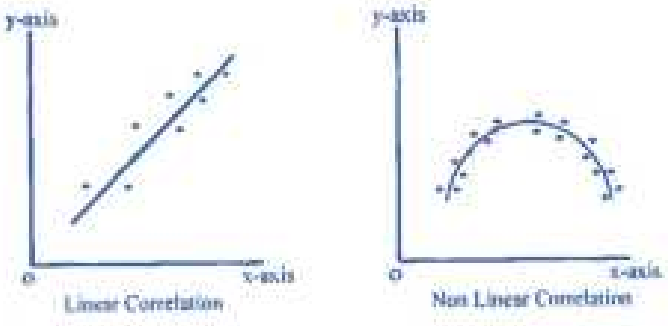
For interval or ratio type data, use Pearson's techniques. The value of a correlation coefficient can vary from minus one to plus one. A minus one indicates a perfect negative correlation, while a plus one indicates a perfect positive correlation. A correlation of zero means there is no relations hip between two variables. When there is negative correlation between two variables, as value of one variable increase, the value of the other variable decrease, and vice versa.

Types of Correlation

1. **Positive correlation**: if two variables X & Y moves in the same direction, i.e. if one rises, other rises too & vice versa it is called positive correlation. Examples; relationship between price and supply.
2. **Negative correlation**: if two variable X and Y move in opposite directions, i.e. if one rise other falls & if one falls, other rises, then it is called as negative correlation. Examples: relationship between demand & price.



3. **Linear correlation**: the ratio of change of two variables X & Y remain constant throughout, then they are said to be linearly correlated, like as when every time supply of commodity rises by 20% as often as its price by 10%, then such two variables have linear relationship.
4. **Non-linear correlation**: if the ratio between the two variables is not constant but changing, correlation is said to be curvi-linear, like as when every time price of a commodity rises by 10%, then sometimes supply rises by 20%, sometimes by 10% & sometimes by 40%.

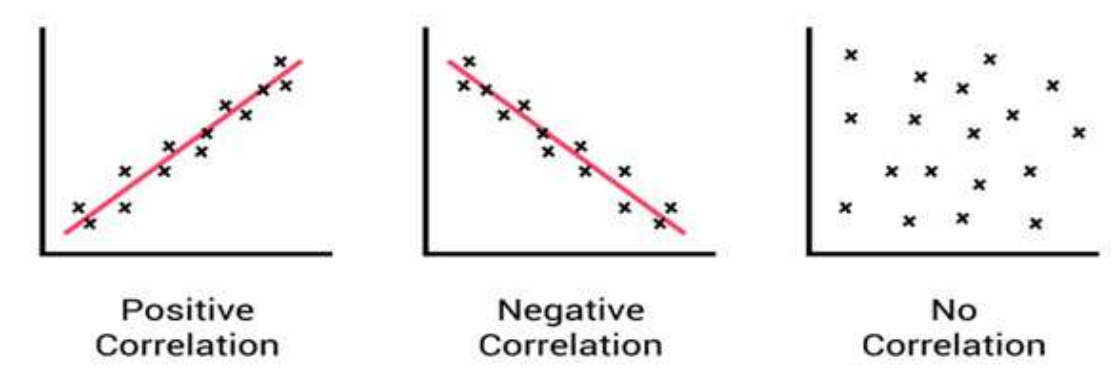


5. **Simple correlation**: when we study the relationship between the two variables only, then it is called simple correlation. Example, relationship between price and demand.
6. **Partial correlation**: when three or more variables are taken but relationship between any two of the variables is studied, assuming other variables as constant, then it is called partial relationship. Suppose, under constant temperature, we study the relationship between amount of rainfall and wheat yield, then this will be called as partial correlation.
7. **Multiple correlation**: when we study the relationship among three or more variables, then it is called multiple correlation. For example, if we study the relationship between rainfall, temperature and yield of wheat, then it is called multiple correlation.

Methods of Correlation

1. Scatter Diagram Method
2. Karl Pearson's Co-efficient of Correlation
3. Rank Correlation Coefficient
4. Concurrent Deviation Method

1. **Scatter Diagram–**Scatter diagram is a graphic method of finding out correlation between two variables. By this method, direction of correlation can be ascertained. For constructing a scatter diagram, X-variable is represented on X-axis and the Y-variable on Y-axis. A visual observation of graph will give abroad idea of the direction of movement and closeness of two curves. If the curves move in the same direction, then correction is positive. If they move in the opposite direction, then the correlation is negative.



2. **Karl Pearson's Co-efficient of Correlation–**it is most widely used method of measuring the degree of relationship between two variables. The Pearson's coefficient of correlation is denoted by the symbol. This method is based on the following assumption.

1. There is linear relationship between the two variables.
2. There is cause and effect relationship between two variables which means one of the variables is independent and the other one is dependent.
3. The two variables under study are affected by a large number of independent causes so as to forma normal distribution.

$$r = \frac{\sum (X - \overline{X})(Y - \overline{Y})}{\sqrt{\sum (X - \overline{X})^2}\sqrt{(Y - \overline{Y})^2}}$$

Where, = mean of X variable

= mean of Y variable

Karl Pearson's Co-efficient of Correlation can be calculated by applying following formula:

3. Rank Correlation Coefficient – The Karl Pearson method discussed above is based on the assumption that the population being studied is normally distributed. When it is known that the population is not normal or when the shape of the distribution is not kwon, there is need for a measure of correlation that involves no assumptions about the parameter of the populations. It is possible to avoid making any assumption about the population being the studied by ranking the observations according to size and basing the calculation or the ranks rather than upon the original observations. This method is finding out co-variability or the lack of it between two variables was developed by the British psychologist Charles Edward Spearman in 1904. The main objective of this coefficient is to determine the extent to which the two sets of ranking are similar or dissimilar.

Rank Correlation can be calculated by applying following formula:

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

ρ = Spearman's rank correlation coefficient.

d = Difference between the two ranks or each observation.

n = Number of observations

11.4.6 Regression Analysis

The study of regression has special importance in statistical analyses. We know that the mutual relationship between two series is measured with the help of correlation. Under correlation, the direction and magnitude of the relationship between two variables is measured. But it is not possible to make the best estimate of the value of a dependents variables is measured. But it is not possible to make the best estimate of the value of dependent

variables on the basis of the given values of the independent variable by correlation analysis. Therefore, to make the best estimates and future estimation, the study of regression analysis is very useful and important. According to Oxford English Dictionary, the word 'Regression' analysis means "Stepping back" or "Returning to average value". The term was first of all used by a famous Biological Scientist in 19th century, Sir Francis Galton relating to a study of hereditary characteristics'. In statistical analyses, the term 'Regression' is taken in wider sense. Regression is the study of nature of relationship between the variables so that one may be able to predict the unknown value of one variable for a known value of another variable. In regression, one variable is considered as an independent variable and other is independent variable.

Simple Linear Regression

In simple regression analysis, we study only two variables at a time, in which one variable is dependent and other is independent. The functional relationship between income and expenditure is an example of simple regression. On the contrary, we study more than two variables at a time in multiple regression analysis (i.e. at least three variables) in which one is dependent variable and other are independent variable. The study of fact of rain and irrigation on yield of wheat is an example of multiple regression.

Regression Equations

Simple linear regression is a statistical device with the help of which we are in a position to estimate the unknown values of one variable from known values of another variable. The variable which is used to predict the variable of interest is called the independent variable or explanatory variable and the variable we want to predict is called the dependent variable or explained variables. The independent variable is denoted by X and dependent by Y. The analysis used is called the simple linear regression analysis-simple because there is only one independent variable, and linear regression analysis simple because there is only one independent variable, and linear because of the assumed linear relationship between the dependent and the independent variables. The basic relationship between X and Y variables is given by

$Yc = a + bX$

Regression equations are the algebraic formulation of regression lines. Regression equation represents regression lines. Just as there are two regression lines, similarly there are two regression equations, which are as follows:

1. **Regression Equations of X on Y :** this equation is used to estimate the probable values of Y on the basis of the given values of X. this equation is expressed in the following way:

   $$Y = a + bX$$

   Here, a and b are constants.

2. **Regression Equations of Y on X :**this equation is used to estimate the probable values of X on the basis of the given values of Y. this equation is expressed in the following way:

   X = a + bY

   Here, a and b are constants.

Regression Coefficients

There are two regression equations; similarly there are two regression coefficients. Regression coefficient measures the average change in the value of one variable for a unit change in the value of another variable. For two variables X and Y, there are two regression coefficients, which are given as follows:

1. **Regression coefficient of Y on X:** This coefficients hows that with a unit change in the values of X variable, what will be the average change in the value of Y variable. This is represented by byx. Its formula is as follows:

$$b_{yx} = r \frac{\sigma y}{\sigma x}$$

2. **Regression coefficient of X on Y:** This coefficients hows that with a unit change in the values of Y variable, what will be the average change in the value of X variable. This is represented by bxy. Its formula is as follows:

$$b_{xy} = r \frac{\sigma x}{\sigma y}$$

11.4.7 Hypothesis Testing

A hypothesis is a tentative statement about the relationship between two or more variables. A hypothesis is a specific, testable prediction about what researcher expects to happen in his study. Hypothesis requires as convenient mathematical approach for simplifying cumber some calculation. Setting-up and testing hypothesis is an integral part of statistical inference.

The testing of hypothesis starts with an assumption or guess, termed as hypothesis that is made about a population parameter. The testing of hypothesis is a process of testing the significance of a parameter of the population on the basis of sample.

Characteristics of Hypothesis

i) Hypothesis is an attempt explanation of certain puzzled facts. It is the attempt to find out the possibility of the occurrence of such a fact. Sometimes it is framed to explain certain scientific truth or to explain a law.

ii) It is a probable explanation or presupposition of a cause. If the cause of an event is not known, the investigation starts with a probable cause. For example, if we perceive the effect of an accident and the cause is not witnessed, then the possible reasons of the accident are thought of for investigations.

iii) No hypothesis is certain or definite at the stage of assumption. It is merely probable. It may be framed without evidence or evidence avowedly insufficient. So it requires verification for confirmation.

iv) Through hypothesis facts are organized in a systematic manner. The aim of hypothesis is to reach at the real explanation and to remove the puzzlement concerning the event.

v) Formation of hypothesis is keenly connected with the verification of it. Hypothesis is found in the form of a conclusion.

Null Hypothesis

A null hypothesis is a type of statistical hypothesis that proposes that no statistical significance exists in a set of given observations. Hypothesis testing is used to assess the credibility of a hypothesis by using sample data. Sometimes referred to simply as the "null," it is represented as H_0

Alternative Hypothesis

If H_0 is rejected, It may lead to acceptance of an alternative hypothesis denoted by H1. In other words, if sample results fail to support the null hypothesis, we must conclude that something else is true which is termed as alternative hypothesis.

Steps in Hypothesis Testing:

- The first step in hypothesis testing is to specify the null hypothesis (H0) and the alternative hypothesis (H1). If the research concerns whether one method of presenting pictorial stimuli leads to better recognition than another, the null hypothesis would most likely be that there is no difference between methods (H0: ì1- ì2= 0). The alternative hypothesis would be H1: ì1≠ ì 2. If the research concerned thecorrelation between grades and SAT scores, the null hypothesis would most likely be that there is no correlation (H0:ñ=0).The alternative hypothesis would be H1:ñ ≠ 0.
- The next step is to select a significance level. Typically the 0.05 or the 0.01 level is used.
- The third step is to calculate a statistic analogous to the parameter specified by the null hypothesis.
- The fourth step is to calculate the probability value (often called the p value). The p value is the probability of obtaining a statistic as different or more different from the parameter specified in the null hypothesis as the statistic computed from the data. The calculations are made assuming that the null hypothesis is true.

- The probability value computed in Step 4 is compared with the significance level chosen in Step2. If the probability is less than or equal to the significance level, then the null hypothesis is rejected; if the probability is greater than the significance level then the null hypothesis is not rejected. When the null hypothesis is rejected, the outcome is said to be "statistically significant" when the null hypothesis is not rejected then the outcome is said be "not statistically significant."
- If the outcome is statistically significant, then the null hypothesis is rejected in favor of the alternative hypothesis. If the rejected null hypothesis were that ì1- ì2 = 0, then the alternative hypothesis would be that ì1≠ ì2. If M1were greater than M2 then the researcher would naturally conclude that ì 1 ≥ ì2.
- The final step is to describe the result and the statistical conclusion in an understandable way.

Two Tailed and One Tailed Test of Hypothesis:

A two-tailed testis a method in which the critical area of a distribution is two-sided and tests whether a sample is greater than or less than a certain range of values. It is used in null-hypothesis testing and testing for statistical significance. If the sample being tested falls into either of the critical areas, the alternative hypothesis is accepted instead of the null hypothesis.

When a hypothesis test is set up to show that the sample mean would be higher *or* lower than the population mean, this is referred to as a one-tailed test. The one-tailed test gets its name from testing the area under one of the tails (sides) of a normal distribution. When using a one-tailed test, an analyst is testing for the possibility of the relationship in one direction of interest, and completely disregarding the possibility of a relationship in another direction.

If the sample being tested falls into the one-sided critical area, the alternative hypothesis will be accepted instead of the null hypothesis. A one-tailed test is also known as a directional hypothesis or directional test. A two-tailed test, on the other hand, is designed to examine both sides of a specified data range to test whether a sample is greater than or less than the range of values.

Suppose that you suspect that a particular class's performance on a proficiency test is not representative of those people who have taken the test. The national mean score on the test is74.There search hypothesis is:

The mean score of the class on the test is not 74.

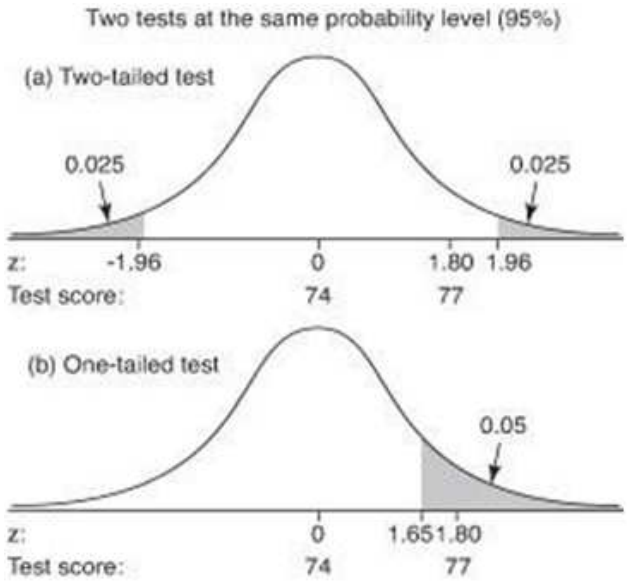
Ha: ì ≠ 74

The null hypothesis is: The mean score of the class on the test is 74.

*H*0: ì = 74

As you decide 5 percent probability level for the test. Both tests have a region of rejection, then, of 5 percent, or 0.05. In this example, however, the rejection region must be split between both tails of the distribution—0.025 in the upper tail and 0.025 in the lower tail—because your hypothesis specifies only a difference, not a direction, as shown in Figure (a).You will reject the null hypotheses of no difference if the class sample mean is either much higher or much lower than the population mean of 74.

Figure shows the comparison of (a) a two tailed test and (b) a one tailed test, at the same probability level (95 percent).



The decision of whether to use a one or a two tailed test is important because a test statistic that falls in the region of rejection in a one tailed test may not do so in a two tailed test, even though both tests use the same probability level.

11.4.7.1 Student T test

The Student t-test is probably the most widely used parametric test. It was developed by a statistician working at the Guinness brewery and is called the Student t-test because of proprietary rights. The t-test is a test in statistics that is used for testing hypotheses regarding the mean of a small sample taken population when the standard deviation of the population is not known.

- The t-test is used to determine if there is a significant difference between the means of two groups.
- The t-test is used for hypothesis testing to determine whether a process has an effect on both samples or if the groups are different from each other.
- Basically, the t-test allows the comparison of the mean of two sets of data and the determination if the two sets are derived from the same population.

- After the null and alternative hypotheses are established, t-test formulas are used to calculate values that are then compared with standard values.
- Based on the comparison, the null hypothesis is either rejected or accepted.
- The T-test is similar to other tests like the z-test and f-test except that t-test is usually performed in cases where the sample size is small (nd ≤ 30).

T-tests can be performed manually using a formula or through some software.

One-Sample T-Test

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

$\bar{x}$ = observed mean of the sample
μ = assumed mean
s = standard deviation
n = sample size

Two-Sample T-Test

$$t = \frac{(\bar{x}_1 - \bar{x}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$\bar{x}_1$ = observed mean of 1st sample
$\bar{x}_2$ = observed mean of 2nd sample
s_1 = standard deviation of 1st sample
s_2 = standard deviation of 2nd sample
n_1 = sample size of 1st sample
n_2 = sample size of 2nd sample

11.4.7.2 Z Test:

The z-test is also a hypothesis test in which the z-statistic follows a normal distribution. The z-test is best used for greater-than-30 samples. A z-test is a statistical test used to determine whether two population means are different when the variances are known and the sample size is large. A z-test is a hypothesis test in which the z-statistic follows a normal distribution. Z-tests are closely related to t-tests, but t-tests are best performed when an experiment has a small sample size. Z-tests assume the standard deviation is known, while t-tests assume it is unknown.

With the z-test, the variance of the standard population, rather than the standard deviation of the study groups, is used to obtain the z-test statistic. Using the z-chart, like the t-table, we see what percentage of the standard population is outside the mean of the sample population. If, like the t-test, greater than 95 per cent of the standard population is on one side of the mean, the p-value is less than 0.05 and statistical significance is achieved. As some assumption of sample size exists in the calculation of the z-test, it should not be used if sample size is less than 30. If both then and the standard deviation of both groups are known, a two sample t-test is best.

11.4.7.3 ANOVA Analysis

Analysis of variance (ANOVA) is an analysis tool used in statistics that splits an observed aggregate variability found inside a data set into two parts: systematic factors and random factors. The systematic factors have a statistical influence on the given data set, while the random factors do not. Analysts use the ANOVA test to determine the influence that independent variables have on the dependent variable in a regression study.

- Analysis of variance, or ANOVA, is a statistical method that separates observed variance data into different components to use for additional tests.
- A one-way ANOVA is used for three or more groups of data, to gain information about the relationship between the dependent and independent variables.
- If no true variance exists between the groups, the ANOVA's F-ratio should equal close to 1.

The Formula for ANOVA is**:**

$$F = \frac{MST}{MSE}$$

Where: F = ANOVA coefficient

MST = Mean sum of squares due to treatment

MSE = Mean sum of squares due to error

One-Way ANOVA Versus Two-Way ANOVA

There are two main types of ANOVA: one-way (or unidirectional) and two-way. There also variations of ANOVA. For example, MANOVA (multivariate ANOVA) differs from ANOVA as the former tests for multiple dependent variables simultaneously while the latter assesses only one dependent variable at a time.

One-way or two-way refers to the number of independent variables in your analysis of variance test. A one-way ANOVA evaluates the impact of a sole factor on a sole response variable. It determines whether all the samples are the same. The one-way ANOVA is used to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups.

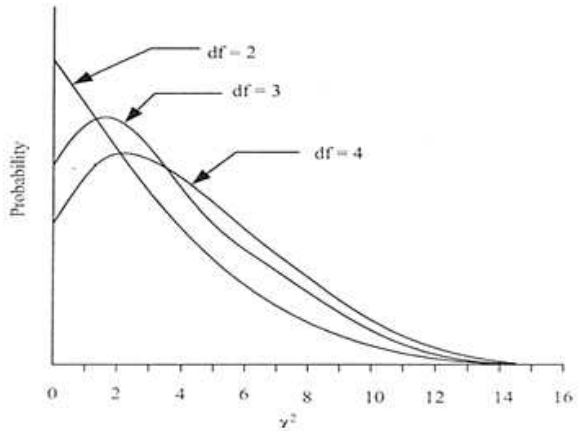
A two-way ANOVA is an extension of the one-way ANOVA. With a one-way, you have one independent variable affecting a dependent variable. With a two-way ANOVA, there are two independents. For example, a two-way ANOVA allows a company to compare worker productivity based on two independent variables, such as salary and skill set. It is utilized to observe the interaction between the two factors and tests the effect of two factors at the same time.

11.4.6.4 Chi-Square Test

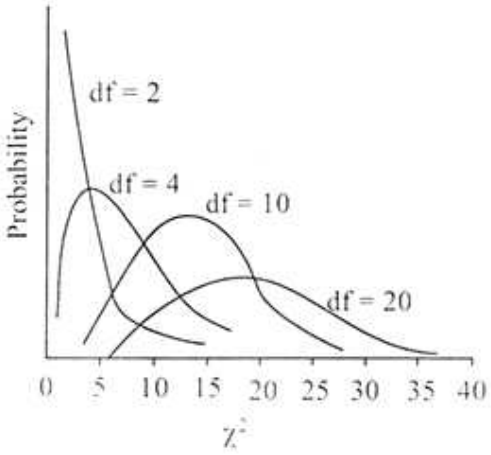
The chi-square distribution is a probability distribution. Under some proper conditions the chi-square distribution can be used as a sampling distribution of chi-square. The chi-square distribution is known by its only parameter. Number of degree of freedom. The meaning of degrees of freedom is the same as the one you have used in student t-distribution. Figure shows the three different chi square distributions for three different degrees of freedom.

The chi-square distribution is a probability distribution. Under some proper conditions the chi-square distribution can be used as a sampling distribution of chi-square. The chi-square distribution is known by its only parameter number of degrees of freedom. The meaning of degrees of freedom is the same as the one you have used in student t-distribution. Figure shows the three different chi square distributions for three different degrees of freedom.

Chi-Square Sampling Distributions for df = 2, 3 and 4



It is to be noted that as the degrees of freedom are very small, the chi-square distribution is heavily skewed to the right. As the number of degrees of freedom increases, the curve rapidly approaches symmetric distribution. You may be aware that when the distribution is symmetric, it can be approximated by normal distribution. Therefore, when the degrees of freedom increase sufficiently, the chi-square distribution approximates the normal distribution. This is illustrated in Figure.



Like student t-distribution there is a separate chi-square distribution for each number of degrees of freedom.

The chi-square test is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories. Hence, it is non-parametric test of statistical significance, which compares observed data with expected data and testing the null hypothesis, which states that there is no significant difference between the expected and the observed result.

The Chi-square is computed by using the following formula.

$$x^2 \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

Whether or not a calculated value of chi-square is significant, can be ascertained by looking at the tabulated values of chi-square for given degree of freedom at a certain level of significance (generally 5% level is taken). If calculated value of chi-square exceeds the table value, the difference between the observed and expected frequencies is taken as significant but if the table value is more than the calculated value, then the difference is considered as insignificant. Insignificant value is considered to have arisen as a result of chance and as such can be ignored.

11.5 Summary

Analysis of data refers to the computation of certain measures along with searching for pattern of relationship that exist among data groups. Data analysis helps in structuring the findings from different sources of data collection like survey research. It is also helpful in breaking a macro problem into micro parts. Data analysis acts like filter when it comes to acquiring meaning insight out of huge data set. It provides a meaningful base to critical decisions. Data analysis can be done by way of frequency distribution, diagrams and graphs. The averages cannot alone describe adequately a set of observations, unless all the observations are the same. It is necessary to describe the variability or dispersion of the observation. In statistics Kurtosis refers, whether a frequency distribution is more flat-topped or more peaked than the normal distribution.

Correlation is measure of association between two variables. The variables are not designed as dependents or independent. Regression is a statistical device with the help of which we are in a position to estimate the unknown values of one variable from known values of another variable. The testing of hypothesis is a process of testing the significance of a parameter of the population on the basis of sample. T-test, ANOVA, z-test, chi-square test etc. are used to test the hypothesis.

11.6 Glossary

- **Statistics –** it can be defined as a collection of methods for planning experiments, obtaining data, and then organizing, summarizing, presenting, analysing, interpreting and drawing conclusions based on the data.

- **Parameters** – it is characteristics of population based on all the units of the population or a numerical measurement describing some characteristics of a population.
- ***Central Tendency****: refers to the statistical measure that identifies a single value as representative of an entire* distribution
- **Dispersion**: is *a means of describing the extent of distribution of data around a central value*.
- **Kurtosis**: is a statistical measure used to describe the degree *to which scores cluster in the tails or the peak of a frequency distribution*.
- **Correlation**: is a statistical measure that expresses the extent to which two variables are linearly related.
- ***Regression*** analysis: is a set of statistical methods used for the estimation of relationships between a dependent variable and one or more independent variables.
- **Hypothesis:** *is an assumption that is made based on some evidence*.

11.7 ANSWERSOFSELFASSESSMENTQUESTIONS:

1. What is meant by data analysis?
2. Write short note on importance of data analysis
3. Distinguish between null and alternative hypothesis
4. Student's T test
5. Z test
6. Chi Square test
7. ANOVA
8. Difference between Skewness and Kurtosis

11.8 Suggested Readings

- Bhandarkar, P.L. and Wilkinson, T.S. (2016). Methodology and Techniques of Social Research. Himalaya Publishing House: New Delhi.
- Donald R. Cooper and Pamela S. Schindler. (2006). Business Research Methods. 9th Edition, Tata McGraw Hill.
- Ghosh, B.N. (2015). Scientific Method and Social Research. Himalayan Publishing House, New Delhi.
- Goode, William J., and Hatt, Paul K. (1952). Methods in Social Research, New York: McGraw-Hill.
- Gopal, M.H. (1970). An introduction to *research* procedures in *social sciences.* Asia Publishing House, New Delhi.

- Gupta, S.P. (2021). Statistical Method (46th edition), Sultan Chand and Sons, New Delhi.
- Kothari, C.R. (2004). Research Methodology Methods and Techniques, New Age International (P) Limited: New Delhi.
- Panneerselvam, R. (2013). Research Methodology. Prentice-Hall of India Pvt. Ltd., New Delhi.
- Rao K.V. (1993). Research Methodology in Commerce and Management, Sterling Publishers Private Limited: New Delhi.
- Sadhu A.N. and A. Singh. (2017). Research Methodology in Social Sciences, Himalaya Publishing House, New Delhi.
- Saravanavel, P. (2019). Research Methodology. KitabMahal. Allahabad.
- Sekaran, U. (2006). Research methods for Business, Wiley India, New Delhi.
- Thakur, H.K. (2021). Research Methodology in Social Sciences. Corvette Press, New Delhi.

11.9 Terminal Questions

1. What do you mean by Data Analysis? What considerations are taken into account while analyzing data?
2. Discuss the different methods of Data Analysis.
3. What is Hypothesis? Discuss the procedure for testing Hypothesis.
4. Explain the concept of correlation and regression? Discuss the difference between correlation and regression.
5. Discuss the application of t-test, z-test and chi-square test.
6. Define the term ‘Measure of dispersion’. What are various methods of measuring dispersion?

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Chapter-12
REPORT WRITING

STRUCTURE

12.0 Learning Objectives

After going through this lesson you will be able to:

- Define a Report,
- Explain the significance of report writing
- Discuss the different steps in writing the reports
- Identify the Mechanics in writing a research report
- Explain the ethics in research

12.1 Introduction

The last and final chapter of the voyage in research is writing of the report. After the collected data has been analyzed and interpreted and generalizations have been drawn the report has to be prepared. The task of research is incomplete till the report is presented. Writing of a report is the last step in a research study and requires a set of skills somewhat different from those called for in respect of the earlier stages of research. This task should be accomplished by the researcher with utmost care.

12.2 Report Writing

A research report is a publication that reports on the findings of a research project or alternatively scientific observations on or about a subject. Normally the research assignments like projects, investigations, explorations, theses, dissertations fall in this category. A research report is a well-crafted document that outlines the processes, data, and findings of a systematic investigation. It is an important document that serves as a first-hand account of the research process, and it is typically considered as an objective and accurate source of information.

12.3 Features of a Research Report

A good research report is marked by certain features:

(1) A good research report should be written lucidly, precisely in simple language and should provide a detailed presentation of the whole of research processes. It should present the data in tables and figures with suitable objective explanations. The end part should include the concluding remarks, the prime findings and recommendations, if any.

(2) The language and style should be academic, formal, less flaunting and simple.

(3) The report is normally based on the first hand information collected by the researcher. However, the reports written on the basis of secondary data are also presented in a systematic and lucid manners.

(4) A research report should normally be written in the third and avoid use of pronouns like, 'I', 'Me', 'My' etc.

(5) The report should facilitate the reader with systematic presentation like proper headings, titles, sub-tiles, tables, graphs, parts and even bullet points where required.

(6) The reports normally forward recommendations too as the solutions to the problems and policy making by the concerned authorities, corporate organizations, institutions and governments.

12.4 Significance of Report Writing

The significance of report writing can be understood from following points.

(1) Report gives merged information- Report presents large information in compressed form.

(2) Present complicated matters easily- Report writing is best way to represent any complicated matter easily and attractively.

(3) Facilitates Decision making and planning- Decisions can be easily made based on the recommendations given in report.

(4) **Builds relationship-** report build relationship between author and reader. It creates impression on author's knowledge and philosophy between author and reader. It creates impression on author's knowledge and philosophy and also provides insight regarding his analytical and critical understanding.

(5) **Unveil Unknown Information-** Report gives its readers hitherto to unknown information about the problem or issue.

(6) **Provides foundation for future research-** Report provides information in terms of tables, graphs, charts and illustration and therefore we can be aware of facts and figures as an update. One can re-use this information for future reference.

(7) **Augment writing skills in presenting practical work-** Writing report is not a layman's task. The rewriting and editing again and again enhances the writing skills of researcher.

(8) **Highlights important details about the research process-** Report highlights important details about the research process. By simply going through the report one can know the objectives, methodology and results of research.

(9) **Permanent record and is easy to verify-** The written report is as a permanent record. When it is needed, important information can be easily collected from the preserved report. The information and messages that are preserved can be verified easily. If there arises any misunderstanding any party can easily verify the information.

12.5 Different Steps in Writing the Report

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

(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 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 who 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 the rough draft- This step happens to be the 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 weakness 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 bricks and loose bricks". 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 woks which the researcher has consulted. The bibliography should be arranged alphabetically and may be divided into two parts; the first part may contain the names of books and pamphlets, and the second part may contain the names of magazine and newspaper articles. Generally, this pattern of bibliography is considered convenient and satisfactory from the point of view of reader, though it is not the only way of presenting bibliography. The entries on bibliography should be made adopting the following order:

For books and pamphlets the order may be as under:

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

(vi) Writing the final draft – This constitutes the last step. The final draft should be written in a concise and objective style and in simple language, avoiding vague expressions such as "it seems", there may be" and the like ones. While writing the final draft, the researcher must avoid abstract terminology and technical illustration

and examples based on common experiences must be incorporated in the final draft as they happen to be most effective in communicating the research findings to others. A research report should not be dull, but must enthuse people and maintain interest and must show originality, It must be remembered that every report should be an attempt to solve some intellectual problem and must contribute to the solution of a problem and must add to the knowledge of both the researcher and the reader.

12.6 Guidelines for Writing a Report

Researcher who are affective in report writing agree that there are a series of guidelines which should be followed. Such guidelines can be enumerated as under:

- **Consider the Audience:** Make the report clear, use only words familiar to the readers and defined all technical terms. To make the comparison of figures easier, usepercentages, rounded off figures, ranks or ratios; put the exact data in a table within the text or in the appendix**.**
- **Address the information Needs:** Remember the research report is designed to communicate information to decision makers. Make sure that it clearly relates the research findings to the objectives of the management.
- **Be Concise, Yet Complete:** Most managers will not want to read about the details of a research report. Knowing what to include and what to leave out is a difficult task. It is up to you, the researcher, to take into account the information needs of the decision maker when writing your report.
- **Be Objective:** You will probably face at least one situation in which you know that the client will not easily accept the results. The findings may be conflict with the decision makers experience and judgment or they may reflect unfavorable on the wisdom of previous decisions. In these circumstances, there is a strong temptation to start the report by making the result more acceptable to the management. A professional researcher, however, will present the research findings in an objective manner and will present the research findings in an objective manner and will defend their validity if they are challenged by the client.
- **Style:** The style of writing a research report is important because it shows a way of presentation. Here are a few a tips to help you write a report that is easy to read.
- Use short words and sentences.
- Be concise.
- Use the active voice
- Consider appearance-space makes a long report easier to read.
- Avoid clichés.
- Write in present tense.

12.7 Layout of the Research Report

Major Parts	Sections
a) Preliminary Part	1. Title 2. Certificate/Authorisation document 3. Contents 4. Preface & Acknowledgements 5. List of Tables/Figure 6. Acronyms (If applicable)
b) Main Body	1. Introduction 2. Review of Literature 3. Research Objectives/Questions/Hypotheses 4. Research Methodology 5. Data Analysis/Results/Discussion 6. Conclusions and Findings 7. Recommendations
c) End Part	1. Endnotes/References 2. Appendices 3. Bibliography 4. Index

12.7.3 Preliminary Part

Preliminary part of a research report includes the title page of the report, certificate of authentication by the research supervisor or letter of accreditation/authorisation by research sponsoring agency, the contents of the report based on the chapter scheme, foreword, preface and acknowledgements, and the list of tables or figures, if any. Usually, foreword is written by an expert of the area. Preface is the face of report i.e. a brief discussion about the research problem, objectives and researcher's approach about dealing with it. Tables or figures are normally numbered on the basis of Chapter No. and tables in continuity e.g. Table No.1.1; 1.2; 1.3; 1.4; 1.5 or Table 2.1; 2.2; 2.3; 2.4 etc.

12.7.4 Main Body

1. Introduction

Introduction is the most important part of the report since it introduces the topic, the objectives, the methodology and the context or background in which the problem is discussed. Background information may include a brief review of the literature already available on the topic so that you are able to 'place' your research in the field. Some brief details of your methods and an outline of the structure of the report and the purpose, significance and implications of the study should be discussed too.

2. Review of Literature

'Literature Survey' is the first major task to be performed by a researcher before and after the selection of problem. It could be done even before selection of problem to determine the research problem to be selected. The reason of carrying out a Literature Survey is to exhibit and develop one's familiarity with other people's works related with the research problem chosen. It normally involves the survey or search of written works in the shape of books and papers in academic journals, and also speeches, letters, documents, films or other outputs. There are many types of Literature Survey, andit depends on one's needs like looking through citations, quotations, bibliographies, indexes etc. In literature review the major works related with research problems are reviewed in brief. The review could be done on the basis of classification of works thematically or could be done in chronological order. The researcher should be able to underline the major argument, content or finding of the work reviewed and present that analytically in reference to the research problem showing the existing gap, difference or lag in the study.

3. Research Methodology

Research Methodology means the adoption of the special procedures, tools and techniques in order to find, categorise, select, process, and analyze information about a particular research problem. In a research document, be it a paper, dissertation, thesis or project the methodology section allows the reader to critically evaluate a study's overall validity and reliability. Jansen and Warren (2020) observe that the research methodology simply refers to the practical "how" of any given piece of research. More specifically, it's about how a researcher systematically designs a study to ensure valid and reliable results that address the research aims and objectives. It includes research approach, sample plan, data sources, questionnaire type etc.

In methodology section the researcher discusses in details the research methodology he has followed i.e. what he did and how he did it. Methodology should be clearly written so that other researcher could also understand it and follow it in similar kind of research endeavours. Methodology is normally written in a passive voice e.g. 'the population was selected on the basis of stratified sampling' or 'the respondents were asked to answer the questions' instead of writing in active voice e.g. I asked the respondents to fill the questionnaire'.

4. Data Analysis

'Data Analysis' is the step to be followed once the first-hand information has been collected. It refers to the process to examine, elicit, elucidate and explain the data, in the course of which concepts or theories are likely to be considered, advanced and developed. The application of tools or techniques depends upon the nature of the data and suitability of the tools for analysing it. It is also classified into preliminary analysis or hypotheses testing. While the former involves the presentation of data in graphs or tables the latter refers to testing of the inferences (hypotheses) made in the beginning. The data can be small, medium or large in quantum and quantitative (numeric) or qualitative (textual) in nature.

5. Results

The results represent the findings of the study based upon the methodology or methodologies applied in collection of data and the tools and techniques applied in data analysis. The results should statethe findings of the research in a systematic manner and in logical sequence without bias or interpretation. It is here where the researcher indicates what he has found. In simple words it is the data collected and arranged systematically ready for interpretation.

6. Discussion

Discussion mostly forms part of the natural science or quantitative studies. However, they can be used in social sciences too wherever the data is presented cartographically in quantitative manner or patterns or figures drawn even in qualitative research. The purpose of the discussion is to interpret and describe the significance of your findings in light of what was already known about the research problem being investigated, and to explain any new understanding or fresh insights about the problem after you've taken the findings into consideration. The discussion will always connect to the introduction by way of the research questions or hypotheses you posed and the literature you reviewed, but it does not simply repeat or rearrange the introduction; the discussion should always explain how your study has moved the reader's understanding of the research problem forward from where you left them at the end of the introduction' (Paul 2008). In this section one discusses the relevance of results and how the findings fit with other research in the area. It will relate back to your literature review and your introductory thesis statement.

7. Conclusion

Conclusion refers to the broad drawing of the study done and the major findings and suggestions made. It can also be called the summary of the major findings of the study. In conclusions the researchers are advised not to include any new information or idea not discussed in the previous chapters. However, one can specify the limitations of the study and the zones of its utility and applications.

8. Recommendations

Normally recommendations are included in the concluding part or in conclusions. However, they can be presented separately too. Recommendations include suggestions for what needs to be done as a result of your findings. Recommendations are usually listed in order of priority.

12.7.5 End Part

The End Part' of the report comprises of endnotes, references, appendices, bibliography and indexes. It also includes endnotes if foot notes are not used in the report. Endnotes are like footnotes but are located at the back rather than the bottom of each page. These would include all of the references for all works cited in the review of related literature

or any other sections of the report as well as the references for quotations, either direct or indirect, taken from other sources, or any footnote comments that might have been included. These are listed in numeric order as presented in the text (Hill, 1970).

1. Bibliography

Bibliography includes all the references used in the report or referred to for background information. Bibliography preparation is based on specific patterns. Kindly check the stylesheets for learning how to prepare a bibliography.

2. Appendices

Any information in the forms of tables/figures, acts, documents, letters, speeches or other materials which is not totally central to the analysis but needs to be mentioned is placed in appendices. They should add extra information to the report. If you include appendices they must be referred to in the body of the report and must have a clear purpose for being included. Each appendix must be named and numbered.

3. Abstract/Synopsis

Many universities have the tradition of asking for the abstracts of the thesis or dissertations. The purpose is to supply in brief the essence of the work done. Abstracts give a very brief overview of the report in a condensed form ranging from introduction to the conclusions.

12.8 Mechanics of Writing a Research Report

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

(i) **Size and Physical Design-** The manuscript should be written on un ruled paper 8''×11" in size. If it is to be written by hand, then black or blue-black ink should be used. A margin of at least half an inch at the right hand of the paper. There should also be one –inch margins, top and bottom. The paper should be neat and legible /if the manuscript is to be typed, then all typing should be double-spaced on one side of the page only except for the insertion of the long quotations.

(ii) **Procedure –** various steps in writing the report should be strictly adhered

(iii) **Layout-** Keeping in view the objective and nature of the problem, the layout of the report should be thought of and decided and accordingly adopted.

(iv) **Treatment of Quotations-** Quotations should be placed in quotation marks and double spaced, forming an immediate pat of the text. But if a quotation is of considerable length (more than four or five type written lines) then it should be single-spaced and indented at least half an inch to the right of the normal text margin.

(v) The footnotes – Regarding footnotes one should keep in view of the followings:

(a) The footnotes serve two purposes viz., the identification of materials used in quotations in the report and the notice of materials not immediately necessary to the body of the research text but still of supplemental value. In other words, footnotes are meant for cross references, citation of authorities and sources, acknowledgement and elucidation or explanation of a point of view. It should always be kept in view that footnote is neither an end nor a means of the display of scholarship. The modern tendency is to make the minimum use of footnotes for scholarship does not need to be displayed.

(b) Footnotes are placed at the bottom of the page on which the reference quotation which they identify or supplement ends. Footnotes are customarily separated from the textual material by a space of half an inch and a line about one and a half inch long.

(c) Footnotes should be numbered consecutively, usually beginning with 1 in each chapter separately. The number should be put slightly above the line, say at end of a quotation. At the foot of the page, again, the footnote number should be indented and typed a little above the line. Thus, consecutive numbers must be used to correlate the reference in the text with its corresponding note at the bottom of the page, except in the case of statistical tables and other numerical material, where symbols such as the asterisk(*) or the like one may be used to prevent confusion.

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

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

(i) Regarding the single-volume reference

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

(ii) Regarding multi-volumed reference

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

(iii) Regarding woks arranged alphabetically

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

Example1

"Salamanca." Encyclopaedia Bitannica,14th Edition.

(iv) *Regarding periodicals reference*

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

(iv) Regarding anthologies and collections reference

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

(v) Regarding second-hand quotations reference

In such cases the documentation should be handled as follows:

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

Example

J.f. Jones, *Life in Ployensia,p.16, quoted in History of the Pacific Ocean area,* R.B, Abel,p.191.

(vii) *Case of multiple authorship*

If there are more than two authors or editors, then in the documentation the name of only the first is given and the multiple authorship is indicated by "et al." or "and others'.

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

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

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

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

9. **The final draft –** Revising and rewriting the rough draft of the report should be done with great care before writing the final draft. For the purpose, the researcher should put to himself questions like: Are the sentences written in the report clear? Are they grammatically correct? Do they say what is meant? Do the various points incorporated in the report fit together logically? "Having at least one colleague read the report just before the final revision is extremely helpful. Sentences that seem crystal clear to the writer may prove quite confusing to other people; a connection that had seemed self

evident may strike others as a non-sequitur. A friendly critic, by pointing out passages that seem unclear or illogical, and perhaps suggesting ways of remedying the difficulties can be an invaluable aid in achieving the goal of adequate communication."

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

12.9 Ethics in research

Ethics are nothing but the accepted codes of conduct. The term is derived from a Greek word ethos which means custom, habit, character or disposition. In research, ethics are a method, procedure, or perspective for deciding how to act and for analyzing complex problems and issues. Ethics are applied on all stages of research, such as planning, conducting and evaluation. Webster dictionary defines ethical (behavior) as conforming to the standards of conduct of a given profession or group."

a) Ethical Principles in Research

In research it is impossible to construct general ethical principles. But in social science research there are some ethical principles which are very important.

(i) **Principle of Autonomy-** The principle of autonomy requires that protection be given to potentially vulnerable populations such as children, the elderly, the mentally ill, or prisoners. Individuals in these groups may be incapable of understanding information that would enable them to make an informed decision about study participation. They are considered potentially "vulnerable." Consequently, careful consideration of their situation and needs is required and extra care must be taken to protect them.

(ii) **Principle of non-maleficence –** The principle of "Non-Maleficence" requires an intention to avoid needless harm or injury that can arise through acts of commission or omission. Non-Maleficence asserts that the primary concern when carrying out a research is to do no harm.

(iii) **Principle of Beneficence** – Beneficence obligates the researcher to secure the well-being of all study participants. It is the responsibility of researcher to protect participants from harm, as well as ensure that they experience the possible benefits of involvement.

(iv) Principle of Justice – This principle of justice raises the question of who ought to receive the benefits of research and bear its burdens. An injustice occurs when some benefit to which a person is entitled is denied without good reason or when some burden is imposed unduly. It requires that the benefits and risks of research should be fairly distributed among people.

b) Important Ethical Guideline for Social Science Research

(i) Integrity and Quality- Integrity and Quality relate to the honesty of a research how honesty he or she undertakes a research. In research confidential communication, such as papers or grants submitted to publication, personal records, trade or military secrets, and patient records should be protected. The integrity of investigator is must because any breach of integrity and quality weakens or even invalidated the research.

(ii) Objectivity – A researcher should avoid personal bias and should try to bring objectivity in research. He should minimize bias or self-deception in experimental design, data analysis, data interpretation, peer review, grant writing and other aspects of research where objectivity is expected or required.

(iii) Essentiality- For undertaking research, a researcher should give adequate consideration to existing literature/ knowledge and its relevance. This will justify the need for the study. It may be possible that there are alternatives available on the subject/issue under the study and study is not required.

(iv) Confidentiality- The confidentiality of respondents should be maintained. They should be assured that identifying information will not be made available to anyone who is not directly involved in the study.

(v) Anonymity- Anonymity means that the participant will remain anonymous throughout the study-even to the researchers themselves. Clearly, it is standard of privacy, but it is some time difficult to accomplish, especially in situations where participants have to be measured at multiple time points like pre test and post test measurements, in different situations, etc.

(vi) Free from coercion voluntary participants- It requires that people should not be compelled or forced to participate in research. This is especially relevant where researchers has to rely on 'captive audiences' for their participants-prisons, universities, and places like that.

(vii) Informed Consent- The prospective research participants must be fully informed about the procedures and risks involved in research and should be taken in research only after they give their consent to participate.

(viii) Legality- A researcher should be aware of all the legal aspects of the research problem. He should know and obey relevant laws and institutional and governmental policies and follow them

(ix) **Maximization of public interest and of social justice-** In social sciences research is usually carried out for the benefit of society. A researcher should strive to promote social good and prevent or mitigate social harms through research. The research should be undertaken with the motive of maximization of public interest and social justice.

(x) **Accountability and transparency-** The research should be conducted in a fair and transparent way. The researcher should always be willing for social and financial review of his or her research. Researcher should also make appropriate arrangements for the preservation of research records for a reasonable period of time so that it can be verified.

(xi) **Independence and impartiality of researcher-** A researcher should work independently and impartially. He should not get influenced and pressurized by the funding agencies and authorities and should report and forecast factual results. He should also not indulge in pseudo-pilot studies.

12.10 Summary

A report is prepared after interpretation of data. It is defined as a document in which a given problem is examined for the purpose of conveying information, report findings, putting forward ideas and sometimes making recommendations. A research report can be classified into decision oriented report and popular report. In the popular report, the main emphasis is on the methods employed, assumptions made in the course of study and the detailed presentation of the findings including their limitations and supporting data. The popular report is intended detail of research methods and terminology.

The contests of the research report must include preliminary pages, main text and the end matter. Different steps involved in report writing are: logical analysis of the subject matter, preparation of the final outline, preparation of the rough draft, rewriting and polishing, preparation of the final bibliography, and writing the final draft.

12.11 Glossary

- **Ethics-** Ethics are nothing but the accepted codes of conduct. The term is deived from a Greek word ethos which means custom, habit, character or disposition. In research, ethics are a method, procedure, or perspective for deciding how to act and for analyzing complex problems and issues.
- **Plagiarism-**Plagiarism is using other people's work without acknowledging their contribution it can be of passing off somebody else's ideas, thoughts, theories, words or stories as own. It is a kind of stealing from the original author.
- **Fabrication-** Fabrication is the international act of making up data or results and recording or reporting them. For example suppose a researcher/interviewer completes a questionnaire for a fictitious subject that he never interviewed.

- **Falsification-** Falsification is manipulating research materials, equipments, or processes, of changing or omitting/ suppressing data or results without scientific or statistical justification, such that the research is not accurately represented.
- **Post factum –** means occurring after the fact, or ex post facto design is a quasi-experimental study examining how an independent variable, present prior to the study in the participants, affects a dependent variable.
- **Quotation-** quoting means repeating the author's exact words. In some disciplines, such as literary studies and history, quoting is used frequently to support the argument.
- **Generalisation –** which is an act of reasoning that involves drawing broad inferences from particular observations, is widely-acknowledged as a quality standard in quantitative research but more controversial in qualitative research.

12.12 Answers to Self-Check Exercises

1. Explain report writing?
2. What do you understand by ethics in research?
3. Explain Mechanics of report writing?

12.13 Suggested Readings

- Bhandarkar, P.L. and Wilkinson, T.S. (2016). Methodology and Techniques of Social Research. Himalaya Publishing House: New Delhi.
- Donald R. Cooper and Pamela S. Schindler. (2006). Business Research Methods. 9th Edition, Tata McGraw Hill.
- Ghosh, B.N. (2015). Scientific Method and Social Research. Himalayan Publishing House, New Delhi.
- Goode, William J., and Hatt, Paul K. (1952). Methods in Social Research, New York: McGraw-Hill.
- Gopal, M.H. (1970). An introduction to *research* procedures in *social sciences.* Asia Publishing House, New Delhi.
- Gupta, S.P. (2021). Statistical Method (46th edition), Sultan Chand and Sons, New Delhi.
- Kothari, C.R. (2004). Research Methodology Methods and Techniques, New Age International (P) Limited: New Delhi.
- Panneerselvam, R. (2013). Research Methodology. Prentice-Hall of India Pvt. Ltd., New Delhi.

- Rao K.V. (1993). Research Methodology in Commerce and Management, Sterling Publishers Private Limited: New Delhi.
- Sadhu A.N. and A. Singh. (2017). Research Methodology in Social Sciences, Himalaya Publishing House, New Delhi.
- Saravanavel, P. (2019). Research Methodology. KitabMahal. Allahabad.
- Sekaran, U. (2006). Research methods for Business, Wiley India, New Delhi.
- Thakur, H.K. (2021). Research Methodology in Social Sciences. Corvette Press, New Delhi.

12.14 Terminal Questions

1. What is report writing? Discuss the different types of reports.
2. Discuss the guidelines to be taken in to account for writing a report.
3. Explain the layout of the research report.

*****

Chapter-13
References Style in Research Report

Structure

13.0 Learning Objectives

After reading this chapter, you will be able to:

- explain how to write references in a scientific research report as per APA;
- describe the art of referencing; and
- write a research report references in APA format.

13.1 Introduction

The reference section is a very important component of the report. It contains all the necessary literature that have been referred to before, during and after the study and contains books, journal articles and documents from where the materials have been referred to. References differ from bibliography in that references are those literature which have been cited in the main text of the report in different places. Bibliography includes many referred as well as many un-referred literature in the text of the report. Sometimes a book would have been consulted but not necessarily referred to in the text. Thus the bibliography will be inclusive of many materials which have not been referred in the text. Of course it may

contain the referred materials also. On the other hand the references will contain basically the referred materials. In this unit we are going to focus on references, how to write the same and the importance of reference etc. Basically we will be depending on the APA source for this purpose.

13.2 Reference List (The Format)

As per Publication Manual of American Psychological Association (Sixth Edition, 2009) just as data in the paper support interpretations and conclusions, so Reference citations support document statements made about the literature.

All citations in the manuscript must appear in the Reference list, and all References must be cited in the text.

The Reference list should be succinct, not exhaustive; simply provide sufficient references to support your Research. Choose References judiciously and cite them accurately. For example, if you retrieve an abstract but do not also retrieve and read the full article, your Reference should be identified as an abstract.

The standard procedures for citation ensure that References are accurate, complete, and useful to investigators and readers.

Whenever possible, support your statements by citing empirical work, such as method and results of an empirical study or a review of empirical studies (Lalumiere, 1993). When you cite non-empirical work, make this clear in your narrative as given in the examples below (see the box).

Tripathi (1991) theorized that Pandey (in press) argued that Parmeshwar (1993).

Similarly, when you want to direct the reader to background information, signal the reader with phrases such as “for a review, see” and “(e.g., see [author, year]).

“References” section begins at a new page with the label “References” at the centre. References comprise all documents including journals, books, technical Reports, computer programmers and unpublished works mentioned in the text of the Report.

References are arranged in alphabetical order by the last name of the author(s) and the year of publication in parenthesis or in case of unpublished citations, only the Reference is cited.

Sometimes no author is listed and then, in that condition the first word of the title or sponsoring organisation is used to begin the entry. When more than one name is cited within parenthesis, the References are separated by semicolons.

In parenthesis page number is given only for direct quotations. The Researcher should check carefully that all References cited in the text appear in.

13.3 References (Process of Writing)

References should not be confused with Bibliography. A bibliography contains everything that is included in the Reference section plus other publications which are useful but were not cited in text or manuscript. Bibliography is not generally included in Research Reports. Only References are usually included.

References in APA Format

The APA style guide prescribes that the Reference section, Bibliographies and other lists of names should be accumulated by surname first, and mandatory inclusion of surname prefixes. For example, “Martin de Rijke” should be sorted as “De Rijke, M” and “Saif Al Falssi” should be sorted as “Al-Falasi, S.” (The preference forArabic names now is to hyphenate the prefix so that it remains with the surname.).

Reference citations in text are done using parenthetical referencing. Most usually, this involves putting the author’s surname and the date of publication within parentheses, separated by a comma, generally placed immediately after the Reference or at the end of the sentence in which the Reference is made.

However, it is also common for the authors to be the subject or object of a sentence. In such a case only the year is in parentheses. In all cases of citation, author name(s) are always followed immediately by the year in which the article was published. In the case of a quotation, the page number is also included in the citation.

Full bibliographic information is then provided in a Reference section at the end of the article. APA style defines that the Reference section may only include articles that are cited within the body of an article. This is the distinction between a document having a Reference section and a Bibliography, which may incorporate sources read by the authors as background but not referred to or included in the body of a document.

Let us now see how to write references if it is single author, multiple author etc.

- ***Single author***

Format should be Author’s last name followed directly by a comma, then the year of publication. When one makes the Reference to the author(s) directly as a part of the narrative, then only the year (and page number if needed) would remain enclosed within parentheses. The same holds for multiple authors.

Examples are given below:

“A recent study found a possible genetic cause of alcoholism (Pauling, 2005).” “Pauling (2005) discovered a possible genetic cause of alcoholism.”

- ***Two authors***

Authors should be presented in order that they appear in the published article. If they are cited within closed parentheses, use the ampersand (&) between them. If not enclosed in parentheses then use expanded “and”.

Examples are given below:

"A recent study found a possible genetic cause of alcoholism (Pauling & Liu, 2005)."
"Pauling and Liu (2005) discovered a possible genetic cause of alcoholism."

- ***Three to five authors***

With three to five authors, the first Reference to an article includes all authors. Subsequent citations in the same document may refer to the article by the principal author only plus "et al."

All authors must be present in the References section.

A recent study found a possible genetic cause of alcoholism (Pauling, Liu, & Guo, 2005).

Examples are given below:

"Pauling, Liu, and Guo (2005) conducted a study that discovered a possible genetic cause of alcoholism."

"Pauling et al. (2005) discovered a possible genetic cause of alcoholism."

"A recent study found a possible genetic cause of alcoholism (Pauling et al., 2005)."

- ***Six or seven authors***

The correct format in the text is (First Author et al., Year) or First Author et al. (Year).

Examples given below:

"Brown et al. (2005) discovered a possible genetic cause of alcoholism."

In the Reference section, all authors' names should be included if there are six or seven authors.

- ***Eight or more authors***

In the text, the first and all subsequent References should be to First Author et al. (Year) or (First Author et al., Year).

In the Reference list, list the first six authors, and then put an ellipsis (three periods), and then list the last author.

Example given below:

"Brown, A.B., Johnson, C., Laird, K., Howard, O. P., Evans, S., . . . Pritchard, J. (2004) (study has eight or more authors)"

- ***Multiple publications, same author***

If an author has multiple publications that you wish to cite, you use a comma to separate the years of publication in chronological order (oldest to most recent). If the publications occur in the same year, the *Publication Manual* recommends using suffixes a, b, c, etc. (note that corresponding letters should be used in the Reference list, and these References should be ordered alphabetically by title).

Example given below:

"Recent studies have found a possible genetic cause of alcoholism (Pauling, 2004, 2005a, 2005b)."

"Pauling (2004, 2005a, 2005b) has conducted studies that have discovered a possible genetic cause of alcoholism"

- ***Multiple publications, different authors***

Follow the rules for one author above, and use a semicolon to separate articles. Citation should first be in alphabetical order of the author, then chronological.

Example given below:

"Recent studies found a possible genetic cause of alcoholism (Alford, 1995; Pauling, 2004, 2005; Sirkis, 2003)"

- ***Direct quotes***

The same rules as above apply here, the format being (Author, Year, Page Number). Example given below:

"When asked why his behaviour had changed so dramatically, Max simply said, "I think it's the reinforcement" (Pauling, 2004, p. 69)."

13.4 Reference List and Print Sources

The APA style guide prescribes that the *Reference* section, Bibliographies and other lists of names should be accumulated by surname first, and mandates inclusion of surname prefixes. For example, "Martin de Rijke" should be sorted as "de Rijke, M." and "Saif Al-Falasi" should be sorted as "Al-Falasi, S."

For names in non-English languages, follow the capitalisation standards of that language. For each of the source types below a hanging indent should be used where the first line is flush to the left margin and all other lines are indented.

Book by one author

Sheril, R. D. (1956). *The terrifying future: Contemplating color television*. San Diego, CA: Halstead.

Book by two authors

Kurosawa, J., & Armistead, Q. (1972). *Hairball: An intensive peek behind the surface of an enigma*. Hamilton, Ontario, Canada: McMaster University Press.

Chapter in an edited book

Mcdonalds, A. (1993). Practical methods for the apprehension and sustained containment of supernatural entities. In G. L. Yeager (Ed.), *Paranormal and occult studies: Case studies in application* (pp. 42–64). London, England: Other World Books.

Dissertation (Ph.D. or masters)

Mcdonalds, A. (1991). *Practical dissertation title* (Unpublished doctoral dissertation). University of Florida, Gainesville, FL.

Article in a journal with continuous pagination (nearly all journals use continuous pagination)

Rottweiler, F. T., & Beauchemin, J. L. (1987). Detroit and Narnia: Two foes on the brink of destruction. *Canadian/American Studies Journal, 54,* 66–146.

Kling, K. C., Hyde, J. S., Showers, C. J., & Buswell, B. N. (1999). Gender differences in self-esteem: A meta-analysis. *Psychological Bulletin, 125,* 470–500.

Article in a journal paginated separately Journal pagination

Crackton, P. (1987). The Loonie: God's long-awaited gift to colourful pocket change? *Canadian Change, 64*(7), 34–37.

Article in a weekly magazine

Henry, W. A., III. (1990, April 9). Making the grade in today's schools. *Time, 135,* 28–31.

Article in a weekly magazine with DOI

Hoff, K. (2010, March 19). Fairness in modern society. *Science, 327,* 1467-1468. doi:10.1126/science.1188537

Article in a print newspaper

Wrong, M. (2005, August 17). "Never Gonna Give You Up" says Mayor. *Toronto Sol,* p.4.

13.5 Electronic Sources

For electronic References, websites, and online articles, APA Style asserts some basic rules, including to direct readers specifically to the source material using URLs which work include retrieval date ONLY when content is likely to change (e.g., wikis) include all other relevant APA Style details for the source.

Online article based on a print source, with DOI (e.g., a PDF of a print source from a database)

Example is given below:

Krueger, R. F., Markon, K. E., Patrick, C. J., & Iacono, W. G. (2005). Externalizing psychopathology in adulthood: a dimensional-spectrum conceptualisation and its implications for DSM-V. Journal of Abnormal Psychology, 114, 537-550. doi:10.1037/ 0021-843X.114.4.537

Online article based on a print source, without DOI (e.g., a PDF of a print source from a database)

Marlowe, P., Spade, S., & Chan, C. (2001). Detective work and the benefits of color versus black and white. *Journal of Pointless Research, 11,* 123–127.

Online article from a database, no DOI, available ONLY in that database (proprietary content—not things like Ovid, EBSCO, and PsycINFO)

Liquor advertising on TV. (2002, January 18). Retrieved from http://factsonfile.infobasepublishing.com/

or

Liquor advertising on TV. (2002, January 18). Retrieved from *Issues and Controversies* database.

Article in an Internet-only journal

McDonald, C., & Chenoweth, L. (2009). Leadership: A crucial ingredient in unstable times. *Social Work & Society, 7.* Retrieved from http://www.socwork.net/2009/1/articles/mcdonaldchenoweth

Article in an Internet-only newsletter (eight or more authors)

Paradise, S., Moriarty, D., Marx, C., Lee, O. B., Hassel, E., . . . Bradford, J. (1957, July). Portrayals of fictional characters in reality-based popular writing: Project update. *Off the Beaten Path, 7*. Retrieved from http://www.newsletter.offthebeatenpath.news/otr/complaints.html

Article with no author identified

Britain launches new space agency. (2010, March 24). Retrieved from http://news.ninemsn.com.au/technology/1031221/britain-launches-new-space-agency

Article with no author and no date identified (e.g., Wiki article)

Harry Potter. (n.d.). In *Wikipedia.* Retrieved March 12, 2010, from http://en.wikipedia.org/wiki/Harry_Potter

Entry in an online dictionary or Reference work, no date and no author identified Verisimilitude.(n.d.).In *Merriam-Webster's online dictionary* (11th ed.). Retrieved from http://www.merriam-webster.com/dictionary/verisimilitude

E-mail or other personal communication (cite in text only) Monterey, personal communication, September 28, 2001)

13.6 Book on CD, Tape and Movie

Nix, G. (2002). *Lirael, Daughter of the Clayr* [CD]. New York, NY: Random House/Listening Library.

Book on tape

Nix, G. (2002). *Lirael, Daughter of the Clayr* [Cassette Recording No. 1999- 1999-1999]. New York, NY: Random House/Listening Library.

Movie

Gilby, A. (Producer), & Schlesinger, J. (Director). (1995). *Cold comfort farm* [Motion picture]. Universal City, CA: MCA Universal.

13.7 Reference Specifications

Text citations: Source material must be documented in the body of the paper by citing the author(s) and date(s) of the sources. The underlying principle is that ideas and words of others must be formally acknowledged. The reader can obtain the full source citation from the list of References that follows the body of the paper.

When the names of the authors of a source are part of the formal structure of the sentence, the year of publication appears in parentheses following the identification of the authors. Consider the following example:

Wirth and Mitchell (1994) found that although there was a reduction in insulin dosage over a period of two weeks in the treatment condition compared to the control condition, the difference was not statistically significant. [Note: *and* is used when multiple authors are identified as part of the formal structure of the sentence. Compare this to the example in the following section.]

When the authors of a source are *not* part of the formal structure of the sentence, both the authors and year of publication appear in parentheses. Consider the following example:

Reviews of Research on religion and health have concluded that at least some types of religious behaviours are related to higher levels of physical and mental health (Gartner, Larson, & Allen, 1991; Koenig, 1990; Levin & Vanderpool, 1991; Maton & Pargament, 1987; Paloma & Pendleton, 1991; Payne, Bergin, Bielema, & Jenkins, 1991). [Note: *&*is used when multiple authors are identified in parenthetical material. Note also that when several sources are cited parenthetically, they are ordered alphabetically by first authors' surnames and separated by semicolons.]

When a source that has two authors is cited, both authors are included every time the source is cited.

When a source that has three, four, or five authors is cited, all authors are included the first time the source is cited. When that source is cited again, the first author's surname and "et al." are used. Consider the following example:

Reviews of Research on religion and health have concluded that at least some types of religious behaviours are related to higher levels of physical and mental health (Payne, Bergin, Bielema, & Jenkins, 1991).

Payne et al. (1991) showed that ...

When a source that has six or more authors is cited, the first author's surname and "et al." are used every time the source is cited (including the first time).

Every effort should be made to cite only sources that you have actually read. When it is necessary to cite a source that you have not read ("Grayson" in the following example) that is cited in a source that you have read ("Murzynski & Degelman" in the following example), use the following format for the text citation and list only the source you have read in the References list:

Grayson (as cited in Murzynski & Degelman, 1996) identified four components of body language that were related to judgments of vulnerability.

To cite a personal communication (including letters, emails, and telephone interviews), include initials, surname, and as exact a date as possible. Because a personal communication is not “recoverable” information, it is not included in the References section. For the text citation, use the following format:

B. F. Skinner (personal communication, February 12, 1978) claimed ...

To cite a Web document, use the author-date format. If no author is identified, use the first few words of the title in place of the author. If no date is provided, use “n.d.” in place of the date. Consider the following examples:

Degelman (2009) summarises guidelines for the use of APA writing style.

Changes in Americans’ views of gender status differences have been documented (*Gender and Society*, n.d.).

To cite the Bible, provide the book, chapter, and verse. The first time the Bible is cited in the text, identify the version used. Consider the following example:

“You are forgiving and good, O Lord, abounding in love to all who call to you” (Psalm 86:5, New International Version). [Note: No entry in the References list is needed for the Bible.]

Quotations: When a direct quotation is used, always include the author, year, and page number as part of the citation.

A quotation of fewer than 40 words should be enclosed in double quotation marks and should be incorporated into the formal structure of the sentence. Consider the following example:

Patients receiving prayer had “less congestive heart failure, required less diuretic and antibiotic therapy, had fewer episodes of pneumonia, had fewer cardiac arrests, and were less frequently intubated and ventilated” (Byrd, 1988, p. 829).

A lengthier quotation of 40 or more words should appear (without quotation marks) apart from the surrounding text, in block format, with each line indented five spaces from the left margin.

References: All sources included in the References section must be cited in the body of the paper (and all sources cited in the paper must be included in the References section).

Pagination: The References section begins on a new page.

Heading: “References” (centered on the first line below the running head)

Format: The References (with hanging indent) begin on the line following the References heading. Entries are organised alphabetically by surnames of first authors. Most Reference entries have the following components:

Authors: Authors are listed in the same order as specified in the source, using surnames and initials. Commas separate all authors. When there are eight or more authors, list the first six authors followed by three ellipses (...) and then the final author. If no author is identified, the title of the document begins the Reference.

Year of Publication: In parentheses following authors, with a period following the closing parenthesis. If no publication date is identified, use “n.d.” in parentheses following the authors.

Source Reference: Includes title, journal, volume, pages (for journal article) or title, city of publication, publisher (for book). Italicize titles of books, titles of periodicals, and periodical volume numbers.

Electronic Retrieval Information: Electronic retrieval information may include digital object identifiers (DOIs) or uniform resource locators (URLs). DOIs are unique alphanumeric identifiers that lead users to digital source material. To learn whether an article has been assigned a DOI, go to http://www.crossref.org/guestquery/.

Example of APA-formatted Internet References: Go to http://www.vanguard.edu/uploadedFiles/Psychology/References.pdf

Examples of sources

Journal article with DOI

Murzynski, J., & Degelman, D. (1996). Body language of women and judgments of vulnerability to sexual assault. *Journal of Applied Social Psychology, 26,* 1617- 1626. doi:10.1111/j.1559-1816.1996.tb00088.x

Journal article without DOI, print version

Koenig, H. G. (1990). Research on religion and mental health in later life: A review and commentary. *Journal of Geriatric Psychiatry, 23,* 23-53.

Journal article without DOI, retrieved online

For articles retrieved from databases, include the URL of the journal home page. Database information is not needed. Do not include the date of retrieval.]

Aldridge, D. (1991). Spirituality, healing and medicine. *British Journal of General Practice, 41,* 425-427. Retrieved from http://www.rcgp.org.uk/publications/bjgp.aspx

Book

Paloutzian, R. F. (1996). *Invitation to the psychology of religion* (2nd ed.). Boston, MA: Allyn and Bacon.

Informally published Web document

Degelman, D. (2009). *APA style essentials.* Retrieved from http://www.vanguard.edu/faculty/ ddegelman/detail.aspx?doc_id=796

Informally published Web document (no date)

Nielsen, M. E. (n.d.). *Notable people in psychology of religion.* Retrieved from http://www.psywww.com/psyrelig/psyrelpr.htm

Informally published Web document (no author, no date)

Gender and society. (n.d.). Retrieved from http://www.trinity.edu/~mkearl/gender.html

13.8 Abstract from Secondary Database

Garrity, K., & Degelman, D. (1990). Effect of server introduction on restaurant tipping. *Journal of Applied Social Psychology, 20,* 168-172. Abstract retrieved from PsycINFO database.

Article or chapter in an edited book Shea, J. D. (1992). Religion and sexual adjustment. In J. F. Schumaker (Ed.),*Religion and mental health* (pp. 70-84). New York, NY: Oxford University Press.

Diagnostic and Statistical Manual of Mental Disorders

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

13.9 Footnotes

Footnotes: Content footnotes are occasionally used to support substantive information in the text. A content footnote may be placed at the bottom of the page on which it is discussed or on a separate page following the References.

Pagination: Footnotes begin on a separate page.

Heading: "Footnotes" is centered on the first line below the running head.

Format: Indent the first line of each footnote 5-7 spaces and number the footnotes (slightly above the line) as they are identified in the text.

Example of APA-formatted

Footnotes: http://www.vanguard.edu/uploadedFiles/Psychology/Footnote.pdf

Tables: A common use of tables is to present quantitative data or the results of statistical analyses (such as ANOVA). See the *Publication Manual* (2010, pp. 128- 150) for detailed examples. Tables must be mentioned in the text.

Pagination: Each Table begins on a separate page.

*Heading: "*Table 1" (or 2 or 3, etc.) is typed flush left on the first line below the running head. Double-space and type the table title flush left (italicized in uppercase and lowercase letters).

Example of APA-formatted Tables.

http://www.vanguard.edu/uploadedFiles/Psychology/table.pdf

Figures: A common use of Figures is to present graphs, photographs, or other illustrations (other than tables). See the *Publication Manual* (2010, pp. 150-167) for detailed examples.

Pagination: Figures begin on a separate page.

Figure Caption: "*Figure 1.*" (or 2 or 3, etc.) is typed flush left and italicized on the first line below the figure, immediately followed on the same line by the caption (which should be a brief descriptive phrase).

Example of APA-formatted

Figure: http://www.vanguard.edu/uploadedFiles/Psychology/figure.pdf

Appendixes: A common use of appendixes is to present unpublished tests or to describe complex equipment or stimulus materials.

Pagination: Each Appendix begins on a separate page.

*Heading :*If there is only one appendix, "Appendix" is centered on the first line below the manuscript page header. If there is more than one appendix, use Appendix A (or B or C, etc.). Double-space and type the appendix title (centered in uppercase and lowercase letters).

Format: Indent the first line 5-7 spaces.

Example of APA-formatted Appendix

http://www.vanguard.edu/uploadedFiles/Psychology/Appendix.pdf

13.10 General Guidelines to Write References

Start on a new page. Center the word References at the top. As usual, double space. Any citations made in the manuscript must be presented in this section and vice versa. That is, if something is not cited in the text, then it should not appear in this section. In still other words, this is not a bibliography.

In any of the previous sections, whenever you say something like studies have shown you must provide a citation. This section tells the reader where they can find these citations. This section is alphabetized by last name (of the first author involved in the study).

A hanging indent is employed for each Reference, that is, the first line is not indented and the rest are five-space indented.

For each author, give the last name followed by a comma and the first (and middle) initials followed by periods.

Separate multiple authors with commas and the last author with the ampersand ('&') rather than the word "and".

After the author(s) comes the year (in parentheses and followed by a period).

For a journal Reference, italicize the title of the journal and the volume number. Note that issue numbers are typically not included. Also, capitalize the important words of the journal title.

For a book Reference, just italicize the title. Only capitalise the first word of the title. Do include the city, state (as a two-letter abbreviation without periods), and the publisher's name.

See the example Reference section. It provides several types of References, including: Single and multiple author, journal articles, book, and book chapter, web page, as well as a government document.

13.11 Summary

In this unit we have tried to present how the references should be written. We have tried to differentiate between references and bibliography. We pointed out that a list of Reference is an integral part of the Research Report. It may be headed as 'References' or 'Bibliography'. While Bibliography is a comprehensive term which includes, in addition to referred literature, other related and very useful literature which readers may like to read which the Researcher has himself read but not referred to it in the text of the thesis. All literature referred to in the text must appear in the Reference list. We learnt all about the guidelines to follow while writing references, in the style of American Psychological Association (APA) format.

We also discussed how to write the reference when it is a single author, more than one author and multiple authors. When there is more than one author, the initial of the first author must be followed by 'a comma'. The wording of the title should appear exactly as it does on the title page of the book or first page of the article. The name of the journal should either appear as it is or be abbreviated according to accepted abbreviations.

We also learned about how to write the reference for the same author who has published in different years and also in the same year. How to write a journal reference and a book reference were also presented.

13.12 Glossary

- **References:** comprise all documents including journals, books, technical Reports, computer programmers and unpublished works mentioned in the text of the Report.
- **Bibliography**: contains everything that is included in the Reference section plus other publications which are useful but were not cited in text or manuscript.
- **APA style**: uses the author/date method of citation in which the author's last name and the year of the publication are inserted in the actual text of the paper. It is the style recommended by the American Psychological Association and used in many of the social sciences.

13.13 Answers to Self-check Exercise

1. What is the significance of References in a Research Report?
2. How will you differentiate between references and bibliography
3. If the same author has multiple books how would you write the reference for them?

13.14 Suggested Readings

- Bhandarkar, P.L. and Wilkinson, T.S. (2016). Methodology and Techniques of Social Research. Himalaya Publishing House: New Delhi.
- Donald R. Cooper and Pamela S. Schindler. (2006). Business Research Methods. 9th Edition, Tata McGraw Hill.
- Ghosh, B.N. (2015). Scientific Method and Social Research. Himalayan PublishingHouse, New Delhi.
- Goode, William J., and Hatt, Paul K. (1952). Methods in Social Research, New York: McGraw-Hill.
- Gopal, M.H. (1970). An introduction to research procedures in social sciences. AsiaPublishing House, New Delhi.
- Gupta, S.P. (2021). Statistical Method (46th edition), Sultan Chand and Sons, New Delhi.
- Kothari, C.R. (2004). Research Methodology Methods and Techniques, New AgeInternational (P) Limited: New Delhi.
- Panneerselvam, R. (2013). Research Methodology. Prentice-Hall of India Pvt. Ltd., New Delhi.
- Publication Manual of the American Psychological Association (Sixth Edition, 2009). American Psychological Association. Washington, DC.
- Rao K.V. (1993). Research Methodology in Commerce and Management, Sterling Publishers Private Limited: New Delhi.
- Sadhu A.N. and A. Singh. (2017). Research Methodology in Social Sciences, Himalaya Publishing House, New Delhi.
- Saravanavel, P. (2019). Research Methodology. Kitab Mahal. Allahabad.
- Sekaran, U. (2006). Research methods for Business, Wiley India, New Delhi.
- Singh, AK. (2009). Test Measurements and Research Methods in Behavioural Sciences (Fifth Edition). Bharti Bhawan Publishers & Distributors.
- Thakur, H.K. (2021). Research Methodology in Social Sciences. Corvette Press, NewDelhi.

13.16 Terminal Questions

1. Elaborate upon the central guidelines for writing references from diverse sources. Give suitable examples.
2. How will you write references for the internet resources?
3. Elucidate the style of referencing according to the APA format, especially single author and multiple authors.
4. How will you write the references for internet books in particular? Give examples.

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Chapter 1-4
REFERENCING SOFTWARE

STRUCTURE

14.0 Learning Objectives

After going through this lesson, you will be able to:

- Know why the referencing softwares use in research, and
- List the most common referencing softwares used in the research with their strengths and weakness.

14.1 Introduction

In the research work, referencing softwares help you to gather, organize, and cite your sources more effectively- saving you time and energy in the long run. Good referencing softwares can make all the difference for academic researchers and Ph.D. students from

making sure your references are formatted correctly to helping you find and use them quickly and easily. They allow you to keep track of your references, create bibliographies, and collaborate with other researchers.But with so many different types of software to choose from, how do you know which one is right for you? This chapter aims to give you an overview of the most common referencing softwares used in the research and discussed their strengths and weakness.

14.2 Referencing Software

Referencing software, or citation manager, is a program or online service that helps you collect, organize, cite, and share your research sources. Most of these programs also allow you to create bibliographies and footnotes in your research papers.

Referencing or Citation softwares help you find sources more quickly and easily. Most softwares have built-in search engines that allow you to quickly find articles and other resources related to your topic. They also allow you to save search parameters and customize your results. The more sources you find, the better equipped you will be to make an informed decision about how to word your paper's thesis statement and plan out the rest of the writing process.

14.3 Use of Referencing Software for Research

Whether you are a Ph.D. student or an academic researcher, it's important to use referencing software for research. Here are three reasons why:

1. It can help you find information quickly and easily. With the right software, you can quickly and easily find the information you need- no more wasted time searching through endless pages of results.
2. It makes collaboration much easier. Have a group project? Reference management software will help you share resources with ease. No more passing around notes or spending hours trying to compile everything together by hand!
3. It can help you stay organized. When you're dealing with a lot of information, it's important to have a system for keeping track of it all. Reference manager can help you do just that.

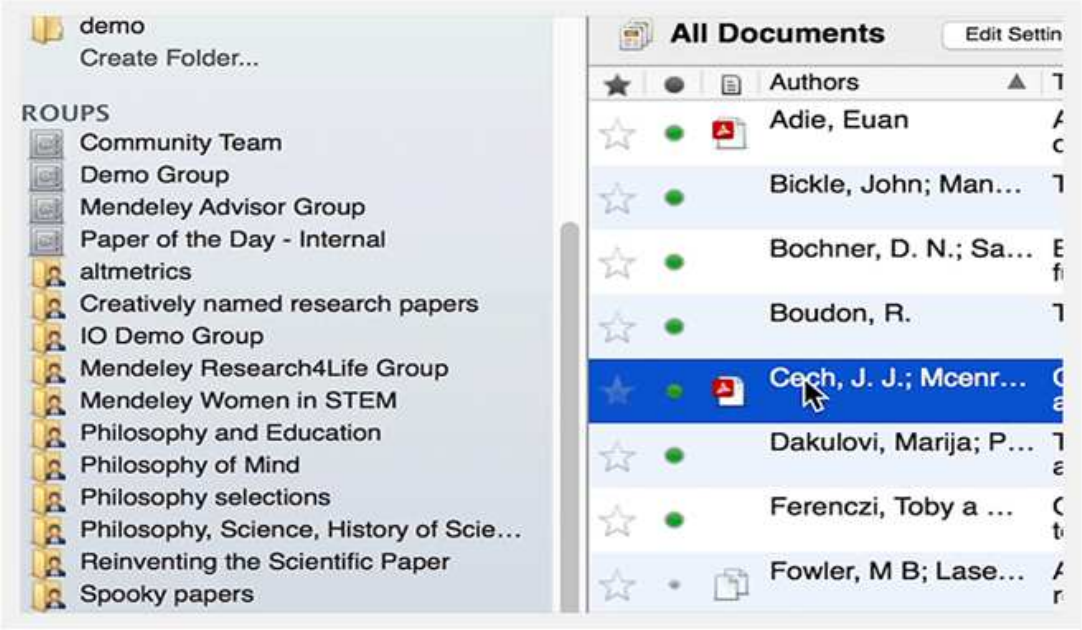
14.4 Best Referencing Softwares

14.4.1 Mendeley

Mendeley is a software that helps researchers manage their references. It can be used to create bibliographies and citations, and it also allows users to collaborate with other researchers. Mendeley can be accessed online or offline, and it is available for both Windows and Mac users.

Mendeley reference manager allows you to store, organize, and search all of your references from just one reference library. It makes it easy to add references and bibliographies to your google docs. Mendeley reference manager allows you to read, highlight, and annotate PDFs, and retain all of your ideas in one location across numerous pages.

www.mendeley.com



Strengths

- Increased collaboration as it allows you to invite your teammates who have Mendeley to share the same paper.
- Portability is made easier as the software can simultaneously be installed on different devices.
- It offers a browser plugin that works with Firefox and Google Chrome, so all you need to do is bookmark your desired web pages, and it saves on your Mendeley library.

Weakness

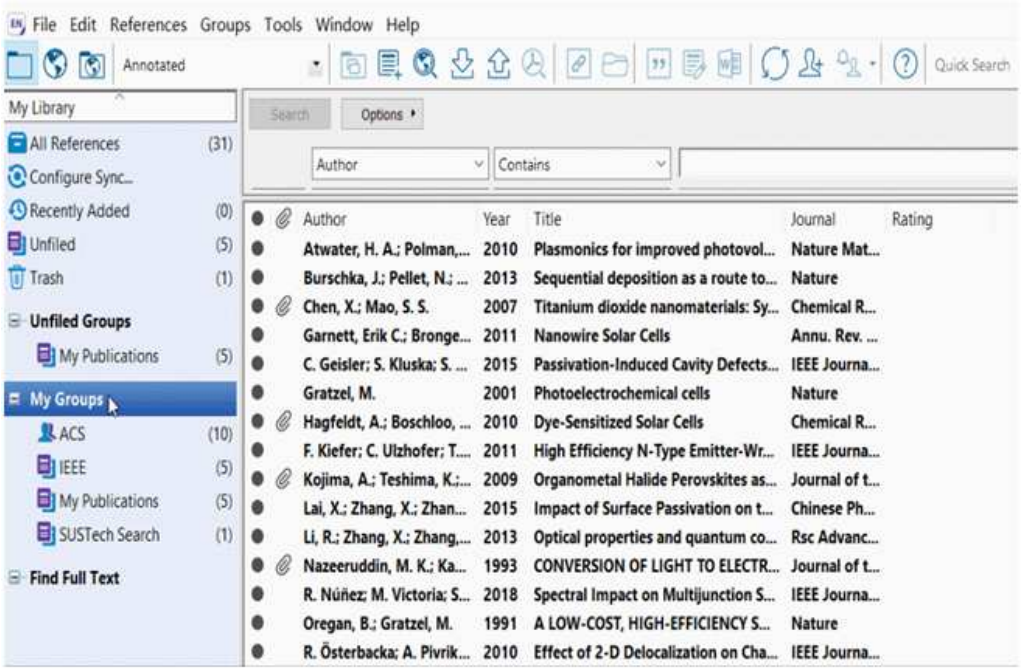
- Not allow you to edit subscript and superscript characters in the title. For instance, number 2 in H2O needs to be in a small subscript which cannot be done through it.

Pricing/Free Version

- Free Version available with up to 2GB of cloud storage.
- Paid plans start from $4.99/month.

14.4.2 End Note

Endnote software is used to manage and import references. It can help Ph.D. students with compiling, storing, and managing references. Endnote desktop software helps to create citations and bibliographies. It also allows for the sharing of references with colleagues.



sustech.libguides.com

Strengths

- Endnote basic allows you to search databases and import citation info in Microsoft word.
- It has both online and offline options, the ability to edit output styles based on Journal requirements, and allows you to attach pdfs to references.

Weakness

- Does NOT work well with Google Drive
- Not free and takes longer to learn

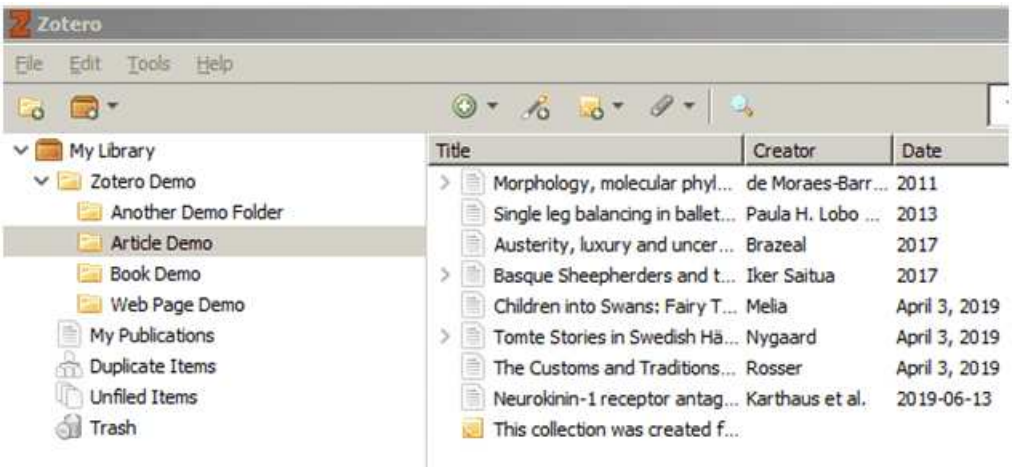
Pricing/Free Version

- Free 30-day trial available.
- Paid version comes with a one-time cost of $99.

14.4.3 Zotero

Zotero is a reference management software that can be used by students and researchers of all levels. It's a great way to keep track of your sources, as well as easily create citations and bibliographies. Here are some of the ways Zotero can be especially helpful for Ph.D. students.

Zotero helps you stay organized by allowing you to collect and save information about your sources in one place.It can be used to create citation information and bibliographies in no time, so you can spend less time on paperwork and more time on your research.Zotero integrates with many popular word processing programs, so you can easily use it as a citation management program for your papers as you write them.



fondrenlearning.blogs.rice.edu

Strengths

- It is an open-source and free citation management software.
- Works as a plugin to your web-based browser thus allowing one-click import of the references.
- It also has social features(shared bibliographies) and can import BibTeX and export to various word processing software (MS Word, Latex, etc.)
- Zotero saves your citation library to your local computer but syncs with multiple computers so you can work from wherever you want.

Weakness

- The only shortcoming I noticed is that it does not work with WordPress, where I write a lot of my papers. Although there is a WordPress widget for Zotero, it still needs some work.

Pricing/Free Version

- Free plan available.

14.4.4 Docear

Docear is one of the most unique and powerful reference management tools that helps researchers manage their references and PDFs. It integrates a number of features, such as PDF management, reference management, mind mapping, and note-taking. Because of its versatile features, Docear is an ideal tool for students, academics, and professionals.

Strengths

- Not just a reference manager, but also a composer of all research work.
- Very good for drafting your new paper by automatically including all of your comments in pdf files in your word file.

Weakness

- Might not be easy to understand at first, as it has a unique way of handling all of your references.

Pricing/Free Version

- Free – open source

14.4.5 Citavi

Citavi is incredibly versatile which makes it so popular among academic researchers. It can be used to manage references for all types of research projects, from essays and theses to books and articles. This makes it an essential tool for any researcher who wants to stay organized and efficient. Citavi is easy to use. It's simple enough that even novice researchers can quickly learn how to use it without any trouble. But it's also powerful enough that more experienced researchers will appreciate all its features.

Strengths

- Compatible with the most common writing software that makes it easy to get your manuscript done in a brief period.
- It is easy to handle and is able to sort all the things you will need in your research(references, notes, tasks).
- Citavi's Add-In for MS Word and its LaTeX support ensures accurate citations. You can choose the style of the bibliography you want automatically inserted. There are over 10,000 professional citation styles available for all academic disciplines.

Weakness

- The software is not always compatible with all devices, which can be a problem for researchers who want to work on their references on the go.

Pricing/Free Version

- Free trial available

14.4.6 Wizfolio

There are a number of different software options available for reference management, each with its own pros and cons. But if you're looking for software that can help you manage your references effectively and efficiently, Wizfolio is definitely worth considering.

Wizfolio is a cloud-based reference management software that was designed specifically for academic researchers. It allows you to quickly and easily gather all of your references in one place, as well as organize them according to your own personal preferences. Wizfolio also comes with a number of helpful features that make it fairly convenient to use.

Strengths

- It integrates with the web browser and word processing software.
- The web browser integration is very useful as all you have to do is click to add a page as a reference. It is also an operating system independent.
- It also integrates with WordPress and allows you to easily share references easily between researchers.

Weakness

- It can be difficult to keep track of all your references if you don't use the software correctly.

Pricing/Free version

- Contact Wizfolio to get a customized quote.

14.4.7 Paperpile

If you're an academic researcher, Paperpile should be your go-to reference management software. It's designed specifically for academics, making it the perfect choice for those who need to keep track of a large number of citations. Paperpile makes it easy to import references from a variety of sources, including PubMed, Google Scholar, and Web of Science.

It also has powerful search features that allow you to quickly find the information you need. And if you're working on a collaborative project, Paperpile makes it easy to share references with your colleagues.

Strengths

- They can link to your Google account, so theoretically, you'll have 15GB of storage and a nice Chrome extension, so adding papers to your library is incredibly simple. In addition, Google Docs integration for citations is available, and a beta test for Word is currently underway.
- Paperpile is a web-based reference management software that makes it easy to import references from databases, journals, and websites.
- It automatically formats citations and bibliographies in a variety of styles, including APA, MLA, and Chicago.

Weakness

- Paperpile is not as comprehensive as some of the other software options available.

Pricing/Free Version

- Free to use for one user and two papers.
- Paid plans from $2.99/month.

14.4.8 RefWorks

If you're an academic researcher, then you know the importance of using the right tools for the job. And when it comes to reference management, there's no better tool than RefWorks. RefWorks is a web-based application that allows you to create and manage your references from anywhere in the world. With RefWorks, you can easily import citations from databases, journals, and websites, and then create bibliographies in any format you need.

But perhaps the best thing about RefWorks is its collaborative features. With RefWorks, you can share your references with colleagues or classmates and work together on projects. You can also create groups to collaborate on research topics.

Strengths

- Has Proprietary, Operating system support, Export file formats, Citation styles and Word processor integration.
- Offers partial support for reference list file formats.
- Supports import file formats.

Weakness

- Does not have database connectivity.
- Doesn't store copies of articles.

Pricing/Free Version

- Free trial subscription available.
- Get a customized quote from the sales team.

14.4.9 Papers

Papers is a Mac OS X and Windows reference management program for academic researchers and Ph.D. students used for managing bibliographies and references for writing essays and articles. It's mostly used to collect references and maintain a PDF document library, but it also offers a unified interface for document repository searches, metadata editing, full screen viewing, and a range of document import and export options.

Strengths

- It is very easy to fill with PDFs and bibliographic data can easily added.
- It is integrated well to work with Word for Mac.
- It is available for the iPhone/iPad, which offers the opportunity to carry all your references with you in your smartphone.

Weakness

- Many users have complained about the software's clunky interface and how difficult it can be to navigate.

Pricing/Free Version

- 30 day free trial available.
- From $3/month.

14.4.10 Sciwheel

SciWheel is a referencing software that can be very significant for academic researchers. It helps manage references, PDFs, notes, and ideas. SciWheel has a powerful search engine that makes it easy to find any document you need. It also allows you to create groups for your documents, making it easy to keep track of your research.

Strengths

- A user-friendly interface that is easy to learn and use.
- Integrated search capabilities that allow you to search for information both inside and outside of SciWheel.
- Collaborative features that allow you to share information with other researchers.

Weakness

- The software can be slow and cumbersome at times.
- It can be difficult to find information that is buried deep in the system.

Pricing/Free Version

- Free plan available.
- From $9.95/month.

14.5 Guide to Best Referencing Softwares for Academic Research

When looking for referencing software, it's important to consider the features that will be most helpful for academic researchers. Some features include:

1) The ability to import citations from a variety of sources, including online databases, journals, and the internet.
2) The ability to organize citations into folders or groups.
3) The ability to create bibliographies or reference lists in a variety of formats, such as MLA, APA, and Chicago.
4) The ability to export citations and bibliographies into Word documents or PDFs.
5) A search function that allows you to quickly find the citation you need.
6) A user-friendly interface that allows for quick and efficient organization.

14.6 Summary

In scholarly articles and research documents, citations play an important role for both researchers and readers. It is also very time-consuming to integrate these citations accurately into research documents without the aid of referencing software. In this chapter, the most common referencing softwares used in research are discussed with their strengths and weaknesses.

14.7 Glossary

- **Referencing software**: is a program or online service that helps to collect, organize, cite, and share the research sources.
- **References:** comprise all documents including journals, books, technical Reports, computer programmers and unpublished works mentioned in the text of the Report.
- **Bibliography**: contains everything that is included in the Reference section plus other publications which are useful but were not cited in text or manuscript.
- **APA style**: uses the author/date method of citation in which the author's last name and the year of the publication are inserted in the actual text of the paper. It is the style recommended by the American Psychological Association and used in many of the social sciences.

14.8 Answers to Self-Check Exercises

1. What are the uses of referencing software for academic research
2. Write a note on Mendeley referencing software
3. How does EndNote referencing software use for academic research.

14.9 Suggested Readings

- Bhandarkar, P.L. and Wilkinson, T.S. (2016). Methodology and Techniques of Social Research. Himalaya Publishing House: New Delhi.
- Donald R. Cooper and Pamela S. Schindler. (2006). Business Research Methods. 9th Edition, Tata McGraw Hill.
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- Gupta, S.P. (2021). Statistical Method (46th edition), Sultan Chand and Sons, New Delhi.
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- Rao K.V. (1993). Research Methodology in Commerce and Management, Sterling Publishers Private Limited: New Delhi.

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- Sekaran, U. (2006). Research methods for Business, Wiley India, New Delhi.
- Thakur, H.K. (2021). Research Methodology in Social Sciences. Corvette Press, New Delhi.

14.10 Terminal Questions

1. Discuss the most common referencing softwares used for academic research with their strengths and weaknesses.

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