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RESEARCH METHODOLOGY

M.A (H.R.M), Semester – II, Paper-IV

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FOREWORD

Since its establishment in 1976, Acharya Nagarjuna University has been forging ahead in the path of progress and dynamism, offering a variety of courses and research contributions. I am extremely happy that by gaining 'A' grade from the NAAC in the year 2016, Acharya Nagarjuna University is offering educational opportunities at the UG, PG levels apart from research degrees to students from over 443 affiliated colleges spread over the two districts of Guntur and Prakasam.

The University has also started the Centre for Distance Education in 2003-04 with the aim of taking higher education to the door step of all the sectors of the society. The centre will be a great help to those who cannot join in colleges, those who cannot afford the exorbitant fees as regular students, and even to housewives desirous of pursuing higher studies. Acharya Nagarjuna University has started offering B.A., and B.Com courses at the Degree level and M.A., M.Com., M.Sc., M.B.A., and L.L.M., courses at the PG level from the academic year 2003-2004 onwards.

To facilitate easier understanding by students studying through the distance mode, these self-instruction materials have been prepared by eminent and experienced teachers. The lessons have been drafted with great care and expertise in the stipulated time by these teachers. Constructive ideas and scholarly suggestions are welcome from students and teachers involved respectively. Such ideas will be incorporated for the greater efficacy of this distance mode of education. For clarification of doubts and feedback, weekly classes and contact classes will be arranged at the UG and PG levels respectively.

It is my aim that students getting higher education through the Centre for Distance Education should improve their qualification, have better employment opportunities and in turn be part of country's progress. It is my fond desire that in the years to come, the Centre for Distance Education will go from strength to strength in the form of new courses and by catering to larger number of people. My congratulations to all the Directors, Academic Coordinators, Editors and Lesson- writers of the Centre who have helped in these endeavors.

Prof. P. Raja Sekhar
Vice-Chancellor (FAC)
Acharya Nagarjuna University

RESEARCH METHODOLOGY

SYLLABUS

UNIT – I

Scientific Method and Social Phenomena Meaning of Research-Objectives of Research Motivation in Research- Types of Research - Research Approaches - Significance of Research - Research Methods versus Methodology- Research and Scientific Method Importance of Knowing How Research is Done - Research Process -Criteria of Good Research

UNIT–II

Formulating A Research Problem and Research Design

Reviewing the literature- The place of the literature review in research Bringing clarity and focus to your research problem Meaning of Research Design Need for Research Design-Features of a Good Design-Important Concepts Relating to Research Design-Different Research Designs-Basic Principles of Experimental Designs

UNIT – III

Sampling : Random, stratified Random, Cluster and Purposive sampling; Data collection and Research Tools : Documentary Information, Observating, Interview, Questionnaire, Schedule, Interview Guide, Scaling Techniques : Likert, Gutman and Thurstone scales. Pilot Study; and pretesting for validity and reliability of the tools. Data analysis : Qualitative and Quantitative Data analysis,

UNIT – IV

Constructing hypotheses The definition of a hypothesis The functions of a hypothesis The testing of a hypothesis, The characteristics of a hypothesis, Types of hypothesis, Errors in testing a hypothesis Hypotheses in qualitative research

UNIT – V

Interpretation and Report Writing-Techniques of Interpretation, Precaution, Significance of Report writing, Different steps in Report Writing, Layout of Research Report, Type of Reports, Oral Presentation, Mechanisms of Report writing, Precautions of Writing Reports

Prescribed Books:

Allen L. Edward : Techniques of Attitude Scale Construction
Festnger and Katz : Research Methods in Behavioural Sciences.
Elhance : Fundamentals of Statistics
Goode and Hatt : Methods in Social Research.
Gopal, H.M. : Introduction to the study of Research Procedures in Social Sciences.
Gupta C.B. : Statistical Methods
Gupta S.P. : Statistical Methods
ICSSR Survey Reports : I.C.S.S.R. Publication.
Michael V.B. : Research Methodology in Management
Sadhu and Singh : Research Methodology in Social Sciences.
Singh V.B (Ed) : Labour Research in India .
Young P.V. : Scientific Social Surveys and Research

CONTENTS

LESSON - 1

INTRODUCTION TO RESEARCH

Learning Objectives

- ✓ To study the Characteristic of Research
- ✓ To Understand the Objectives of Research
- ✓ To know Types of Research
- ✓ To learn The Research Process

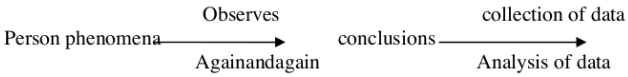
Structure

1.0 Introduction

The unique characteristic of human mind is the curiosity to know about the universe. Innumerable questions arise in our mind about our environment, planet and the universe. Most of these questions starting with what, why, how and soon. For example, what are stars? why day and night alternate? How is rain formed and why the mode of life and activities of human beings vary from place to place? Whenever such questions arise, we seek answer to them or we try to find out solutions to them. Seeking answers to questions and finding solutions to the problems have been thebasis of human progress. A systematic search for an answer to a question or a solution to a problem is called research.

Actually, research is simply the process of arriving as dependable solution to a problem through the planned and systematic collection, analysis and interpretation of a data. Research is the most important process for advancing knowledge for promoting progress and to enable man to relate more effectively to his environment to accomplish his purpose and to

solve his conflicts. Although it is not the only way, it is one of the most effective ways of solving problems. The term research consists of two words,' Re'+'Search'. "Re" means again and again and "Search" means to find out something. The following is the process;



Therefore, the research is a process of which a person observes the phenomena again and again and collects the data and on the basis of data he draws some conclusions.
Research seeks to find out explanations to unexplained phenomena to clarify the doubtful propositions and to correct the misconceived facts. It simply means a search for facts, answer to questions and solutions to problems. The search for facts may be made through either
(a) arbitrary (unscientific) method or
(b) scientific method.

Arbitrary method of seeking answer to questions is based on imagination, blind belief or impression. It is vague and inaccurate.

Scientific method is a systematic rational approach to seeking fact. It is objective, precise and arrives at conclusions on the basis of verifiable evidences. Hence research is systematic and logical study of an issue problem or phenomenon through scientific method. Following definitions may reveal the proper meaning of the concept of research.

1.1 Definition of Research

a) According to Black and Champion, "scientific research consists of obtaining information through empirical observation that can be used for systematic development of logically related propositions attempting to establish casual relations among variable".
b) Emory defines research as "any organized inquiry designed and carried out to provide information for solving a problem".
c) Kerlinger defines research as a" systematic, controlled, empirical and critical investigation of hypothetical relations among natural phenomena".
d) L.V. Redman and A.V.H. Morry have defined "systematic effort to gain new knowledge we call research".

1.2 Characteristic of Research

The above definitions reveal the following characteristics of research.
a) Research is a systematic and critical investigation to a phenomenon.
b) It aims at interpreting and explaining a phenomenon.
c) It adopts scientific method.
d) It is based on empirical evidences and observable experience.
e) It develops generalizations, principles or theories.
f) It directed towards finding answer to the questions and solutions to the problems.

1.3 objectives of research

The objectives of research are varied. They are,
a) Research extends knowledge of human beings' social life and environment.

b) Research reveals the mysteries of nature.
c) Research establishes generalizations and general laws and contributes to theory building in various fields of knowledge.
d) Research verifies and tests existing facts and theory.
e) Research helps us to improve our knowledge and ability to handle situation.
f) General laws developed through research may enable us to make reliable predictions of events.
g) Research aims to analyze inter-relationship between variables and to derive causal explanations, which help us to better understanding of the world in which we live.
h) Research aims to finding solutions to the problem, e.g.:- socio-economic problems, health problems, organizational and human relational problems and so on…
i) Research also aims at developing new tools, concepts and theories for better understanding to unknown phenomena.
j) Research helps national planning board to focus our national development. It enables the planners to evaluate alternative strategies, on-going programs and evaluation etc.,
k) Research provides functional data for rational decision making and formulation of strategies and policies.

1.4 Types of Research

It is imperative that a marketer has to have a broad understanding of the various types of research, in general. There are eleven types of research depending on whether it is primarily "fundamental" or "applied" in nature. They are as follows:

1. **Applied research,** also known as *decisional research,* use existing knowledge as an aid to the solution of some given problem or set of problems.

2. **Fundamental research,** frequently called basic or pure research, seeks to extend the boundaries of knowledge in a given area with no necessary immediate application to existing problems.

3. **Futuristic research:** Futures research is the systematic study of possible future conditions. It includes analysis of how those conditions might change as a result of the implementation of policies and actions, and the consequences of these policies and actions.

4. **Descriptive research** includes surveys and fact-finding enquiries of different kinds. It tries to discover answers to the questions who, what, when and sometimes how. Here the researcher attempts to describe or define a subject, often by creating a profile of a group of problems, people, or events. The major purpose of descriptive research is description of the state of affairs as it exists at present

5. **Explanatory research***:* Explanatory research goes beyond description and attempts to explain the reasons for the phenomenon that the descriptive research only observed. The research would use theories or at least hypothesis to account for the forces that caused a certain phenomenon to occur.

6. **Predictive research***:* If we can provide a plausible explanation for an event after it has occurred, it is desirable to be able to predict when and in what situations the event will

occur. This research is just as rooted in theory as explanation. This research calls for a high order of inference making. In business research, prediction is found in studies conducted to evaluate specific courses of action or to forecast current and future values.

7. **Analytical research***:* The researcher has to use facts or information already available, and analyse these to make a critical evaluation of the material.

8. **Quantitative research***:* Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity.

9. **Qualitative research***:* It is concerned with qualitative phenomenon (i.e.) phenomena relating to or involving quality or kind. This type of research aims at discovering the underlying motives and desires, using in depth interviews for the purpose. Other techniques of such research are word association test, sentence completion test, story completion tests and similar other projective techniques. Attitude or opinion research i.e., research designed to find out how people feel or what the think about a particular subject or institution is also qualitative research.

10.**Conceptual research***:* Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones.

11.**Empirical research***:* It is appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a give hypothesis.

1.5 The Research Process

Eight Steps in Research Process

There are a variety of approaches to research in any field of investigation, irrespective of whether it is applied research or basic research. Each particular research study will be unique in some ways because of the particular time, setting, environment, and place in which it is being undertaken.Nevertheless, all research endeavors share a common goal of furthering our understanding of the problem and thus all traverse through certain basic stages, forming a process called the research process.
An understanding of the research process is necessary to effectively carry out research and sequencing of the stages inherent in the process.
These 8 stages in the research process are;

- Identifying the problem.
- Reviewing literature.
- Setting research questions, objectives, and hypotheses.
- Choosing the study design.
- Deciding on the sample design.
- Collecting data.
- Processing and analyzing data.

- Writing the report.

The research process outlined above is, in essence, part and parcel of a research proposal. It is an outline of your commitment that you intend to follow in executing a research study.

A close examination of the above stages reveals that each of these stages, by and large, is dependent upon the others.
One cannot analyze data (step 7) unless he has collected data (step 6). It is also true that one cannot write a report (step 8) unless he has collected and analyzed data (step 7).
Research then is a system of interdependent related stages. Violation of this sequence can cause irreparable harm to the study. It is also true that several alternatives are available to the researcher during each of the stages stated above. A research process can be compared with a route map. The map analogy is useful for the researcher because at each stage of the research process, and there are several alternatives to follow.

Choosing the best alternative in terms of time constraints, money, and human resources in our research decision is our primary goal.

Before explaining the stages of the research process, we explain the term 'iterative' appearing within the oval-shaped diagram at the center of the schematic diagram. The key to

a successful research project ultimately lies in iteration: the process of returning again and again to the identification of the research problems, methodology, data collection, etc. which lead to new ideas, revisions and improvements.

Often, by discussing the research project with advisers and peers, one will find that new research questions need to be added, variables to be omitted, added or redefined, and other changes to be made. As a proposed study is examined and reexamined from different perspectives, it may begin to transform and take a different shape.

This is to be expected and is an essential component of a good research study.

Besides, it is important to examine study methods and data to be collected from different viewpoints to ensure a comprehensive approach to the research question.

In conclusion, there is seldom any single strategy or formula for developing a successful research study, but it is important to realize that the research process is cyclical and iterative.

Step – 1: Identifying the Problem

The first and foremost task in the entire process of scientific research is to identify a research problem. A well-identified problem will lead the researcher to accomplish all-important phases of the research process, starting from setting objectives to the selection of the research methodology.

But the core question is: whether all problems require research. We have countless problems around us, but all that we encounter do not qualify as research problems, and thus, these do not need to be researched. Keeping this point in view, we must draw a line between a research problem and a non-research problem. Intuitively, researchable problems are those who have a possibility of thorough verification investigation, which can be affected through the analysis and collection of data, while the non-research problems do not need to go through these processes.

Researcher need to identify both Non-research Problem, and Research Problem.

Non-Research Problem

A non-research problem is one that does not require any research to arrive at a solution. Intuitively, a non-researchable problem consists of vague details and cannot be resolved through research.

It is a managerial or built-in problem that may be solved at the administrative or management level. The answer to any question raised in a non- research setting is almost always obvious. The outbreak of cholera, for example, following a severe flood, is a common phenomenon in many communities. The reason for this is known. It is thus not a research problem. Similarly, reasons for the sudden rise in prices of many essential commodities following the announcement of the budget by the finance minister need no investigation. Hence it is not a problem that needs research.

Example A recent survey in District A found that 1000 women were continuous users of contraceptive pills. But last month's service statistics indicate that none of these women were using contraceptive pills (Fisher et al. 1991:4). The discrepancy is that 'all 1000 women should have been using a pill, but in fact, none is doing so. The question is: why the discrepancy exists? Well, the fact is, a monsoon flood has prevented all new supplies of pills reaching District A, and all old supplies have been exhausted. Thus, although the problem situation exists, the reason for the problem is already known. Therefore, assuming that all the facts are correct, there is no reason to research the factors associated with pill discontinuation among women. This is thus a non-research problem.

Here are some of the problems we frequently encounter, which may well be considered as non-research problems:

- Rises in the price of warm clothes during winter;
- Preferring admission in public universities over private universities;
- Crisis of accommodations in sea resorts during summer
- Traffic jam in the city street after office hours;
- High sales in department stores after an offer of a discount.

Research Problem

In contrast to a non-research problem, a research problem is of primary concern to a researcher.

A research problem is a perceived difficulty, a feeling of discomfort, or a discrepancy between the common belief and reality.

As noted by Fisher et al. (1993), a problem will qualify as a potential research problem when the following three conditions exist:

There should be a perceived discrepancy between "what it is" and "what it should have been." This implies that there should be a difference between "what exists" and the "ideal or planned situation"; A question about "why" the discrepancy exists. This implies that the reason(s) for this discrepancy is unclear to the researcher (so that it makes sense to develop a research question); and There should be at least two possible answers or solutions to the questions or problems. The third point is important. If there is only one possible and plausible answer to the question about the discrepancy, then a research situation does not exist.

It is a non-research problem that can be tackled at the managerial or administrative level.

Example The Government of Bangladesh has been making all-out efforts to ensure regular flow of credit in rural areas at a concession rate through liberal lending policy and establishing a large number of bank branches in rural areas. Knowledgeable sources indicate that expected development in rural areas has not yet been achieved mainly because of improper utilization of the credit. More than one reason is suspected of such misuse or misdirection. These include, among others: Diversion of credit money to some unproductive sectors Transfer of credit money to other people like money lenders, who exploit the rural people with this money Lack of knowledge of proper utilization of the credit.

Step – 2: Reviewing of Literature

A review of relevant literature is an integral part of the research process. It enables the researcher to formulate his problem in terms of the specific aspects of the general area of his interest that has not been so far researched.

Such a review, not only provides him exposure to a larger body of knowledge but also equips him with enhanced knowledge to efficiently follow the research process.

Through a proper review of the literature, the researcher may develop the coherence between the results of his study and those of the others.

A review of previous documents to similar or related phenomena is essential even for the beginning researchers. To ignore the existing literature may lead to wasted effort on the part of the researchers. Why spend time merely repeating what other investigators have already done? If the researcher is aware of earlier studies of his topic, or related topics, he will be in a much better position to assess the significance of his work and to convince others that it is important. A confident and expert researcher is more crucial in his questioning of the others'

methodology, the choice of the data, and the quality of the inferences drawn from the study results.
In sum, we enumerate the following arguments in favour of reviewing the literature:

- It avoids duplication of the work that has been done in the recent past.
- It helps the researcher to find out what others have learned and reported on the problem.
- It helps the researcher to become familiar with the types of methodology followed by others.
- It helps the researcher to understand what concepts and theories are relevant to his area of investigation.
- It helps the researcher to understand if there are any significant controversies, contradictions, and inconsistencies in findings.
- It allows the researcher to understand if there are any unanswered research questions.
- It might help the researcher to develop an analytical framework.
- It will help the researcher to consider the inclusion of variables in his research that he might not otherwise have thought about.

Step – 3: Setting research questions, objectives, and hypotheses
After discovering and defining the research problem, researchers should make a formal statement of the problem leading to research objectives.
An objective will precisely say what should be researched, to delineate the type of information that should be collected, and provide a framework for the scope of the study. The best expression of a research objective is a well-formulated, testable research hypothesis.
A hypothesis is an unproven statement or proposition that can be refuted or supported by empirical data. Hypothetical statements assert a possible answer to a research question.

Step -4: Choosing the study design
The research design is the blueprint or framework for fulfilling objectives and answering research questions.
It is a master plan specifying the methods and procedures for collecting, processing, and analyzing the collected data. There are four basic research designs that a researcher can use to conduct his or her study;

- survey,
- experiment,
- secondary data study, and
- observational study.

Step – 5: Deciding on the sample design
Sampling is an important and separate step in the research process. The basic idea of sampling is that it involves any procedure that uses a relatively small number of items or portions (called a sample) of a universe (called population) to conclude the whole population. It contrasts with the process of complete enumeration, in which every member of the population is included. Such a complete enumeration is referred to as census.

A population is the total collection of elements about which we wish to make some inference or generalization. A sample is a part of the population, carefully selected to represent that population. If certain statistical procedures are followed in selecting the sample, it should have the same characteristics as the population as a whole. These

procedures are embedded in the sample design. Sample design refers to the methods to be followed in selecting a sample from the population and the estimating technique, vis-a-vis formula for computing the sample statistics.
The basic question is, then, how to select a sample?
To answer this question, we must have acquaintance with the sampling methods.

These methods are basically of two types: probability sampling and non-probability sampling. Probability sampling ensures every unit a known nonzero probability of selection within the target population. If there is no feasible alternative, a non-probability sampling method may be employed.

The basis of such selection is entirely dependent on the researcher's discretion. This approach is variously called judgment sampling, convenience sampling, accidental sampling, and purposive sampling.

The most widely used probability sampling methods are simple random sampling, stratified random sampling, cluster sampling, and systematic sampling. They have been classified by their representation basis and unit selection techniques.

Two other variations of the sampling methods that are in great use are multistage sampling and probability proportional to size (PPS) sampling. Multistage sampling is most commonly used in drawing samples from very large and diverse populations.
The PPS sampling is a variation on multistage sampling in which the probability of selecting a cluster is proportional to its size, and an equal number of elements are sampled within each cluster.

Step – 6: Collecting data

The gathering of data may range from simple observation to a large-scale survey in any defined population. There are many ways to collect data. The approach selected depends on the objectives of the study, the research design, and the availability of time, money, and personnel. With the variation in the type of data (qualitative or quantitative) to be collected, the method of data collection also varies. The most common means for collecting quantitative data is the structured interview. Studies that obtain data by interviewing respondents are called surveys. Data can also be collected by using self-administered questionnaires. Telephone interviewing is another way in which data may be collected. Other means of data collection include the use of secondary sources, such as the census, vital registration records, official documents, previous surveys, etc.

Step-7: Processing and Analyzing Data

Data processing generally begins with the editing and coding of data. Data are edited to ensure consistency across respondents and to locate omissions, if any.
In survey data, editing reduces errors in the recording, improves legibility, and clarifies unclear and inappropriate responses. In addition to editing, the data also need coding. Because it is impractical to place raw data into a report, alphanumeric codes are used to reduce the responses to a more manageable form for storage and future processing. This coding process facilitates processing the data. The personal computer offers an excellent opportunity in data editing and coding processes. Data analysis usually involves reducing accumulated data to a manageable size, developing summaries, searching for patterns, and applying statistical techniques for understanding and interpreting the findings in the light of the research questions.

Further, the researcher, based on his analysis, determines if his findings are consistent with the formulated hypotheses and theories.

The techniques to be used in analyzing data may range from simple graphical technique to very complex multivariate analysis depending on the objectives of the study, research design employed, and the nature of data collected.

As in the case of methods of data collection, an analytical technique appropriate in one situation may not be appropriate for another.

Step-8: Writing the report – Developing Research Proposal, Writing Report, Disseminating and Utilizing Results

The entire task of a research study is accumulated in a document called a proposal.

A research proposal is a work plan, prospectus, outline, an offer, a statement of intent or commitment from an individual researcher or an organization to produce a product or render a service to a potential client or sponsor.

The proposal will be prepared to keep in view the sequence presented in the research process. The proposal tells us what, how, where, and to whom it will be done.

It must also show the benefit of doing it. It always includes an explanation of the purpose of the study (the research objectives) or a definition of the problem.

It systematically outlines the particular research methodology and details the procedures that will be utilized at each stage of the research process.

The end goal of a scientific study is to interpret the results and draw conclusions.

1.6 Role of Information in Problem Formulation

Problem formulation starts with a sound information seeking process by the researcher. The decision maker is the provider of information pertaining to the problem at the beginning of the research process (problem formulation) as well as the user of the information that germinates at the end of the research process. Given the importance of accurate problem formulation, the research should take enough care to ensure that information seeking process should be well within the ethical boundaries of a true research. The researcher may use different types of information at the problem formulation stage. They are:

1. Subjective information termed as those based on the decision maker"s past experiences, expertise, assumptions, feelings or judgments without any systematic gathering of facts. Such information is usually readily available.
2. Secondary information are those collected and interpreted at least once for some specific situation other than the current one. Availability of this type of information is normally high.
3. Primary information refers to firsthand information derived through a formalized research process for a specific, current problem situation.

In order to have better understanding on problem formulation, the researcher may tend to categorize the information collected into four types. The categorization of the information is done based on the quality and complexity of the information collected. They are:

1. Facts are some pieces of information with very high-quality information and a higher degree of accuracy and reliability. They could be absolutely observable and verifiable. They are not complicated and are easy to understand and use.
2. Estimates are information whose degree of quality is based on the representativeness of the fact sources and the statistical procedures used to create them. They are more complex than facts due to the statistical procedures involved in deriving them and the likelihood of errors.
3. Predictions are lower quality information due to perceived risk and uncertainty of future conditions. They have greater complexity and are difficult to understand and use for

decision-making as they are forecasted estimates or projections into the future.

4. Relationships are information whose quality is dependent on the precision of the researcher"s statements of the interrelationship between sets of variables. They have the highest degree of complexity as they involve any number of relationships paths with several variables being analysed simultaneously.

1.7Approaches to the Problem

The outputs of the approach development process should include the following components: (i) Objective/theoretical framework (ii) analytical model (iii) Research questions (iv) hypothesis. Each of these components is discussed below:

(i) Objective/theoretical framework: Every research should have a theoretical framework and objective evidence. The theoretical framework is a conceptual scheme containing:

a set of concepts and definitions

a set of statements that describes the situations on which the theory can be applied a set of relational statements divided into: axioms and theorems

The theoretical evidence is very much imperative in research as it leads to identification of variables that should be investigated. They also lead to formulating the operational definition of the marketing problem. An operational definition is a set of procedures that describe the activities one should perform in order to establish empirically the existence or degree of existence of a concept.

application of the concepts. Operational definition would specify a procedure that involves say, for example, a weighing machine that measures the weight of a person or an object.

(ii) Analytical model: An analytical model could be referred to as a likeness of something. It consists of symbols referred to a set of variables and their interrelationships represented in logical arrangements designed to represent, in whole or in part, some real system or process. It is a representation of reality making explicit the significant relationships among the aspects. It enables the formulation of empirically testable propositions regarding the nature of these relationships. An empirical model refers to research that uses data derived from actual observation or experimentation.

(iii) Research Questions: Research questions are refined statements of the specific components of the problem. It refers to a statement that ascertains the phenomenon to be studied. The research questions should be raised in an unambiguous manner and hence, would help the researcher in becoming resourceful in identifying the components of the problem. The formulation of the questions should be strongly guided by the problem definition, theoretical framework and the analytical model. The knowledge gained by the researcher from his/her interaction with the decision maker should be borne in mind as they sometimes form the basis of research questions.

The researcher should exercise extreme caution while formulation research questions as they are the forerunner for developing hypothesis. Any flaw in the research questions may lead to flawed hypothesis. The following questions may be asked while developing research questions:

Operationalizing the concept gives more understanding on the meanings of the concepts specified and explication of the testing procedures that provide criteria for the empirical

a) Do I know the area of investigation and its literature?
b) What are the research questions pertinent to the area of investigation?
c) What are the areas that are not explored by the previous researchers?
d) Would my study lead to greater understanding on the area of study?
e) Are enough number of literatures available in this topic area?
f) Is my study a new one thus contributing to the society or has it been done before?

(iv) Hypothesis: Hypothesis could be termed as tentative answers to a research problem. The structure of a hypothesis involves conjectural statements relating to two or more variables. They are deduced from theories, directly from observation, intuitively, or from a combination of these. Hypothesis deduced from any of the means would have four common characteristics. They should be clear, value-free, specific and amenable to empirical testing. Hypothesis could be viewed as statements that indicate the direction of the relationship or recognition of differences in groups. However, the researcher may not be able to frame hypotheses in all situations. It may be because that a particular investigation does not warrant a hypothesis or sufficient information may not be available to develop the hypotheses.

1.8 Summary

The unique characteristic of human mind is the curiosity to know about the universe. Innumerable questions arise in our mind about our environment, planet and the universe. Most of these questions starting with what, why, how and soon.

Problem formulation starts with a sound information seeking process by the researcher. The decision maker is the provider of information pertaining to the problem at the beginning of the research process (problem formulation) as well as the user of the information that germinates at the end of the research process. Given the importance of accurate problem formulation, the research should take enough care to ensure that information seeking process should be well within the ethical boundaries of a true research. The researcher may use different types of information at the problem formulation stage.

1.9 Key words

Applied research-also known as decisional research, use existing knowledge as an aid to the solution of some given problem or set of problems.

Fundamental research- frequently called basic or pure research, seeks to extend the boundaries of knowledge in a given area with no necessary immediate application to existing problems.

Futuristic research-Futures research is the systematic study of possible future conditions. It includes analysis of how those conditions might change as a result of the implementation of policies and actions, and the consequences of these policies and actions.

Descriptive research- includes surveys and fact-finding enquiries of different kinds. It tries to discover answers to the questions who, what, when and sometimes how.

Explanatory research-Explanatory research goes beyond description and attempts to explain the reasons for the phenomenon that the descriptive research only observed.

Quantitative research-Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity.

Qualitative research-It is concerned with qualitative phenomenon (i.e.) phenomena relating to or involving quality or kind.

Conceptual research- Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones.

1.10 Self-Assessment Questions

1) Definition Of Research and the Characteristic of Research?
2) What are the objectives of research?
3) Explicate the types of research?
4) Elucidate Research Process and Problem Identification?
5) What are the Role Of Information In Problem Formulation?
6) Explain the Approaches to the Problem?

1.11 Suggested Readings

1. Allen L. Edward: Techniques of Attitude Scale Construction
2. Festnger and Katz: Research Methods in Behavioural Sciences.
3. Elhance : Fundamentals of Statistics
4. Goode and Hatt : Methods in Social Research.
5. Gopal, H.M.: Introduction to the study of Research Procedures in Social Sciences.
6. Gupta C.B.: Statistical Methods
7. Gupta S.P. : Statistical Methods
8. ICSSR Survey Reports : I.C.S.S.R. Publication.
9. Michael V.B. : Research Methodology in Management
10. Sadhu and Singh : Research Methodology in Social Sciences.
11. Singh V.B (Ed) : Labour Research in India .
12. Young P.V. : Scientific Social Surveys and Research

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LESSON -2

SCIENTIFIC METHOD AND SOCIAL SCIENCE PHENOMENA

Learning Objectives

- ✓ To discuss Essentials of scientific method & Basis of scientific method
- ✓ To study Difficulties in the use of scientific methods in social science research
- ✓ To examine the Contribution of research to theory
- ✓ To Know the Social Science Research Meaning and Scope
- ✓ To learn the Characteristics of Social science Research
- ✓ To identify Nature of Social Science Research

Structure

2.0 Introduction

All scientists use common methods for their enquiry. All sciences whether natural or social agree up on methods of studying phenomena. But their materials differ. A biologist studying the structure of some flowers, a chemist studying radioactive properties of an element and a sociologist studying crime situation in an urban slum. All follows similar scientific methods of inquiry. But their subjects of study are different. Therefore, they use different techniques of investigation for their study. As their materials are different, their purposes also differ. All of them will observe the phenomenon and analyze them to find out their sequences this is called scientific method. Thus scientific method is a systematic step-by-step procedure (three steps-observation, hypothesis and verification) following logical process of reasoning.

According to Prof. Morgan "scientific method being highly elastic, can be applicable to all domain of human activity where the discovery of truth is the objective". So the scientific method is means for gaining knowledge of the universe. As Karl Person observed "there is no short-cut to truth, no way to gain a knowledge of the universe expect through the gate way of scientific method". Two elements of scientific method are, a)Procedural components and b)Personal Components.

a) Procedural Components

Observation, hypothesis and verification are the three procedural components. Observation helps to collect data and help to build hypothesis. The second step is formation of one or more hypotheses. A hypothesis is tentative conclusion. It guides collection of data. The third stage is verification of hypothesis. It is done by analytical tools.

b) Personal Components

The researcher needs imagination, analytical ability resourcefulness, skill, capacity to find out the hearts of the problem. Researcher's ability and attitude are more important than the method of approach. Ambitions interest and perseverance are very much required to go on successfully with research. Researcher should have an objective scientific and professional qualification and personal quality and interest.

Meaning and essentials of scientific method

Scientific method is a way in which one can test opinion, impressions or guess by examining available evidences fore and against them. So it is controlling lot of things and establishing stable belief.

2.1 Essentials of scientific method

1. Scientific method aims at discovering facts.
2. It is itself corrective in nature.
3. It is itself based on systematic doubts.
4. Scientific theories are abstract in nature.
5.

2.2 Basis of scientific method

Following are the major basis of scientific method

(a) Reliance on empirical evidence:

Scientific method involves a systematic process. The answer to a question is not decided by intuition or imagination.

Relevant data are collected through observation and experimentation. The validity and the reliability of data are checked carefully and the data are analyzed thoroughly using appropriate methods of analyses.

(b) Use of concepts:

We use concepts to deal with real facts. Concepts are logical constructs or abstractions created from sense impressions. They are the symbols representing the meaning that we hold.

(c) Commitment to objectivity:

Objectivity is the hallmark of the scientific method. It means forming a judgment upon facts unbiased by personal impressions. The conclusion should not vary from person to person. It should be same for all persons.

(d) Ethical neutrality

Science does not pass normative judgment on facts. It does not say they are good or bad. Science aims nothing but making true and adequate statements about its object.

(e) Generalization.

Scientist tries to find out the commonality of a series of event. They aim at discovering the uniformity. Assumed a discovered uniformity a logical class and it's observed pattern, a descriptive generalization is formulated.

(f) Verifiability

The findings of a research should be verifiable. Scientist must make know to others, how he arrived at his conclusion. He should thus expose his own methods and conclusions to critical scrutiny. When others test his conclusion under the same conditions, then it is accepted as correct.

(g) Logical reasoning process.

The scientist method involves the logical process of reasoning. This reasoning process is used for drawing inference from the finding of a study or for arriving at conclusion. This logical reasoning process consists of induction and deduction.

Induction:

One of the methods of logical reasoning process. The inductive method consists of studying several individual cases drawing a generalization. It involves two processes- observation and generalization. Conclusion from induction method is subjected to further conformation based on more evidence.

Deduction:

Deduction is reasoning from the general to the particular. This reasoning establishes a logical relationship between a major premise. A minor premise and a conclusion. A major premise is a previously established generalization or assumption. A minor premise is a particular case related to the major premise. The logical relationship of these premise lead to conclusion.

E.g. major premise: - All men are mortal Minor premise: - A is a man Conclusion: - A is mortal.

The logical process of both induction and deduction are useful in research studies. Both are inseparable parts of a system of reasoning. Both processes are often used simultaneously.

2.3 Difficulties in the use of scientific methods in social science research

Some theorists argue that scientific method is more applicable to physical or natural sciences: and it can not applicable to social sciences. The following are the major difficulties.

a) Human behavior is different. It s very difficult to categories.
b) When human behavior is studied and analyses by another human, there may be personal problems.
c) Psychological nature of human behavior can not be measurable.
d) Human behavior is not uniformed and predictable. Uncertainty is existing.
e) Difference in choice and decision.

2.4Research and Theory

2.4.1 Meaning of theory

Research is closely related to theory. Theory provides a conceptual model for research. Research in turn contributes to theory. It is important to distinguish the modern scientific usage of the word theory from other meanings the word may have. In common parlance, theory is frequently identified with speculations, what is theoretical is unrealistic, visionary. This is a wrong notion; theory is the accumulated stored facts. It may define as a set of systematically interrelated concepts, definitions and propositions that are advanced to explain and predict phenomena (facts). Arnold Rose defines theory as "an integrated body of definitions, assumptions and general propositions covering a given subject matter from which a comprehensive and consistent set of specific and testable principles can be deducted logically".

2.4.2 Criteria of Theory

Theories start out as ideas. How much these ideas conform to the basic demands of proposition formulation that determines whether or not they will assume the status of theory. The criteria to be met by the set of ideas are,

a) They must be logically consistent.
b) They must be interrelated.
c) The propositions should be mutually exclusive.
d) They must be capable of being tested through research.

2.4.3 Theory and Facts

Theory and facts are interrelated. Facts are empirically verifiable observation and theories establish relationship between facts and order them in meaningful way. Theory summaries facts in to empirical generalizations; and it predict facts. Facts in turn, help to initiate theories; facts lead to the reformulation of an existing theory and modify them.

Role of Theory in Research

Theory helps research in several useful ways. Following are the major contributions of theory to research.

a) Theory delimits the study.

Theory narrows the range of facts to be studied. It helps to select a few relevant aspects of a phenomenon. Any phenomenon may be studied from different angles. Theory helps the researcher to work with in framework is science.

b) Theory provides conceptual model.

Theory provides a conceptual framework for a study. It helps a researcher to develop conceptual structure for the proper formulation of the selected problems.

c) Theory summarizes.

Theory summarizes what is already known about the object of study. From time to time in any science there will be changes in the structure of relationship between propositions. In each area, scientist move from older systems of theory towards a more acceptable new system.

d) Theory states universal law.

Theory states a general uniformity beyond the immediate observation. E.g. A person sitting under mango tree, observe mangoes falling on ground. But beyond this observation there is a general law of gravitation.

e) Prediction.

Theory helps to predict further facts. For example we may observe low birth rate in modern societies. From this, we can predict that if modern way of life is introduced into a traditional rural or tribal community, its birth rate would decline.

f) Theory fills gap in knowledge.

Theory also points to areas which have not been explored. The gaps in knowledge are brought to light through the questions arising out of theory.

2.5Contribution of research to theory

The relationship between theory and research is contributory. Research contributes to the development of theory. Let us discuss major contributions of research to theory.

a) Research initiate theory.

The findings of research may lead to the formulation of theories. Scientific experiment have led to the development of various theories in physics, chemistry etc,. Similarly research in social sciences has contributed to the development of several theories.

b) Research tests an existing theory.

One major function of empirical research is to test hypotheses deduced from existing theories. If a hypothesis is not conformed by research, the theory from which the hypothesis is deduced in re-examined and tested.

c) Reformulation of an existing theory.

When a theory does not fit in to new findings of research, it is rejected and reformulated to encompass the new findings.

d) Research refocuses theory.

Empirical research may give a new focus to the existing theory.

e) Research clarifies theory.

Concepts are drawn from theory. But researcher cannot proceed on the basis of their theoretical meaning. For research purpose the concepts must be operationalized and defined especially with concrete empirical indications. Such clarifications and redefinitions lead to the discovery of new hypotheses.

In short, theory and research are inseparable complementary components of scientific endeavor.

2.6 Social Science Research Meaning and Scope

Sciences are broadly divided in to natural (physical) sciences and social sciences. Social sciences include various disciplines dealing with human life, human behavior and institutions.

E.g. Anthropology, History, Economics, Education, Commerce, Demography etc,.

Social sciences are not exact science like physical sciences. It deals with human beings. Human nature and mans environment are so complex, that it is more difficult to comprehend and predict human behaviour than the physical phenomena. It is difficult see the underlying uniformities in the diversity of complex human behaviour.

Social science research

Social science research is a systematic method of exploring, analyzing and conceptualizing human life in order to extend, correct or verify knowledge of human behaviour and social life. Social research seeks to find explanations to unexplained phenomena, to clarify the doubtful and correct the misconceived fact of social life.

It involves the application of scientific method for understanding and analyzing of social life inorder to correct and verify the existing knowledge as a system. The main idea behind social research is to discover new inter relations, new knowledge, new facts and also to verify old ones.

Human behavior may be involved by certain values and laws. The main purpose of social research is to discover those laws which can be proper guidelines for studying human contact and behavior.

According to P.V. Young, we may define social research as "the systematic method of discovering new facts and verifying old facts. Their sequences inter relationship, causal explanations and the natural laws govern them". From the above definition we can identify the following

2.7 Characteristics of Social science Research

1) Social Science research deals with social phenomena. It studies human behavior and their feelings.
2) Social science research is carried on both for discovering new facts and verification of the old ones.
3) Social science research tries to establish casual connection between various human activities.

2.8 Nature of Social Science Research

In contrast to the physical science the social science lack the power of exact prediction; this is attributed to the "erratic", idiosynoration and irregular nature of human behavior. Social scientist point out that the low predictable potential in social science is due to our limited knowledge of relevant variables operative in the group like customs, traditions etc,. The cause and effect are difficult to be segregated clearly. The present state of development of social science is far behind physical science. Merton advises to social scientist against their despair; it is possible to develop border applicability.

2.9 Objectives of Social Research

The major objectives of social research are listed as follows:-

a) The aim of social research is to discover new facts and verifying or testing old facts.
b) It tries to understand the human behavior and its interaction with the environment.

c) It tries to find out the casual connection between human activities and natural laws governing them.

2.10 Functions of Social Science Research

The important functions of social science research are discussed below

a) Discovery of facts and their interpretation.

Social research provides answer to questions of what, when, how and why of man, social life and institutions. Discover of facts and their inter relationship help us to discard distortions and contribute to our understanding of social reality.

b) Diagnosis of problems and their analysis.

Our society has innumerable problems such as poverty, unemployment, economic inequality, social tension etc,. The nature and dimensions of such problems have to be diagnosed and analyzed. An analysis of problems leads to an identification of appropriate remedial actions.

c) **Systematization of knowledge**.

The facts discovered through research are systematized and the body of knowledge is developed. It contributes to the growth of theory building.

d) Control over social phenomena.

Research in social science provides first hand information about the nature of social institutions. This knowledge helps us to control over the social phenomena.

e) Prediction.

Social research aims at finding an order among social fact and their casual relations. This affords a sound basis for prediction in several cases.

f) Development planning.

Systematic research can give us the required data base for planning and designing developmental schemes and programmes.

g) Social welfare.

Social research can identify the causes of social evils and problems. It can thus help in taking appropriate remedial actions. It also provides guideline for social welfare.

2.11 Scope of Social Science Research

The fields of social science research unlimited and the materials of research are endless. Every group of social phenomena, every phase of human life and every stages of past and present development are materials for the social scientist. The area of research in various social sciences provides vast scope for research in social sciences.

The main scope of social research are

1. Social research provides new insight in to the organized society and its social structure.
2. Social research also provide new horizon in scientific explanation; advanced and tested principles of procedure and suggested new concepts.
3. Another scope of social research is that exemplified by studies and attempt to test or challenge existing theories and revise them the light of new evidence.
4. Social research helpful to establish new theory and established techniques of

exploration.

5. Social research also provides contributions to existing stone of fruitful ideas, methodology and basis understanding of social life and control of its problems.

2.12 Ethical Issues in Social Sciences Research

An ethic is more than presence of a basic value or values. It is base of action in any science. The conflict between the ethics of science and personal respects of researcher is the major problem in social science research. Issues of ethics arise primarily out of researcher's relation with different sections of society. E.g. research respondents, sponsors' of research, sources of data etc,.

When we talk about 'ethics' in social research, we are addressing those issues that concern the behavior of social researcher and the consequences that their research bring to the people they study. As such, ethical issues have the potential to impart at every stage of the research process andwithin any research project, therefore all social researchers need to have a clear understanding of the ways in which ethical dilemmas can arise when carrying out their research.

Ethical issues arise during the research process

1) Some of the ethical issues can arise during the course of the research process are
2) The research problem itself: - determinants of alcoholism or child sexual abuse.
3) The research setting:- hospitals, prisons or schools
4) The procedure of research: - an experiment method has a negative effect on research participants.
5) The kinds of people serving as research participants:- homeless people, patients, children and relatively powerless to resist being studied.
6) The type of data collected:- sensitive, personal or financial information.
7) The pressure put upon research participants by external agencies such as government, employers etc,.
8) The communication of results:- the sponsors withhold certain results that do not accord with their objectives.
9) Ethical issues relating to the respondents and subject:-
10) Of all ethical issues, the issues concerned with the respondents are far more important. The respondents constitute the research subjects,
11) Some respondents are made to participate in a research project without their consent or knowledge; e.g. socio-anthropological studies of rural or tribal community.
12) The purpose of research is not fully revealed to the respondents.
13) Another non ethical practice is to expose participants to physical or mental stress.
14) In depth interviews or disguised projective test and participant observation are may be an attack on privacy.
15) Other ethical issues related to maintaining anonymity of the respondent. Anonymity might be violated through report and publications.
16) Another ethical issue in social science research is related to agency or sponsors of research. The granting agencies impose several restrictions up on the researcher.
17) To overcome above ethical dilemma in social science research, the research must keep a balance between the moral cost of unethical practices and the potential benefits of research.

2.13 Summary

All scientists use common methods for their enquiry. All sciences whether natural or social agree up on methods of studying phenomena. But their materials differ. A biologist studying the structure of some flowers, a chemist studying radioactive properties of an element and a sociologist studying crime situation in an urban slum. All follows similar scientific methods of inquiry. But their subjects of study are different. Therefore, they use different techniques of investigation for their study. As their materials are different, their purposes also differ. All of them will observe the phenomenon and analyze them to find out their sequences this is called scientific method. Thus scientific method is a systematic step-by-step procedure (three steps-observation, hypothesis and verification) following logical process of reasoning.

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2.14Self AssessmentQuestions

1) What are the Essentials of scientific method and Basis of scientific method ?
2) Explain Difficulties in the use of scientific methods in social science research
3) Explicate the Research and Theory in detail ?
4) Explain Nature ,Objectives, Functions of Social Science Research ?
5) What are the Scope and Ethical Issues of Social Sciences Research ?

2.14Suggested Readings

1. Allen L. Edward : Techniques of Attitude Scale Construction
2. Festnger and Katz : Research Methods in Behavioural Sciences.
3. Elhance : Fundamentals of Statistics
4. Goode and Hatt : Methods in Social Research.
5. Gopal, H.M. : Introduction to the study of Research Procedures inSocial Sciences.
6. Gupta C.B. : Statistical Methods
7. Gupta S.P. : Statistical Methods
8. ICSSR Survey Reports : I.C.S.S.R. Publication.
9. Michael V.B. : Research Methodology in Management
10. Sadhu and Singh : Research Methodology in Social Sciences.
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12. Young P.V. : Scientific Social Surveys and Research.

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LESSON 3

SOCIAL RESEARCH AND SOCIAL SURVEY

Learning Objectives

- ✓ To study the Objectives of Social Research
- ✓ To learn the Characteristics of Research
- ✓ To examine the Significance of Social Research
- ✓ To understand Types and Methods of Social Research

Structure

3.0 Introduction of Social Research and Stages in Social Research

Society is an organized group of persons associated together with shared objective, norms and values pertain to the society. People have social life and social process. Research is systematic and organized effort to investigate a specific problem that needs a solution. It contributes to the general body of knowledge. It also corrects human knowledge. Social research now can be defined as the systematic and objective analysis and recording of controlled observations that may lead to the development of generalization, principles or theories resulting in prediction and possibly ultimate control of events in society. It attempts to answer or solve social problems.

3.1 Social Research

Social research may be defined as a scientific undertaking by means of logical and systematized techniques. Social research consists of the process of formulating and seeking answers to questions about the social world. Social research is fundamentally a scientific enterprise aims to:

1. Discover new facts or verify and test old facts;
2. Analyze their sequences, inter-relationships and causal explanations which are derived with an appropriate theoretical frame of reference;
3. Develop new scientific tools and theories which would facilitate reliable and valid study of human behavior.

3.2Objectives of Social Research

3 To facilitate the understanding of human behavior.
4 To acquire knowledge about social phenomena, events, issue, problems etc.
5 To identify functional relationship existing in the social phenomena.
6 To find out the natural laws that regulates or direct social phenomena.
7 To standardize the society concept, e.g. culture, struggle, generation gap, social distance etc.
8 To formulate solution to social problems.
9 To maintain social organization, remove social tension, misconception, etc.,
10 To develop social revival plan.

3.3 Characteristics of Research

It is directed towards the solution of problems. The ultimate goal is to discover cause-and-effect relationship between social problems.

1. It emphasis the development of generalizations, principles or theories that will be helpful in predicting future occurrences.
2. It is based upon observable experience or empirical evidence.
3. It demands accurate observations and description. Researchers may choose from a variety or non-qualitative description of their observations.
4. It involves gathering new data from primary sources or using existence data for new purpose.
5. Although social research activities may at time be some what random and unsystematic, it is more often characterized by carefully designed procedure that applies rigorous analysis.
6. It requires expertise. The researcher knows what is already known about the problem and how others have investigated.
7. It strives to the objective and logical applying every possible test to validate the procedure employed, data collected and conclusion reached.
8. It involves the guests for answer to unsolved problems.
9. It is characterized by patient and unhurried activity. Researcher must expect disappointment and discouragement as they pursue the answer to difficult question.
10. It is carefully recorded and reported. Each important term is defined, limiting factors are recognized, procedures are described in detail, reference are carefully documented, results are objectively recorded and conclusions are presented with scholarly caution and restraint.
11. It is interdisciplinary in nature

12. It sometimes requires courage.

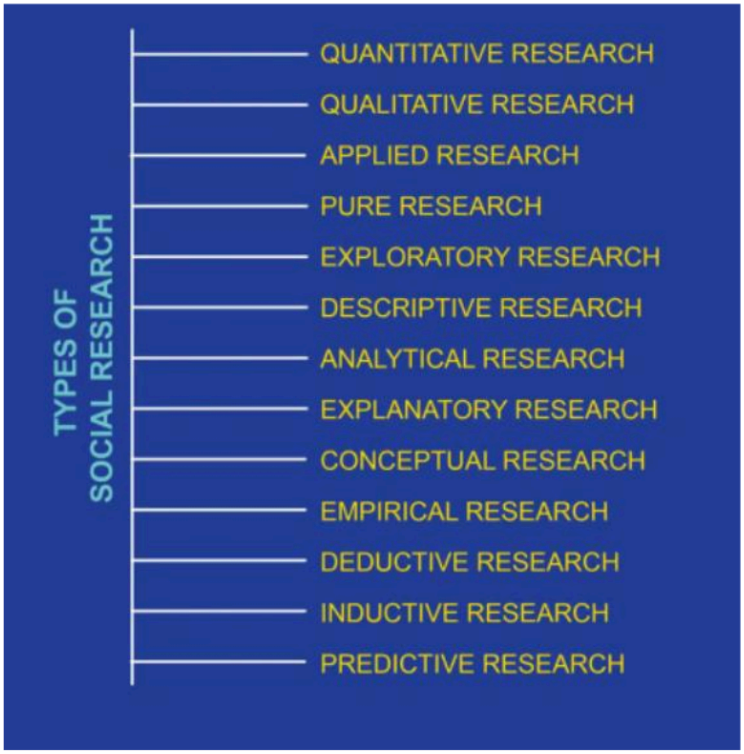
3.4Significance of Social Research

1. It inculcates scientific and inductive thinking
2. It provides new ideas and insights
3. It promotes the development of logical habits of thinking and organization.
4. It evaluate existing policies and helps to formulate new policies
5. It solve various operational problems related to economy, politics, business and Government.
6. It studies social relationships and helps to solve various social problems
7. It helps to improve the level of living in the society

3.5 Types of Social Research

Social research is an approach adopted by sociologists and researchers to learn about people's day to day lives and design the products that best suit their needs. People from different parts of the world have different ways of living their social lives. They might have various views about one problem. To satisfy their requirements and know their thoughts and opinions, social research has always proven to be the best solution. A researcher might want to trigger social research after coming across a new market trend, a new product development or an upgrade to the existing one.

Examples: some examples of social research can be a census of a country, investigation of agricultural lands, literacy rate.



There are various types of research types and you will find different sets of them from different resources. Here are some of the types of social research that are commonly used:

Quantitative Research

Quantitative research refers to collecting and statistically analyzing numerical data. It helps in finding patterns, predictions, averages in the collected data. Quantitative data is collected through conducting surveys, polls, and interviews.

Example: you want to find out how many people who attended the seminar liked it. You will ask questions like "Did you like the seminar?"

You can use a quantitative research model when you want to have numerical data on which you can perform statistical calculations.

Advantages:

- It allows the researcher to reach out to a larger sample size.
- Does not require observation.
- Research performed is anonymous and can have honest responses.

Disadvantages:

- It does not study the reason behind a response.
- Quantitative research can be very expensive.

Qualitative research

Qualitative research is a type of social research which aims at gathering descriptive opinions of people through open-ended questions in a survey or an interview. The data collected from this research is vast and needs to be summarized to get to a conclusion.

Example: You know what people think about your seminar, but you want to know why they think that way and what changes they want in your next seminar. This will allow responders to briefly tell their views.

This method best suits the research problems that include an in-depth understanding of a topic or a group of people.

Advantages:

- It gets to the reason behind the attitude of the responders.
- It gives a lot of data to work on.
- It is not very costly.

Disadvantages:

- It does not statistically represent the data.
- There is a chance of data loss due to its large data nature.
- The results acquired from this approach can be influenced by the researcher's personal opinions.

Applied research

It is research that provides solutions for real-life problems. Researchers use applied research to get to the solutions which they can implement immediately. The problems can be related to health, diet, work-out, etc. the solutions to this research can be technological.

Example: A software solution firm wants to provide a solution that will prompt a message every time someone tries to take a print from the office printer. This will make them consider paper use and can be an initiative towards paper reduction.

Applied research is used in everyday life problems as it can provide solutions in a short period and the solutions are easy to implement as well.

Advantages:

- It helps find solutions for a specific business or other settings.
- Solutions can be implemented right away.

Disadvantages:

- Solutions established from applied research cannot be generalized for other similar problems.

Pure Research

Pure or basic research, unlike applied research, does not concern about providing solutions. This research can be explanatory, exploratory or descriptive. The main objective of this research is to provide a total understanding of a topic.

Example: A researcher conducts a study on how hypertension affects a person's blood pressure.

Pure or basic research is conducted when you want to understand a problem statement without getting into providing any solution for it. This is the major difference between pure research and applied research.

Advantages:

- It expands our knowledge about everyday life.
- It covers a large part of the topic.

Disadvantages:

- It does not provide the deep learning of how to tackle the problem.

Exploratory Research

This research is helping to get to solutions for the problems that are not clear. It provides a better understanding of the existing problem but will not provide final solutions. It is conducted at a preliminary stage of the problem and answers questions like why what and how.

Example: A company owner is not sure if he should expand the branch and hence decides to conduct explanatory research. At the end of the research, he will know if it is a good move to expand an extra branch or not.

Exploratory research can be used when you have to study the scope of the existing problem for its future. It can help you find the focus for the future.

Advantages:

- The researcher can adapt to the changes during the research.
- It costs very low.
- It can give solutions for the future of the problems.

Disadvantages:

- This research may lead to wrong decisions.

Descriptive Research

Descriptive research is research that describes the characteristics of the variables. The characteristics can be the answers to the questions like “what, why, how and when”

It is also called observational research as the variables are not changed during the research.

Example: A person wants to set up a café in a particular area, he wants to know what are the preferences of the people from the area regarding similar cafes.

When you want to conduct an observational study without touching the integrity of the variable, descriptive research is the solution for you.

Advantages:

- As it uses primary data collection, the data is rich in information.
- The survey method can be qualitative and quantitative providing flexibility.

Disadvantages:

- Information collected can be misleading.
- The researcher’s biases can affect the result.
- The size of the sample can have representative issues.

Analytical Research

Analytical research focuses on the cause-effect of the variables. While descriptive analysis tells the facts, analytical research determines what the reason behind those facts is.

Example: A descriptive study says almost all elderly people have joint pain. Analytical research can work to find out the reason behind the illness. It can tell how old age affects the bone structure and result in them weakening.

Analytical research come in handy when you have to resolve the “what, when, how and why” of the existing researched topic.

Advantages:

- Provides more control over the data.
- Determines the reason behind the fact.
- It is inexpensive and simple to implement.

Disadvantages:

- Can include measurement errors.
- Bias in the sample population can affect the results.
- Get Expert's Sampling Guide

Explanatory Research

This research deals with researchers revisiting phenomenon that were not studied in-depth before. It doesn't mean that the research has to provide solutions now. It can be done for the sole purpose of understanding the topic.

Example: A researcher wants to study a literature topic. It may include reading through existing researches, magazines, articles.

Explanatory research aims towards finding out why the phenomenon occurred and what are chances of it occurring in the future are.

Advantages:

- Allows the researcher to know more about the topic.
- Gives a scope to have new solutions.

Disadvantages:

Results can have the researcher's biases affected.

Conceptual Research

It includes observing and analyzing the already existing topic. It doesn't involve any practical research. Researchers state their concepts and ideas regarding the topic. It is just and theoretical ideology of the topic.

Example: Stephan Hawkins had a conceptualization of the black hole on his observation of the universe. Years later we had the first image of a black hole.

Conceptual research is used more in philosophical research. They use it to come up with new concepts and enhance the existing ones.

Advantages:

- It requires few resources which saves time and resources.
- It uses existing literature hence making it convenient.

Disadvantages:

- The results may not be considered reliable and factual.
- It is likely to face errors overtime after new concepts are discovered.
- Improve Survey Response Rates

Empirical Research

Empirical research involves concluding only from verifiable shreds of evidence. This research can be conducted using a qualitative method or quantitative method. The results have a strong background and can be trusted.

Example: A researcher wants to know if listening to motivational speech cause more productivity. He tests this by exposing one group to listen to the motivational speech while the other group doesn't. Empirical research is useful when you want to prove a hypothesis based on strong proof. As people need to have something that can be proven, this research provides exactly just that.

Advantages:

- This makes the conducted research more authentic.
- Strengthens the internal validity.

Disadvantages:

- It can be very time-consuming.
- Data collection can be challenging as it is supposed to be from an authorized source.

Deductive Research

Deductive research is based on an already existing theory. It creates a hypothesis on the theory and then research is done to test if the hypothesis is true. The theories are tested against observations.

Example: All animals drink water. Dog drinks water. The dog is an animal. It is assumed that "all animals drink water" and "dog is an animal" both are correct.

Deductive research stands strong when you have to formulate a hypothesis on a theory, test that hypothesis and examine the results.

Advantages:

- It explains the cause-effect relationship between variables.
- The results can be generalized to a certain extent.

Disadvantages:

- They may not understand the rules.
- It can be misrepresenting.
- New call-to-action
- Inductive Research

Unlike deductive research, inductive research works with a focus on developing a theory. It goes from observation to generalizations of the topic. Commonly, researchers prefer to combine both pieces of research in case of a huge study.

Example: Observation- Dogs is an animal

Observing a pattern- Dog drinks water

Developing a theory- All animals drink water

Inductive research can be used when you want to understand a topic that does not have enough existing literature. It helps you to observe the topic and then come to conclusions which you can apply in a broader sense.

Advantages:

- It can be used to predict what can happen in the future.
- It gives deep knowledge about the research topic.

Disadvantages:

- The reasoning can be incorrect.
- The research is limited to how much you can make a result generalization.

Predictive Research

As the name suggests, this research predicts the outcomes, consequences, costs, and other such factors. These factors are calculated for the existing theories. The predictions are mostly about the things that are not tested or tried yet.

Example: A company owner will study the employees' performances, the projects completed, client satisfaction, speed of project completion, and various other measures to predict the company's success and growth in the coming years.

Predictive analysis is an efficient method of research when you want to find the probability of a phenomenon occurring shortly. It can be used in all types of research problems and is a common practice.

Advantages:

- It has a competitive advantage.
- It also helps reduce risks and the costs behind solving them.
- Deal with problems before they occur.

Disadvantages:

- Data cannot be relied upon totally because people don't always give honest answers in surveys.
- Data collected can be different concerning quality measures.

3.6 Qualitative Research Method (Social Survey Method)

Social Survey Method

Social survey technique is very popular in sociology. Survey research is the systematic gathering of information about individuals and collectivities. The purpose of surveying may be description or casual analysis. Large scale descriptive surveys have long history in social research. National census is the biggest form of social survey in which surveys, the whole nation regarding its population, their economic condition including their earning, birth, death etc.

Definition In general social surveys are concerned with
(a) the formation of constructive programme of social reform and
(b) amelioration of current or immediate conditions of social pathological nature, which have definite social significance.

Duncan Mitchell's Dictionary of sociology defines social survey as follows, "the social survey is a systematic collection of facts about people living in a specific geographic, cultural or administrative area".

Bogardus says "A social survey is the collection of data concerning the living and working conditions, broadly speaking of the people in a given community".

E.W. Burgess defined "A social; survey of a community is the scientific study of its conditions and needs for the purpose of presenting a constructive programme of social advance".

Social surveys are usually for dealing with many related aspects of social problem. They provide the data for administration, rather than for the illustrative or descriptive material. They are generally quantitative and the history of the social survey is intimately bound up with the development of statistics.

Surveys vary greatly in their scope, their design and their content. The specific characteristics of any survey will determine by the basic objectives, which conducting survey there must be a specific pattern or design to follow to collect data.

3.6.1 Procedural ways of social survey

The step by step tasks involved in carrying out a survey from the first state off planning to the preparation of the final report in as follows

a) **Statement of the problem or general objectives**

The problem which make survey necessary and the general objectives of the survey are stated. The statement is generally expressed the area and scope of the study.

b) **Specific objectives of the survey**

Although the general objectives, usually few in number are formulated with out regarding to the requirements of the survey technique; these general objectives are broken down in to numerous specific objectives. The specification of data to be gathered and the hypotheses to be tested by the survey is accomplished at this stage.

c) **Sample**

Two major divisions in the survey sample are (a) the universe of the survey (b) the size and design of the sample. After there two are made the actual selection of the sample units take place.

d) **Questionnaire**

After the selection of sample units a questionnaire is prepared, to collect facts from the sample. The questionnaire must be carefully designed with in limits of the problem. The preparation of questions, degree of probing, the sequence of questions and the establishment of rapport, a specific pattern and a skill to be applied. The questionnaire is pre-tested in the field for proper application.

e) **Field work**

The next important step is field work. Gathering facts from sample through personal interview and observation. The interviewers are usually provided with an instruction manual which explain the objectives of the study and the meaning of each question.

f) **Data coding and tabulation**

After careful coding and editing of the data collected through survey may transcribed into tables. This may be done by preparing a code, a numbered list of major items such summing all the responses received to each question.

g) **Data analysis and reporting**

The data are analysed and a report is written which embodying the survey findings. The survey process is a highly interconnected chain of events so the above steps are independent of one another.

3.6.2 Limitation of survey method

Even though the survey method is applicable to wide range problems, it has evident limitations. The major limitations are;

a) **Sample error**: survey method is subjected to the selection of sample

b) **Errors of measurement**: A scone representing a person's attitude, abilities traits or behaviours may not match with reality.

c) **Limitations of questionnaire**: the imitations on length of the questions, that can be asked in a survey an there are limits to the number of topics that can be covered.

d) **Limitations of population**: A sample survey designed to represent a population over a wide geographical area is likely not to given adequate representation to any population which highly localized in its character.

3.7 Summary

Social Research is a method used by social scientists and researchers to learn about people and societies so that they can design products/services that cater to various needs of the people. Different socio-economic groups belonging to different parts of a county think differently. Various aspects of human behaviour need to be addressed to understand their thoughts and feedback about the social world, which can be done using Social Research. Social Research contains elements of both these methods to analyse a range of social occurrences such as an investigation of historical sites, census of the country, detailed analysis of research conducted to understand reasons for increased reports of molestation in the country etc.

3.8 Key words

Social Research- Social research may be defined as a scientific undertaking by means of logical and systematized techniques. Social research consists of the process of formulating and seeking answers to questions about the social world.

Pure Research- Pure research is focused to collect knowledge without any intention to apply it. It is purely intellectual in character. It is also known as basic or fundamental research

Applied Research- Applied Research is focused up on a real life problem requiring an action pr policy decision. It tries to find out practical and immediate result. It is thus problem oriented and action directed.

Action Research- Conventional social scientific research is concerned to analyse and explain phenomena. The role of research is detached, in order to minimize disturbance of the phenomena under investigation. In action research, research is jointed with action

3.9Self Assessment Questions

1) What are the Objectives of Social Research?
2) Explain Characteristics of Research
3) Explicate Types and Methods Of Social Research
4) Explain Significance of Social Research ?
5) What are the Procedural Ways of Social Survey and limitations?

3.10 Further Readings

1. Allen L. Edward : Techniques of Attitude Scale Construction
2. Festnger and Katz : Research Methods in Behavioural Sciences.
3. Elhance : Fundamentals of Statistics
4. Goode and Hatt : Methods in Social Research.
5. Gopal, H.M. : Introduction to the study of Research Procedures in Social Sciences.
6. Gupta C.B. : Statistical Methods
7. Gupta S.P. : Statistical Methods
8. ICSSR Survey Reports : I.C.S.S.R. Publication.
9. Michael V.B. : Research Methodology in Management

10. Sadhu and Singh : Research Methodology in Social Sciences.
11. Singh V.B (Ed) : Labour Research in India .
12. Young P.V. : Scientific Social Surveys and Research.

LESSON 4

RESEARCH PROCESS

Learning Objectives

- ✓ To study the research process characteristics and requirements
- ✓ To Understand The eight-step model for carrying out research
- ✓ To know the steps involved in constructing the data collection

Structure

4.0 The research process characteristics and requirements

From these definitions it is clear that research is a process for collecting, analysing and interpreting information to answer questions. But to qualify as research, the process must have certain characteristics: it must, as far as possible, be controlled, rigorous, systematic, valid and verifiable, empirical and critical.

Controlled – In real life there are many factors that affect an outcome. A particular event is seldom the result of a one-to-one relationship. Some relationships are more complex than others. Most outcomes are a sequel to the interplay of a multiplicity of relationships and interacting factors. In a study of cause-and-effect relationships it is important to be able to link the effect(s) with the cause(s) and vice versa. In the study of causation, the establishment of this linkage is essential; however, in practice, particularly in the social sciences, it is extremely difficult – and often impossible – to make the link.

The concept of control implies that, in exploring causality in relation to two variables, you set up your study in a way that minimises the effects of other factors affecting the relationship. This can be achieved to a large extent in the physical sciences, as most of the research is done in a laboratory. However, in the social sciences it is extremely difficult as research is carried out on issues relating to human beings living in society, where such controls are impossible. Therefore, in the social sciences, as you cannot control external factors, you attempt to quantify their impact.

Rigorous – You must be scrupulous in ensuring that the procedures followed to find answers to questions are relevant, appropriate and justified. Again, the degree of rigour varies markedly between the physical and the social sciences and within the social sciences.
Systematic – This implies that the procedures adopted to undertake an investigation follow a certain logical sequence. The different steps cannot be taken in a haphazard way. Some procedures must follow others.

Valid and verifiable – This concept implies that whatever you conclude on the basis of your findings is correct and can be verified by you and others.

Empirical – This means that any conclusions drawn are based upon hard evidence gathered from information collected from real-life experiences or observations.

Critical – Critical scrutiny of the procedures used and the methods employed is crucial to a research enquiry. The process of investigation must be foolproof and free from any drawbacks. The process adopted and the procedures used must be able to withstand critical scrutiny

4.1The research process: an eight-step model

Research methodology is taught as a supporting subject in several ways in many academic disciplines at various levels by people committed to a variety of research paradigms. Though paradigms vary in their contents and substance, their broad approach to enquiry, in the author's opinion, is similar. Such ideas have also been expressed by Festinger and Katz, who in the foreword of their book Research Methods in Behavioral Sciences say that, 'Although the basic logic of scientific methodology is the same in all fields, its specific techniques and approaches will vary, depending upon the subject matter' (1966: vi). Therefore, the model developed here is generic in nature and can be applied to a number of disciplines in the social sciences. It is based upon a practical and step-by-step approach to a research enquiry and each step provides a smorgasbord of methods, models and procedures.
Suppose you want to go out for a drive.

Before you start, you must decide where you want to go and then which route to take. If you know the route, you do not need to consult a street directory, but, if you do not know the route, then you need to use one. Your problem is compounded if there is more than one route. You need to decide which one to take. The research process is very similar to

undertaking a journey. As with your drive, for a research journey there are also two important decisions to make. The first is to decide what you want to find out about or, in other words, what research questions you want to find answers to. Having decided upon your research questions or research problems, you then need to decide how to go about finding their answers. The path to finding answers to your research questions constitutes research methodology. Just as there are posts along the way as you travel to your destination, so there are practical steps through which you must pass in your research journey in order to find the answers to your research questions . The sequence of these steps is not fixed and with experience you can change it. At each operational step in the research process you are required to choose from a multiplicity of methods, procedures and models of research methodology which will help you best achieve your research objectives. This is where your knowledge base of research methodology plays a crucial role.

At each operational step, the book aims to provide, at a beginner's level, knowledge of methods and procedures used by both qualitative and quantitative researchers, though there is an inclination towards the quantitative way of thinking.

Quantitative and qualitative research methodologies differ both in their underpinning philosophy and, to some extent, in the methods, models and procedures used. Though the research process is broadly the same in both, quantitative and qualitative research are differentiated in terms of the methods of data collection, the procedures adopted for data processing and analysis, and the style of communication of the findings. For example, if your research problem lends itself to a qualitative mode of enquiry, you are more likely to use the unstructured interview or observation as your method of data collection. When analysing data in qualitative research, you go through the process of identifying themes and describing what you have found out during your interviews or observation rather than subjecting your data to statistical procedures. The below table summarises the differences between qualitative and quantitative research.

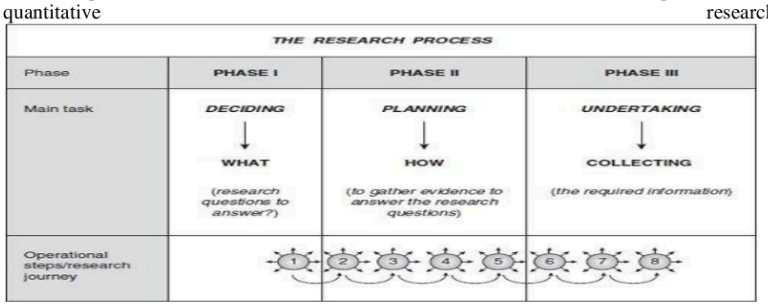


Figure 4.1 The Research Process

The research journey – touch each post and select methods and procedures appropriate for your journey

Since, at a number of steps of the research process, the choice of methods and procedures is influenced by the quantitative/qualitative distinction, the methods and procedures discussed in some of the chapters in this book are dealt with under separate headings for qualitative and quantitative research; however, the author has tried to keep this distinction to a minimum as the model is applicable to both. Also note that this book is for beginners, it does not cover extensively the applicability and use of each method, model and procedure. In addition, the author has elaborated more on methods, models and procedures

associated with quantitative research as compared with those linked with qualitative research. For a deeper understanding of a method or procedure relating to either, you may wish to consult other books identified in the text or in the Bibliography.

Differences between qualitative and quantitative research

Difference with respect to:	Quantitative research	Qualitative research
Underpinning philosophy	Rationalism: 'That human beings achieve knowledge because of their capacity to reason' (Bernard 1994: 2)	Empiricism: 'The only knowledge that human beings acquire is from sensory experiences' (Bernard 1994: 2)
Approach to enquiry	Structured/rigid/predetermined methodology	Unstructured/flexible/open methodology
Main purpose of investigation	To quantify extent of variation in a phenomenon, situation, issue, etc.	To describe variation in a phenomenon, situation, issue, etc.
Measurement of variables	Emphasis on some form of either measurement or classification of variables	Emphasis on description of variables
Sample size	Emphasis on greater sample size	Fewer cases
Focus of enquiry	Narrows focus in terms of extent of enquiry, but assembles required information from a greater number of respondents	Covers multiple issues but assembles required information from fewer respondents
Dominant research value	Reliability and objectivity (value-free)	Authenticity but does not claim to be value-free
Dominant research topic	Explains prevalence, incidence, extent, nature of issues, opinions and attitude; discovers regularities and formulates theories	Explores experiences, meanings, perceptions and feelings
Analysis of data	Subjects variables to frequency distributions, cross-tabulations or other statistical procedures	Subjects responses, narratives or observational data to identification of themes and describes these
Communication of findings	Organisation more analytical in nature, drawing inferences and conclusions, and testing magnitude and strength of a relationship	Organisation more descriptive and narrative in nature

Figure 4.2Differences between qualitative and quantitative research

the above one shows the proposed model. The tasks identified in arrows are the operational steps you need to follow in order to conduct a study, quantitative or qualitative. Topics identified in rectangles are the required theoretical knowledge needed to carry out these steps. The tasks identified in circles are the intermediary steps that you need to complete to go from one step to another. It is important for a beginner to work through these steps in the proposed sequence, though, as already stated, with experience you do not need to follow the sequence.

In this book the theoretical knowledge required is written around each operational step and follows the same sequential progression as is needed when actually undertaking a research investigation. For each operational step, the required theoretical knowledge is further organised, in different chapters, around the operational step to which, in the author's opinion, it is most logically related. Again, for a beginner, it is important to study this diagram to relate the theoretical knowledge to the operational steps.

The research processes

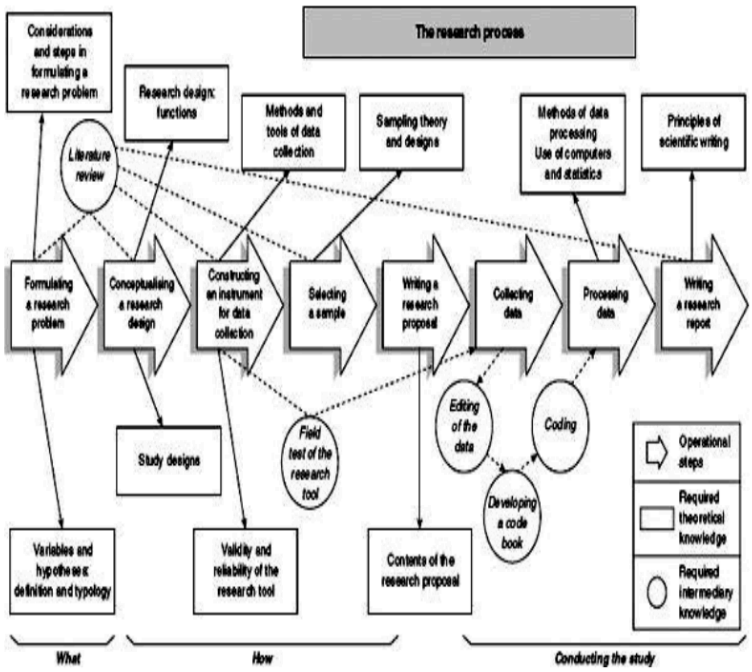
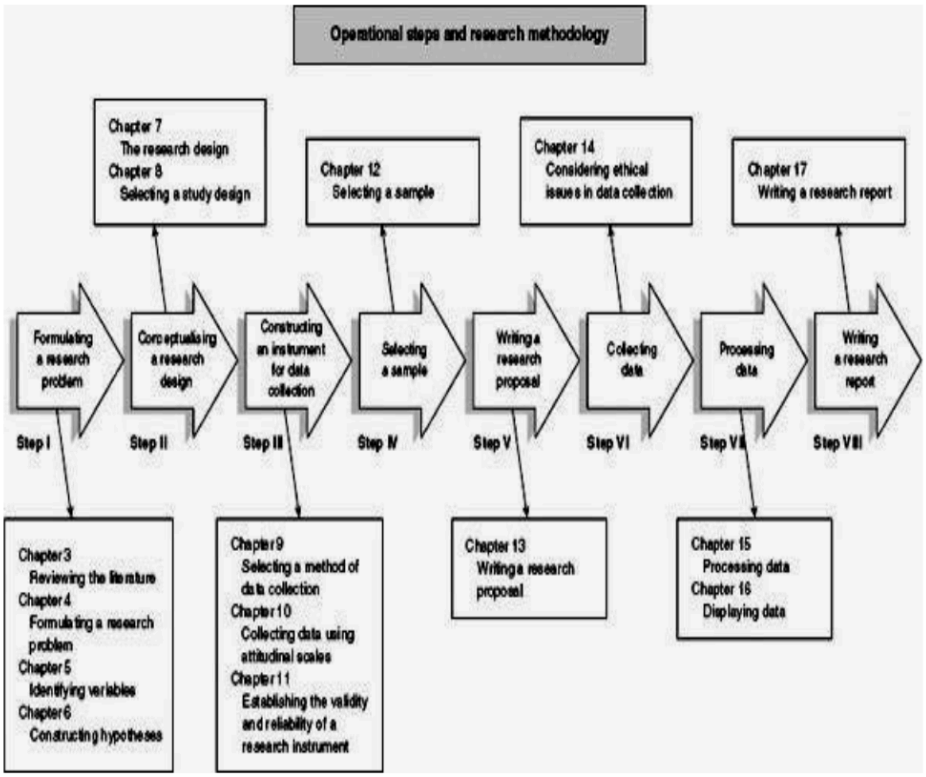


Figure 4.3: Research Process

Figure 4.4 Operational steps and Research Methodology



4.2 Relation to the operational steps

The following sections of this chapter provide a quick glance at the whole process to acquaint you with the various tasks you need to undertake to carry out your study, thus giving you some idea of what the research journey involves.

4.2.1 Phase I: deciding what to research

4.2.1.1 Step I: formulating a research problem

Formulating a research problem is the first and most important step in the research process. A research problem identifies your destination: it should tell you, your research supervisor and your readers what you intend to research. The more specific and clearer you are the better, as everything that follows in the research process – study design, measurement procedures, sampling strategy, frame of analysis and the style of writing of your dissertation or report – is greatly influenced by the way in which you formulate your research problem. Hence, you should examine it thoroughly, carefully and critically. The main function of formulating a research problem is to decide what you want to find out about.

It is extremely important to evaluate the research problem in the light of the financial resources at your disposal, the time available, and your own and your research supervisor's expertise and knowledge in the field of study. It is equally important to identify any gaps in your knowledge of relevant disciplines, such as statistics required for analysis. Also, ask yourself whether you have sufficient knowledge about computers and software if you plan to use them.

4.2.2 Phase II: planning a research study

4.2.2.1 Step II: Conceptualising a research design

An extremely important feature of research is the use of appropriate methods. Research involves systematic, controlled, valid and rigorous exploration and description of what is not known and establishment of associations and causation that permit the accurate prediction of outcomes under a given set of conditions. It also involves identifying gaps in knowledge, verification of what is already known and identification of past errors and limitations. The strength of what you find largely rests on how it was found.

The main function of a research design is to explain how you will find answers to your research questions. The research design sets out the specific details of your enquiry. A research design should include the following: the study design per se and the logistical arrangements that you propose to undertake, the measurement procedures, the sampling strategy, the frame of analysis and the time- frame. (You should not be confused between study design and research design. Note that the study design is one part of the research design. It is the design of the study itself, whereas the research design also includes other parts which constitute the research process.)

For any investigation, the selection of an appropriate research design is crucial in enabling you to arrive at valid findings, comparisons and conclusions. A faulty design results in misleading findings and is therefore tantamount to wasting human and financial resources. In scientific circles, the strength of an empirical investigation is primarily evaluated in the light of the research design adopted. When selecting a research design it is important to ensure that it is valid, workable and manageable.

There is an enormous variety of study designs and you need to be acquainted with some of the most common ones. You must have strong reasons for selecting a particular design; you must be able to justify your selection; and you should be aware of its strengths, weaknesses and limitations. In addition, you will need to explain the logistical details needed to implement the suggested design.

4.2.2.2 Step III: Constructing an instrument for data collection

Anything that becomes a means of collecting information for your study is called a 'research tool' or a 'research instrument', for example observation forms, interview schedules, questionnaires and interview guides.

The construction of a research instrument is the first 'practical' step in carrying out a study. You will need to decide how you are going to collect data for the proposed study and then construct a research instrument for data collection.

If you are planning to collect data specifically for your study (primary data), you need either to construct a research instrument or to select one that has already been constructed.

If you are using secondary data (information already collected for other purposes), you will need to identify what information is needed and then develop a form to extract the required data. In order to determine what information is required, you need to go through the same process as for primary data, described above.

Field testing (or pre-testing) a research tool is an integral part of instrument construction. As a rule, the pre-test of a research instrument should not be carried out on the sample of your study population but on a similar population which you are not proposing to study. If you are planning to use a computer for data analysis, you may wish to provide space for coding the data on the research instrument.

4.2.2.3 Step IV: Selecting a sample

The accuracy of your findings largely depends upon the way you select your sample. The basic objective of any sampling design is to minimise, within the limitation of cost, the gap between the values obtained from your sample and those prevalent in the study population.

The underlying premise in sampling is that a relatively small number of units, if selected in a manner that they genuinely represent the study population, can provide – with a sufficiently high degree of probability – a fairly true reflection of the sampling population that is being studied.

When selecting a sample you should attempt to achieve two key aims of sampling the avoidance of bias in the selection of a sample; and the attainment of maximum precision for a given outlay of resources.

There are three categories of sampling design random/probability sampling designs, non-random/non-probability sampling designs and 'mixed' sampling design.

There are several sampling strategies within the first two categories. You need to be acquainted with these sampling designs – the strengths and weaknesses of each and the situations in which they can or cannot be applied – in order to select the one most appropriate for your study. The type of sampling strategy you use will influence your ability to make generalisations from the sample findings about the study population, and the type of statistical tests you can apply to the data.

4.2.2.4 Step V: Writing a research proposal

Having done all the preparatory work, the next step is to put everything together in a way that provides adequate information about your research study, for your research supervisor and others. This overall plan, called a research proposal, tells a reader about your research problem and how you are planning to investigate. Broadly, a research proposal's main function is to detail the operational plan for obtaining answers to your research questions. In doing so it ensures – and reassures the readers of – the validity of the methodology to obtain answers accurately and objectively.

Universities and other institutions may have differing requirements regarding the style and content of a research proposal, but the majority of institutions would require most of what is set out here. Requirements may also vary within an institution, from discipline to discipline or from supervisor to supervisor. However, the guidelines set out in Chapter 13 provide a framework which will be acceptable to most.

A research proposal must tell you, your research supervisor and a reviewer the following information about your study:

1. what you are proposing to do;
2. how you plan to proceed;
3. why you selected the proposed strategy.

Therefore, it should contain the following information about your study

1. a statement of the objectives of the study; a list of hypotheses, if you are testing any; the study design you are proposing to use; the setting for your study;
2. the research instrument(s) you are planning to use; information on sample size and sampling design; information on data processing procedures;
3. an outline of the proposed chapters for the report; the study's problems and limitations; and
4. the proposed time-frame.

4.2.3Phase III: Conducting a research study

4.2.3.1Step VI: Collecting data

Having formulated a research problem, developed a study design, constructed a research instrument and selected a sample, you then collect the data from which you will draw inferences and conclusions for your study.

Many methods could be used to gather the required information. As a part of the research design, you decided upon the procedure you wanted to adopt to collect your data. In this phase you actually collect the data. For example, depending upon your plans, you might commence interviews, mail out a questionnaire, conduct nominal/focus group discussions or make observations. Collecting data through any one of the methods may involve some ethical issues.

4.2.3.2 Step VII: Processing and Displaying data

The way you analyse the information you collected largely depends upon two things: the type of information (descriptive, quantitative, qualitative or attitudinal); and the way you want to communicate your findings to your readers.

different ways of analysing quantitative and qualitative data and details various methods of displaying analysed data.

In addition to the qualitative–quantitative distinction, it is important for data analysis that you consider whether the data is to be analysed manually or by a computer.

If your study is purely descriptive, you can write your dissertation/report on the basis of your field notes, manually analyse the contents of your notes (content analysis), or use a computer program such as NUD*IST N6, NVivio or Ethnograph for this purpose.

If you want quantitative analysis, it is also necessary to decide upon the type of analysis required (i.e. frequency distribution, cross-tabulations or other statistical procedures, such as regression analysis, factor analysis and analysis of variance) and how it should be presented. You will also need to identify the variables to be subjected to these statistical procedures.

4.2.3.3 Step VIII: Writing A Research Report

There are two broad categories of reports: quantitative and qualitative. As mentioned earlier, the distinction is more academic than real as in most studies you need to combine quantitative and qualitative skills. Nevertheless, there are some solely qualitative and some solely quantitative studies.Writing the report is the last and, for many, the most difficult step of the research process. This report informs the world what you have done, what you have discovered and what conclusions you have drawn from your findings. If you are clear about the whole process, you will also be clear about the way you want to write your report. Your report should be written in an academic style and be divided into different chapters and/or sections based upon the main themes of your study.

4.3 Summary

This chapter has provided an overview of the research process, which has been broken down into eight steps, the details of which are covered in the remainder of this book. At each step the research model provides a smorgasbord of methods, models, techniques and procedures so you can select the one most appropriate for your study. It is like a buffet party with eight tables, each with different dishes made from similar ingredients. You go to all eight tables and select the dish that you like the most from each table. The main difference between the model and this example is that in the model you select what is most appropriate for your study and not what you like the most. For a beginner it is important to go through all the steps, although perhaps not in the same sequence. With experience you can take a number of shortcuts.

The eight steps cover the total spectrum of a research endeavour, from problem formulation through to writing a research report. The steps are operational in nature, following a logical sequence, and detailing the various methods and procedures in a simple step- by-step manner.

4.4 Key words

Research Process- Research methodology is taught as a supporting subject in several ways in many academic disciplines at various levels by people committed to a variety of research paradigms

Data Collection- Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes

Sample - A sample is defined as a smaller set of data that a researcher chooses or selects from a larger population by using a pre-defined selection method. These elements are known as sample points, sampling units, or observations

Research Report-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 an objective and accurate source of information.

4.5 Self Assessment Questions

1) What are the Research Process characteristics?
2) Explain Eight step model for carrying out research?
3) Explicate Phase I and Phase II in carrying out the research?
4) Explain Phase III in carrying out the research?

4.6 Suggested Readings

1. Allen L. Edward : Techniques of Attitude Scale Construction
2. Festnger and Katz : Research Methods in Behavioral Sciences.
3. Elhance : Fundamentals of Statistics
4. Goode and Hatt : Methods in Social Research.
5. Gopal, H.M. : Introduction to the study of Research Procedures in Social Sciences.
6. Gupta C.B. : Statistical Methods
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8. ICSSR Survey Reports : I.C.S.S.R. Publication.
9. Michael V.B. : Research Methodology in Management
10. Sadhu and Singh : Research Methodology in Social Sciences.
11. Singh V.B (Ed) : Labour Research in India .
12. Young P.V. : Scientific Social Surveys and Research.

Dr. B.NAGARAJU

LESSON 5

REVIEW OF LITERATURE

Learning Objectives

- ✓ To study the purpose of review of literature
- ✓ To Understand the types of Literature
- ✓ To Learn the Thematic Review of Literature

Structure

5.0 Introduction

Review of literature is a collective body of works done by earlier scientists and published in the form of books or in the form of articles in journals or published as monograph etc. Every scientific investigation starts with a Review of Literature. In fact, working with the literature is an essential part of the research process which help generate ideas, helps in developing significant questions and is regarded as instrumental in the process of research design. In this unit we will be dealing with the review of literature, how to go about it, what is its importance and how the review should be organized and how to relate it to the present research report.

5.1 Purpose of Review of Literature

A literature review is part of a report. It provides considerable information on the topic being researched and the various works that had gone on in the field over the years. These materials are gathered by the researcher from many sources such as journals, books, documents etc. The review of such a literature could be a matter-of-fact presentation of the information or it could be a synthesis of a large number of information and put together subject wise for the purpose of understanding. It can be just a simple summary of the sources, but it usually has an organizational pattern and combines both summary and synthesis. In summary all the information is synthesized and given in a capsule form. It synthesizes and organizes the entire information in terms of its relevance and appropriateness to the topic of research. It might give a new interpretation of old material or combine new with old interpretations. Or it might trace the intellectual progression of the field, including major debates. And depending on the situation, the literature review may evaluate the sources and advise the reader on the most pertinent and relevant information. Difference between Literature review and Academic research report. The question arises as to how the literature review differs from an academic research paper. While the main focus of an academic research paper is to develop a new argument, a research report will contain the literature review as one of its chapters. In a research report one uses the literature as a basic foundation and support for newer ideas and insights into the research topic of interest. Literature review

on the other hand summarizes and synthesizes the many arguments and literature and research findings gathered from such a review and puts forward arguments in favour or against the particular topic and its findings. Materials to be included in review of literature The next question is regarding how many and how much of materials to be included in review of literature. There is no hard and fast rule about this. The researcher has to definitely include the materials from classic and pioneering works in the area. In addition, the researcher should also include all the relevant research works published more recently especially in the last 5 to 10 years. As for the types of sources to be consulted for review of literature, this includes books, journal articles, monographs, documents, grey literature such as unpublished documents or research papers read at some conferences etc. In addition, the internet is an important source from where articles and abstracts could be downloaded for this purpose. Once all the materials have been gathered from different sources as mentioned above, the researcher should organize the same according to the year of publication and the subject matter must be organized to give meaning to the entire literature gathered keeping in view the present research topic of interest to the researcher. The researcher can evaluate these materials on the basis of the methodology used, the research findings arrived etc. The researcher could also include in such a review certain minimal and directly relevant historical account regarding the research topic.

5.1.1 Identifying variables relevant for research

When the researcher makes a careful Review of the Literature, he becomes award of the important and unimportant variables in the concerned area of research. A careful Review also helps the researcher in selecting the variables lying within the scope of his interest, in defining and operationalizing as well as in identifying variables which are conceptually and practically important. Thus a Review of the Literature, on the whole, prepares the researcher to formulate a research problem in whichconceptualization and practically important variables are selected.

5.1.2 Avoidance of Repetition

A Review of the Literature helps the researcher in avoiding any duplication of work done earlier. A careful review always aims at interpreting prior studies and indicating their usefulness for the study to be undertaken. Thus, prior studies serve as the foundation for present research. In some cases the duplication or replication of prior studies becomes essential. This is especially true when the researcher wants to test the validity of the earlier studies. In such a situation, too, a careful review helps the researcher in getting acquainted with the number and nature of the studies related to the present research whose validity is being assessed at present.

5.1.3 Synthesis of prior works

Review of the Literature enables the researcher to collect and synthesize prior studies related to the present study. This, in turn, helps the researcher in building a better perspective for future research. A synthesized collection of prior studies also helps researcher to identify the significant overlaps and the gaps among the prior works.

5.1.4 Determining meaning and relationship among variables

A careful Review of the Literature enables the researcher in discovering important variables relevant to the area of the present research. When significant variables are discovered, the relationship among them can be identified, Subsequently, the identified relationship is incorporated into different hypotheses. Thus, for conducting a scientific study,

the relationship between the different variables must be explored by reviewing the literature so that a good context may be built up for subsequent investigations. In addition to these specific purposes, there are some general purposes of the literature review:

1. To argue for the relevance and the significance of the research question.
2. To provide the context for one's own methodological approach
3. To establish one's own credibility as a knowledgeable and capable researcher.
4. To argue for the relevance and appropriateness of one's own approach.

5.2 Sources of the review of literature

There are diverse sources of the Review of the Literature. Some of them are enumerated below. Journals and Books

Different research journals and books relevant to the areas of interest are the primary sources of the Review of Literature. Most major libraries have a periodical section where different types of research journals are made easily available. A research journal generally contains the publication of original research reports with their detailed methodology and results. Such journals contain original research reports with their detailed methodology and result. Such journals are referred and therefore are different from non-referred journals. A referred journal is one which reports only those articles which are carefully reviewed by the experts before publication. Often, the reviewer rejects several manuscripts and selects a few for publication. Similarly, books are also direct sources of the Review of Literature. Of these two, journals are regarded as more useful because they provide the researcher with the latest and up-to-date information relevant to the area of interest.

5.2.1 Reviews

Reviews are short articles that give brief information regarding the work done in a particular area over a period of time. Reviews are commonly published in journals, yearbooks, handbooks and encyclopedias. Reviewers select research articles of their interest, organize them content wise, criticize their findings and offer their own suggestions and conclusions. Review articles are a good source for those investigators who wish to have all the relevant researches at one place without taking pains to look for them. Since the reviewers organize all the possible research papers of the relevant area in their review articles, review articles also provide the advantage of prior reviews.

5.2.2 Abstracts

Abstracts provide a summary of the research reports done in different fields psychological abstract (Washington: American Psychological Association), and Sociological abstract (New York: Sociological Abstracts, INC) are the two common examples of abstracts. These abstracts are the useful sources of up-to-date information for researchers. In an abstract, besides a summary, researchers get all the relevant information such as the title of the Research Report, name of the author and the journal pagination information, etc., regarding the research article. The only limitation of abstracts is that they fail to satisfy those researchers who desire detailed information regarding the methodology and results of the research articles.

5.2.3 Indexes

Indexes show the titles of the research report without any abstract. The titles recategorized and arranged alphabetically in each category so that the researcher can locate any article of interest easily. The Education Index (New York: H W WilsonCo.) is a good example of an index. As indexes do not provide detailed information, they keep many a

researcher dissatisfied. They can be best regarded as the supplementary source which, if combined with other sources, can yield valuable information to the researchers.

5.2.4 Internet

Today Internet is a very easy and quick source of Review of Literature. Internet sites are very useful for providing easy access to original writings by important researchers. They also provide such an updated information on the topic that ordinarily is not available in the library. Internet sites also provide for useful bibliographies related toa particular researcher. Search on Internet also reveals some relevant professional societies and academic associations which can provide a lot of support to the studies in the concerned area. Such organizations also sometimes publish important papers or periodicals which can be of immense help to the researchers. Some publishers put the brief content and extracts from the recently published books on the Internet and these can be of valuable help to the researchers. Sometimes, the Internet sites include articles extracted from encyclopedias which can also be very useful and informative as background reading. However, they are not normally suitable for citing in a report.

5.2.5 Doctoral Dissertations

Doctoral dissertations have also been a very good source of the Review of the Literature. In libraries of universities, doctoral dissertations are available. The researcher can choose the dissertations of their interest and find useful and relevant information there. There are no set forms for writing the research report in a doctoral dissertation but most dissertations contain chapters like an Introduction, Review of the Literature, Purpose of the Study, Method of the Study, Results, Discussion, Summary and Conclusion.

Some researchers prefer not to add a separate chapter on Discussion, Summary and Conclusion. Some do not add a separate chapter on the Review of the Literature but incorporate it into the Introduction itself. Thus, the doctoral dissertations present the advantage of prior review. Ordinarily, it is not possible for the researcher to move through all the important libraries in the country to consult all existing doctoral dissertations. Hence, he/she can have access to those dissertations that interest him through Dissertation Abstracts International, which publishes the abstracts of the doctoral dissertations submitted to different universities. In India, the Survey of Research in Education (edited by M B Buch) does much the same function. The second Survey of Research in Education covering the period between 1972-78 has also been released. Recently, the listing of dissertation abstracts has been computerized through DATRIX in terms of the key words (usually words appearing in title of the dissertation).

5.2.6 Supervisors/Research Professors

Supervisors often know the literature well and are able to guide in right direction. They are the recognized authority on the topic or research problems. Therefore, they should be consulted and their suggestions and advices should be carefully analyzed. It may also be that the other research professors have recently sourced and reviewed the literature or an area very close to the literature the researcher is seeking. So they also constitute one important source.

Whatever may be the sources of reviews, the process of reviewing literature itself is not above criticisms. Inevitably, the interpretation of findings insights derived, the manner in which conclusions are drawn are all solely dependent upon the judgments of the reviewer, In other words, such reviews fall prey to what is called subjective judgment.

5.3 Types of Literature

In order to work with appropriate literature, it is essential that the researcher must be able to identify and find it. For this, he/she must have an understanding of various literature types. Some of the common types of literature are as under:

5.3.1 Subject-Specific Books

Introductory and advanced text books and research report can provide important background and context for the research. Such literatures also provide information about theory and method of the research.

5.3.2 Grey Literature

Grey literature means both published and unpublished materials that somehow do not have International Standard Book Number (ISBN) or an International Standard Serial Number (ISSN).Grey literature is a broad category that includes unpublished research newspaper articles, conference paper and pamphlets, etc. During the course of doing research most researchers do Utilize one or the other type of grey literature.

5.3.3 Official Publications, Archives and Statistics

This type of literature serves the dual purpose. Firstly, such literature can be a valuable source of background and contextual information and secondly, they can also be used as a source of secondary data, Document analysis and secondary data analysis are often based upon this type of literature.

5.3.4 Writing Aids

As its name implies, such literature generally offers a significant support during the process of writing and can be easily used to improve the linguistic style of the work. Such literature includes dictionaries, bibliographic works, encyclopedias, thesauruses, yearbooks, books of quotes, almanacs, etc.

5.3.5 Journal Articles

This type of literature is very common among the researches. It popularity is due to several factors, First, journal articles are very credible. Second, they are often targeted for academic audience. Third, they possess. The trait of specialty. Fourth, they possess the regularity of production which meant that research articles are not only relevant but also current.

5.3.6 Writing Process of The Review of Literature

Since the Review of Literature may be a very long chapter, it does need some form of structure. The simplest way of organizing the research works is to discuss them in chronological order. But this may not prove to be appropriate in all situations. Another way is that one can group the works on different subjects together with the date of publication as the only criterion of order. But this may also be confusing. Still another way may be to base the structure on the different types of publications. For example, chapters from books, journal articles and single authored books should be separately grouped and structured. The basic aim of the Review of Literature is to use the literature for informing, establishing and arguing. In fact, the Review of Literature should go beyond the said report.

5.3.7 Find a focus

A literature review not the sources themselves. This means that the researcher will not just list the sources but selectively use them in the research topic area. These can be accommodated in terms of themes, or issues and bring those sources together, and present them. Some of the questions the researcher should ask self are the following:

1. Do they present one or different solutions?
2. Is there an aspect of the field that is missing?
3. How well do they present the material?
4. Do they portray it according to an appropriate theory?
5. Do they reveal a trend in the field?
6. A raging debate?

One of the above themes should be picked up to focus the Organisation of the review.

5.3.8 Construct a working thesis statement

The thesis statement should argue for a particular perspective on the material. Some sample thesis statements for literature reviews are as follows:

The current trend in treatment for congestive heart failure combines surgery and medicine.

More and more cultural studies scholars are accepting popular media as a subject worthy of academic consideration.

5.3.9 Consider Organisation

Once the statement has been made, what is the most effective way of presenting the information? What are the most important topics, subtopics, etc., that the review needs to include? And in what order should they be presented? The researcher should develop an Organisation for the review at both a global and local level:

5.3.10 Cover the basic categories

Just like most academic papers, literature reviews also must contain at least three basic elements: an introduction or background information section; the body of the review containing the discussion of sources; and, finally, a conclusion and/or recommendations section to end the paper.

5.3.11 Organize the body of the report

Once the basic categories are in place, then the researcher must consider how the sources should be presented within the body of the report. To work out an overall organizational framework for the review, the following three typical ways of organizing should be considered

5.3.12 Chronological Method

If your review follows the chronological method, you could write about the materials above according to when they were published. For instance, first you would talk about the studies of the 19th century, then about the book published in the 1970's and then end up with articles about the topic in the recent years.

5.3.13 Method by Publication

If the order demonstrates a particular trend, then the researcher can arrange the reviews in the order of publication chronology. For instance, you could order a review of

literature on the psychological aspects of suicides, if the progression revealed a change in suicidal practices over the years.

5.3.14 Method by trend

Another way to organise the resources is to examine the sources under another trend such trends in couple suicide or suicidal pact etc. Under this method, the researcher would combine the recent studies on suicidal pacts, of a century ago with those that are available today.

5.4 Thematic reviews of literature

Thematic reviews of literature are organized around a topic or issue, rather than the progression of time. However, progression of time may still be an important factor in a thematic review. For instance, the suicidal review could focus on the development of the self-esteem or disappointment in love affair leading to suicide. These studies could be organized chronologically. The only difference here between a "chronological "and a "thematic" approach is what is emphasized the most: the reason of injury Toone'sself-esteem leading top suicide.

5.4.1 A Methodological Approach

This approach differs from the two above in that the focusing factor. Here the focus is on the method used by the researcher. For the suicidal issue, one methodological approach would be to look at cultural differences between the method of suicides. Or the review might focus on the economic impact of suicides. A methodological scope will influence either the types of documents in the review or the way in which these documents are discussed.

Once you've decided on the organizational method for the body of the review, the sections to be included should be easy to figure out. They should arise out of theorganizational strategy. In other words, a chronological review would have subsections for each vital time period. A thematic review would have subtopics based upon factors that relate to the theme or issue.

Sometimes, though, one might need to add additional sections that are necessary for the study, and a few are given below:

(i) Current Situation:

Information necessary to understand the topic or focus of the literature review.

(ii) History

The chronological progression of the field, the literature, or an idea that is necessary to understand the literature review.

(iii) Methods and/or Standards

The criteria used to select the sources in the literature review or the way in which the researcher presents the information. For instance, one may explain that your review includes only peer-reviewed articles and journals.

(iv) Questions for Further Research

What questions about the field has the review sparked? How will the researcher use the review for further work in the area?O'heary (2004) has recommended that for writing a good literature review, the following steps should strictly be followed:

(v) Relevant reviews

The researcher should give a look on the literature reviews done in several of the journal articles, from these reviews, good and relevant reviews should be sorted and this depends upon the research skills of the researchers. Supervisor should help him in selecting the relevant and good reviews.

Write critical annotations while going through the various reviews. The researcher should sort and organize the annotations of the reviews by themes, issue of concern and common limitations, etc While doing so, some patterns would start emerging and this would, in turn, help in developing researcher's own argument.

To develop a structure

The researcher should structure the potential reviews according to the most urgent needs such as topical themes, arguments that the researcher wishes to establish, etc. The structure so developed is always subject to modification with the emergence of new thinking.

To write purposefully

The researcher should note that he can review the literature without any agenda but he cannot write a formal literature review without any definite agenda or aim. The reader must know the reasons why and what are you telling them.

Use the literature to support the argument

The researcher should not use the review only for reporting or borrowing the arguments from others rather he should use the literature for generating ideas that may help or support his own arguments.

Make the literature review an ongoing process

The researcher should make the literature review an ongoing process. In other words, the literature review should answer the researcher's question, theories and methods and these should help in setting the parameters of the literature review. Thus, literature review becomes a cyclical process and should often have a moving target.

Get plenty of feedback

The researcher should not wait up to the last minute of writing process. Whatever has been written should be passed over to supervisors and other experts for their feedback. Early feedback gives a chance for rethinking and modification of ideas being incorporated in the writing process.

Remain prepared for redrafting

In view of the suggestions through feedback, the researcher should redraft the reviewing a coherent manner so that the argument is reasonably supported. Thus, writing the literature review is a complex task which can be made easy by following the above-mentioned steps meticulously.

5.5 How Old Should the Literature Be?

One of the important questions for a researcher is: how old may the literature be?The simplest answer to this question is that it can be of any age, in fact, academic research is a cumulative activity. Each generation of researcher learns from the work of previous generation and current research basically depends upon the work and insights of the previous researchers. Since in any society the latest and contemporary research and publication are in great demand it is preferable to cite as many recent publications as possible.

Despite this, almost in any discipline, there are some seminal works which are centuries old but have become so significant that they are still being preferred by the researchers. Although their original ideas have been modified by the subsequent researchers over the years, their original spirit and views still remain significant and are held in considerable esteem. For example, the work of Sigmund Freud in the field of Psychoanalysis

is of about 150 years back but his ideas, theories, viewpoints are so pertinent and of importance to any researcher of today, that working in this field is bound to have these included in the Review of the Literature. However, it would be a healthy suggestion for researchers that they should always take precaution in citing older works unless they are confident and convinced in quoting them.

5.5.1 Preparation of Index Card for Reviewing and Abstracting

After going through the different sources of the Review of the Literature, researchers prepare their own review and abstract on the index card. Usually, for the purpose, a 6" × 10" index card is recommended. In most journal articles, an abstract in about150 words is provided. The researcher can incorporate it in the abstract being written. Where the article seems to be very important and relevant, the researcher can prepare a more detailed version. Usually, the abstract, thus prepared, is divided into three parts.

i) The first part consists of the purpose and hypothesis of the study. The researcher should write down the purpose of the study in not more than two lines. If the hypotheses are small. they can be recorded verbatim but if they are lengthy, they should be synthesized.

ii) The second part consists of the methodology of the study in which size of the sample, nature of the population, methods for measuring or manipulation of the variables, methods of data collection, designs and statistics are shown insynthesised form.

iii) The third part consists of the findings and conclusions. In this part, the researcher should briefly take down the findings relating to each hypothesis and also concisely the conclusion drawn by the author.

At the top of the index card, a full reference should be clearly written in exactly the same way in which it appears in the researcher's own reference list. There are different types of research formats but that which is followed by the Publication Manual of the American Psychological Association is widely popular and has been adopted by most of the important research journals. The researcher should never trust own memory for recall of the details of any research article and therefore, all the important and relevant details should be carefully noted down in the index card.

Thus, the reviewing and abstracting of the literature on the index card, should be done carefully and systematically. Sometimes it has been reported that researchers trust their memory for recalling a particular detail. But this is not a healthy practice because they are apt to forget the details or their memory may be blurred after some time.

Researchers should try their best to accommodate every important and relevant detail under the three common headings suggested above.

5.6 Summary

A literature review is part of a report. It provides considerable information on the topic being researched and the various works that had gone on in the field over the years. These materials are gathered by the researcher from many sources such as journals, books, documents etc. Literature review differs from an academic research paper in that the main focus of an academic research paper is to develop a new argument whereas a research report will contain the literature review as one of its chapters. To the issue of how many and how much of materials to be included in review of literature, there is no hard and fast rule about this. The researcher has to definitely include the materials from classic and pioneering works in the area. In addition, the researcher should also include all the relevant research works published more recently especially in the last 5 to 10 years. As for the types of sources to be consulted for review of literature, this includes books, journal articles, monographs, documents, grey literature such as unpublished documents or research papers read at some

conferences etc. In addition, the internet is an important source from where articles and abstracts could be downloaded for this purpose. The specific purposes of a Review of the Literature are identifying variables relevant for research, avoidance of repetition, synthesis of prior works and determining meaning and relationship among variables. There are diverse sources of the Review of the Literature, which includes, journals and books, reviews, abstracts, and indexes. Internet, doctoral dissertations are other sources. As for the types of literature available for write up, this includes, subject specific books, grey literature, official publications, writing aids and journal articles. Since the Review of Literature may be a very long chapter, it does need some form of structure. The simplest way of organising the research works is to discuss them in chronological order. The researcher should not use the review only for reporting or borrowing the arguments from others rather he should use the literature for generating ideas that may help or support his own arguments. Since in any society the latest and contemporary research and publication are in great demand it is preferable to cite as many recent publications as possible. In addition, there are some seminal works which are centuries old but have become so significant that they have to be included. As for preparing index cards the details were discussed. It may be added here that the reviewing and abstracting of the literature on the index card, should be done carefully and systematically.

5.7 Key words

Reviews- Reviews are short articles that give brief information regarding the work done in a particular area over a period of time

Grey literature- Grey literature means both published and unpublished materials that somehow do not have International Standard Book Number (ISBN) or an International Standard Serial Number (ISSN).

Abstracts- Abstracts provide a summary of the research reports done in different fields Psychological abstract (Washington: American Psychological Association), and Sociological abstract (New York: Sociological Abstracts, INC) are the two common examples of abstracts

Doctoral Dissertations-Doctoral dissertations have also been a very good source of the Review of the Literature. In libraries of universities, doctoral dissertations are available.

5.8 Self-Assessment Questions

1)Why is review of literature important in a report?
2) What are the pre requisites of literature review? Provide examples
3) What are the various methods of writing the literature review
4) What steps do we follow when we go through the source of review?
5) Why are past work so important? Elucidate.

5.9 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009
2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.

3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners, Kumar, Dr Ranjit Kumar Sage Publications 2015
5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, and Dipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Edu creation Publishing 2019.
7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019.

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LESSON 6

RESEARCH PROBLEM

Learning Objectives

- ✓ To know the professional Experience and Professional Literature
- ✓ To study the Definition and statement of Problem
- ✓ To focus on the Sources of Research problem
- ✓ To Understand the Criteria for Good Research

Structure

6.0 Introduction

A thorough understanding of known facts and ideas in the field of your interest as a researcher constitute the first and the most important step in selecting a problem for your study. A thorough knowledge of the research studies conducted in the field provides you with details about the problems which have remained unresolved. A survey of suggestions for further research given at the end of research reports and reviews of research would help you to get an idea about the gaps which exist in the knowledge pertaining to your field of educational research. Periodicals and bibliographies of educational research are helpful in keeping you informed about the research going on in the field in which you are interested and show competence. The following, are, however, some important sources which would help you identify a suitable and significant problem.

6.1 Professional Experience

Professional experience of a researcher is one of the most fruitful resources which could suggest research problems. For example, if you are a classroom teacher, or academic counselor or working in any distance learning institute, you must be confronted with a number of problems in your day-to-day academic activities. In the classroom, there is a dynamic interaction between you as the teacher and your learners, between learners themselves, and between learners and learning materials. Such interaction provides you with a variety of problems to be solved through research. You may also be confronted with a number of behavioural problems in and outside the classroom. You have to make decisions about the probable effects of classroom instruction on your learner'sbehaviour so as to establish a relationship between instructional objectives, learning experiences and learning outcomes in terms of behavioural changes in the learners. The learner behaviour may be analysed in terms of their academic achievement, interests, attitudes, motivation, values and some personality characteristics. You have to take decisions about the effectiveness of certain innovative teaching methods and techniques so as to base future classroom instructions upon empirical evidence rather than upon your subjective opinion. The teacher may wish to get answers to certain important and significant questions pertaining to certain components of the teaching- learning process. What are the organisational or management techniques that are employed? How are learning materials presented? How do students, teachers and parents feel about the use of certain innovations in the classroom? What out-of-school activities affect students and the teaching- learning process? How does the isolation of a distance student affect his/her progress in a course?

The educational administrators and planners may find subjects of research in the areas concerning decision-making, scheduling, teacher recruitment and placement, instructional supervision, and several other matters with which they are concerned. Contacts and discussions with research-oriented people are also helpful to researchers in identifying crucial problems and issues concerning education. Participation in conferences, seminars and workshops and listening to the learned speakers are very helpful in locating research problems. The Distance Education Council in India has identified some areas of research. They also provide financial aid for doing research in those areas.

6.2 Professional Literature

The study of professional literature will not only expose you to pressing research problems but will also suggest the way in which research is conducted. Research reports, bibliographies of books and articles, periodicals, research abstracts, yearbooks, dictionaries,

research guides etc. would suggest areas in which research is needed. Some specialised sources are:

1. Encyclopedia of Educational Research,
2. Dissertation Abstracts International,
3. Psychological Abstracts, and similar publications are rich sources of research problems. Some journals are:
4. Open Learning
5. The Journal of Distance Education
6. The American Journal of Distance Education
7. Indian Journal of Open Learning

The above publications are exclusively devoted to identifying and bringing into sharp focus the varied research needs in the different areas and aspects of Education and Distance Education in particular. Besides these printed materials, the other important sources for educational research are computerized databases. Most prominent amongst them is the Educational Resources Information Centre (ERIC) database, EBSLO, PsycINFO etc. International Council for Distance Learning (ICDL) database provides information about research literature on Open and Distance Education. All published research reports generally conclude by making suggestions about further research. These suggestions are helpful to researchers for making decisions about methods and procedures employed by other researchers in similar studies with different samples. Many research studies are criticised for weaknesses in design, treatment and analysis of data, contradictions and inconsistencies in the results, and so on. Thus, researchers can make significant contributions not by repeating these studies, but by making necessary modifications in the design and procedures so as to correct the inconsistencies found in earlier works.

6.3 Inference from Theories and Other Sources

Another important source of identifying the research problems lies in the generalisations that are drawn from various theories pertaining to education, psychology, sociology, etc., known to the researcher. For example, the application of general principles involved in various theories to specific problems of Distance Education makes an excellent starting point for research in this area. Various theories of personality, intelligence, motivation, etc. are helpful in identifying problems pertaining to classroom situations and practices. It is only through research that you can profitably test the validity, scope, and practicability of various theories in educational situations. Technological and social changes, and curricular developments constantly give rise to new problems and issues for research. Such innovations as teaching by television, programmed instructions, computers, and other hardware and software techniques need to be carefully evaluated through the research process.

6.4 Definition of The Problem

After a problem has been selected, the next task for you is to define it in a form amenable to research. The definition of a problem amounts to specifying it in detail and narrowing it down to workable size. Each question and subordinate questions to be answered are specified at this stage and the scope and limits of investigation are determined. Usually, it is necessary to review previous studies in order to determine just what is to be done. Sometimes, while defining the problem, it is necessary to formulate the point of view or educational theory on which the research study is to be based. Incase certain assumptions are made, they must be explicitly stated. Formulation of the problem includes:

i) stating the problem in the form of statements or questions which make the problem clear and understandable,
ii) identification and operationalization of the variables concisely, and
iii) evaluating the problem in terms of its significance, novelty and feasibility.

6.5 Statement of the Problem

A good statement of a problem must clarify exactly what is to be determined or solved or what is the research question. It must restrict the scope of the study to specific and workable research questions. So, you are required to describe the background of the study, its theoretical basis and underlying assumptions, and specify the issues in concrete, specific, and workable questions. All questions raised must be related to the problem. Each major issue or element should be separated into its subsidiary or secondary elements, and these should be arranged in a logical order under the major divisions.

6.5.1 Operationalization of Variables

In stating a problem, the researcher should make sure that it is neither stated in terms so general as to make it vague nor specified so narrowly as to make it insignificant and trivial. The most important step in this direction is to specify the variables involved in the problem and define them in operational terms. To illustrate, suppose you state that you want to study the "Effectiveness of television on the performance of students in Course One of Master of Arts (Distance Education) offered by the Indira Gandhi National Open University". This statement is broad and it communicates in a general way what you want to do. But it is necessary to specify the problem with much greater precision. For this the first step is to specify the variables involved in the problem and define them in operational terms.

The variables involved in the problem are, "effectiveness" and "performance". Please note that these expressions are to be understood beyond their dictionary meanings. For example, the dictionary meaning of "effectiveness" is "producing the desired effect". This meaning is not sufficient for research purposes. It is important for you to specify exactly what indicator of effectiveness you will use or what you will do to measure the presence or absence of the phenomenon denoted by the term "effectiveness". Similarly, you have to define the other variable "performance" also in terms of the operations or processes that will be used to measure them. In this study, you might choose to define "effectiveness" as the improvement made by the Diploma students in scores on a standardized achievement test in Course One. The term 'performance' might refer to the scores on the achievement test in Course One.

It is worth noting that the problem should be stated in a way that it indicates a relationship between two or more variables. It should involve neither philosophical issues, values nor questions of judgement that cannot be answered by scientific investigations. For example, should television be more effective in increasing performance level ofstudents?Such value questions cannot be answered through research. Similarly, the question "what is there in television teaching that enhance performances" is a philosophical question which cannot be probed easily.

6.5.2 Evaluation of the Problem

It is worthwhile for you to ask yourself a series of questions before you undertake the research. The questions should be helpful in the evaluation of the problem on various criteria. All such questions must be answered affirmatively before the study is undertaken.
What are the questions that we should ask?
i) Is the problem researchable?

There are certain problems that cannot be effectively solved through the process of research. A researchable problem is always concerned with the relationship existing between two or more variables that can be defined and measured. The problem should be capable of being stated in the form of workable research questions that can be answered empirically.

ii) Is the problem new?

There is no use in studying a problem which has already been adequately investigated by other researchers. To avoid such duplication, it is essential to examine very carefully the literature available in the field concerned. The problem should be selected only when you are convinced that it is really a new problem which has never before been investigated successfully. However, it must be noted that a researcher may repeat a study when he/she wants to verify its conclusions or to extend the validity of its findings in a situation entirely different from the previous one.

iii) Is the problem significant?

The problem should be such that it is likely to fill in the gaps in the existing knowledge, to help to solve some of the inconsistencies in the previous research, or to help in the interpretation of the known facts. The results or findings of a study should either become a basis for a theory,generalizations or principles. Besides, they should lead to new problems for further research or have some useful practical applications.

iv) Is the problem feasible for the particular researcher?

A research problem may be researchable, new or significant, and yet not feasible because of the following considerations:

a. Research competencies

The problem should be in an area in which the researchers qualified and competent. He/she must possess the necessary skills and competencies that may be needed to develop and administer the data gathering tools, and interpret the data available for analysis. The researcher should also have the necessary knowledge of research design, qualitative and quantitative techniques of data analysis etc. that may be required to carry out the research to its completion.

b. Interest and enthusiasm

The researcher should be genuinely interested in and enthusiastic about the problem he/she wants to undertake for research.

c. Financial considerations and feasibility

The problem should be financially feasible. The researcher should ascertain whether he/she has the necessary financial and temporal resources to carry on the study. Each project has a cost, particularly in the case of DE projects where students are dispersed. The cost is an important element in feasibility. It is important to estimate the cost of the project and assess the availability of funds. This will determine whether the project can be actually executed.

d. Administrative considerations

In addition to personal limitations, financial and time constraints, the researcher should also consider the nature of data, equipment,specialized personnel, and administrative facilities that are needed to complete the study successfully. He/she should check whether he/she is able to get the cooperation from various administrative authorities for collecting various types of data.

e. Time: Projects are a time bound exercise, if not all, are already engaged in more than one activity in office, at home and at social organizations. It is important to assess the

time required to complete a study. Besides the assessment of total period, it is necessary to identify the period of the year in relation to the nature of the study. For instance, if you wish to study instructional transactions in personal contactprogrammes your project must be timed so that you can actually observe a series of sessions in personal contact programmes.

6.6 Necessary conditions for Formulation of Research Problem

(i) Systematic Immersion in the subject matter through First hand observation

The researcher must immerse himself thoroughly in the subject matter area within which he wishes to pose a specific problem. For example, if the researcher was interested in the general area of juvenile delinquency, it would serve him well if he visited remained homes, juvenilecenters, juvenile courts etc., the families of delinquents and the locality where the incidence is high.

This exercise helps a great deal in suggesting to the researchers that may be posed for the study to answer.

This process is known by various names, e.g. pilot survey, preliminary survey etc.

(ii) Study of Relevant on Subject

The researcher must be well equipped to experience some difficulty or challenges which in turn would depend upon the researcher being well conversant with relevant theories in the field, reports and records. This could help him to know if there are certain gaps in the theories or whether the prevailing theories applicable to the problem are inconsistent or whether the findings of the different studies do not follow a pattern consistent with theoretical expectations etc.

(iii) Soliciting help of Experience People

Similarly, discussion with persons having rich practical experience in the field study also helps the researcher toorganise has study, sharpen his focus of attention on specific aspects with in the field.

6.7 Sources of Research Problem

The research problem may be selected from the following five sources:

(i) Theory of one's own interest
(ii) Daily Problem
(iii) Technological Changes
(iv) Unexplored Areas
(v) Discussion with Supervisor

6.7.1 Theory of one's own interest

A researcher may select a problem for investigation from a given theory in which he has considerable interest. In such situations the researcher must have through knowledge of that theory and should be sufficiently inquisitive to explore some unexplained aspects or assumptions of that theory.

6.7.2 Daily Problem

Research problem can also be selected on the basis of daily experience of a researcher. Every day problem constantly present something new and worthy of investigation

and it depends on the sharpness of the researcher's intellect to knit has daily experiences into a research problem.

6.7.3Technological Changes

Technological changes in a fast-changing society are constantly bringing forth-new problems and new opportunities for research. What has been the impact of a changed technology on the existing socio-economic set up always interests the researcher and tempts him to undertake such studies.

6.7.4 Unexplored Areas

Research problems can both abstract and of applied nature. These may also be selected from these areas which have not been explored so far, such areas may be theoretical or empirical in nature.

6.7.5 Discussion with Supervisor

Sometimes the researcher, while discussing the interests with the proposed supervisor may come across a problem that can be researched by the investigator. Similarly, reading assignments in text books, special assignments, research reports or term papers may also suggest some additional areas of needed research. Many research articles suggest problems for further investigation that may prove fruitful.

6.8 Criteria for Good Research

Before the proposal research problem can be finalized,several conditions and considerations have to be satisfied. Although there are no standard rules to guarantee the suitability of a research problem, a number of criteria in the form conditions might be listed for guidance in the selection of a topic.

(i) Novelty

It should be sufficiently original so that it does not involve objectionable duplication.

While originality is an important consideration the fact that a problem has been investigated in the past does not mean that it is no longer fit for study.

(ii) Interesting

The problem should be interesting for the investigator himself. He should have a strong inherent motivation for it to enable him to face and overcome the obstacles.

(iii) Importance

It should be significant enough and involve an important principle or practice. If it is not worthwhile, it neither adds to knowledge nor leads to any improvements in current practices, it would be in vain. No research project should be undertaken unless its consequences give promise of improving significantly in that area.

(iv) Feasibility or Amenability

The suitability of the problem for a particular research worker is the matter of its feasibility. It may be a very good problem, but it should be good for the investigator.

He should be able to carry it to its successful conclusion. He should possess the required competence, understanding and knowledge.

(v) Availability of Data

The researcher worker should ensure the availability of valid and reliable data gathering devices and procedures. In case the study demands a confidential sensitive and classified information, will it be possible for him to obtain?

(vi) Availability of cooperation

The study may require cooperation from various institutions, authorities and individuals. The investigator must make sure that necessary permission and cooperation with be readily available.

(vii) Availability of Guidance

Every research activity needs the patronage of a guide and the approval and sanction of a competent authority.

(viii) Availability of other facilities

The investigator should be able to meet them expenses involved in data gathering equipment's, printing, test materials, travel, computerization, clerical help, postage, preparation of reports etc. If the project is expensive in nature, he should explore the possibility of obtaining financial help from other sources.

(ix) Immediate Application

Will the research help in solving an urgent problem? Supposing the research is on eradication of unfair means in the examinations how is this work helpful? If the research is not able to provide the solution to it, then the whole purpose of research is a sheer waste.

(x) Aim of Research

The aim of the research should also influence the selection of the problem. If it is producer research, the problem will be studied to enhance existing knowledge for its own sake. If it is consumer type, the results should befit for immediate application.

(xi) Level of Research

The nature and scope of a study will be determined in the light of levels like Master's degree, M. Phil Degree andPh.D. It may simply be action research or a research to produce a research paper or an experimental project.

6.9 Formulating and Stating the Problem

After the problem has been selected, it must be definitely formulated and stated. The type of statement to be employed depends on the preference of the worker and the nature of the problem.

There are two different ways of stating a problem:

(i) Posing question/questions

(ii) Making declaration statement/statements

Definition of the Problem

It implies the separation of the problem from the context of difficulties and needs.

It is important to define and elucidate the problem as a whole and further define all the technical and unusual terms employed in the statement. The definition helps to establish the frame of reference with which the researcher approaches the problem.

6.10 Delimitation of the Problem

Here the investigator states the restrictions and limitations which he imposes on his study. It will determine the boundaries of the project in hand.
A time schedule should be prepared so that the researcher may budget his time and energy effectively.

- **Justification of the Problem**

The problem should be broad-based enough to provide an investigation of real significance. The research workers would assess to what extent the solution of the problem would contribute for furtherance of human knowledge.
The lust of objectives of the study magnifies further its utility and importance.

- **Common Errors**
  There are a number of errors, which are committed by an average research worker, while selecting and formulating a research problem.

- **Naming a Broad Field**
  To choose the broad area of study instead of specific problem makes no justification.

- **Stating it such that Investigation is Impossible**
  Thus, is also common source of error in selecting and formulating the research problem.

- **Narrowing or Localizing a Topic**
  The problem may be narrowed to such an extent that it becomes too small and insignificant from research point of view.

- **Including in** it Terms of Unscientific Emotional or Biased Nature
  This bias or prejudice is a constant error e.g. "the blessings of leading profession".

- **Lack of Precession in the Instruments**
  The tools, tests or devices which are proposed to be used in data collection and analysis may not be precise enough resulting in another constant error.

6.11 Summary

The choice and identification of a suitable problem is usually difficult. For a beginner to identify a research problem is always a very difficult task. This may be due to his/her limited knowledge of research processes or his/her unpreparedness for identifying the problem. He/she may not be familiar with the problems in the field which need solution through research. Even an experienced researcher finds it difficult to list all the problems that need to be researched. Each researcher selects a problem because of his/her own needs and purposes.

6.12 Key words

Professional Literature-The study of professional literature depends on research reports, bibliographies of books and articles, periodicals, research abstracts, yearbooks, dictionaries, research guides etc.

Statement of the Problem-A good statement of a problem must clarify exactly what is to be determined or solved or what is the research question

Definition of the Problem-The definition of a problem amounts to specifying it in detail and narrowing it down to workable size

Research competencies- The problem should be in an area in which the researcher is qualified and competent. He/she must possess the necessary skills and competencies that may be needed to develop and administer the data gathering tools, and interpret the data available for analysis

6.13 Self-Assessment Questions

1. Discuss the difference between the Professional experience and Professional Literature
2. Describe the Source of Research Problem?
3. Explain the Criteria for Good Research?

6.14 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.Jackson, Cenage Learning Publications, Third Edition, 2009
2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.
3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners, Kumar, Dr Ranjit Kumar Sage Publications 2015
5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja Selvamuthu, andDipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.
7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019.

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LESSON 7

RESEARCH DESIGN

Learning Objectives

- ✓ To study the significance of Research Design
- ✓ To Understand the types of Research Design
- ✓ To Know the Different Research Design

Structure

7.0 Introduction

Research simply means search for facts, answers to questions and solution to problems. It is a purposive investigation. It is an 'organized inquiry'. It seeks to find explanations to unexplained phenomenon. But the task of research is sequential process involving a number of clearly delineated steps. For a scientific social research, research design and sampling are two important stages.

Research design consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps. To formulate a specific research problem, constitutes the first step in scientific inquiry. The formidable problem that follows the task of defining research problem is progress in the research work, popularly known as 'Research design'.

A research design is not just a work plan. A work plan details what has to be done to complete the project but the work plan will ¯ow from the project's research design. The function of a research design is to ensure that the evidence obtained enables us to answer the initial question as unambiguously as possible. Obtaining relevant evidence entails specifying the type of evidence needed to answer the research question, to test a theory, to evaluate a programme or to accurately describe some phenomenon. In other words, when designing research, we need to ask: given this research question (or theory), what type of evidence is needed to answer the question (or test the theory) in a convincing way? Research design deals with a logical problem and not a logistical problem' (Yin, 1989: 29). Before a builder or architect can develop a work plan or order materials, they must first establish the type of building required, its uses and the needs of the occupants. The work plan flows from this. Similarly, in social research the issues of sampling, method of data collection (e.g. questionnaire, observation, document analysis), design of questions are all subsidiary to the matter of `What evidence do I need to collect?' Too often researchers design questionnaires or begin interviewing far too early ± before thinking through what information they require to answer their research questions. Without attending to these research design matters at the beginning, the conclusions drawn will normally be weak and unconvincing and fail to answer the research question.

7.1 Meaning of Research Design

It is important for you to understand that developing research design is a challenge to the researcher because the success of her/his research work is depended on the research design.

Any research is valid when its conclusions are true and verifiable. It is reliable when the findings are repeatable. Reliability and validity of the research require the planning of inquiry, i.e. the detailed strategy of how the research will be conducted. Decisions regarding what, where, when, how much, by what means concerning an inquiry or a research study constitute a research design.

The term 'design' means drawing an outline or planning or arranging details. It is a process of making research related decisions before the situation arises. Research design is planning a strategy of conducting research.

It plans as to:

1. what is to be observed,
2. how it is to be observed,
3. when and where it is to be observed,
4. why it is to be observed, how to record observation,

5. how to analyses interpret observations, and how to generalize.

Research design is thus, a detailed plan of how the goals of research will be achieved.

Design versus method.

7.2 Design method Vs. ResearchDesign

It is different from the method by which data are collected. Many research methods texts confuse research designs with methods. It is not uncommon to see research design treated as a mode of data collection rather than as a logical structure of the inquiry. But there is nothing intrinsic about any research design that requires a particular method of data collection. Failing to distinguish between design and method leads to poor evaluation of designs. Equating cross-sectional designs with questionnaires, or case studies with participant observation, means that the designs are often evaluated against the strengths and weaknesses of the method rather than their ability to draw relatively unambiguous conclusions or to select between rival plausible hypotheses.

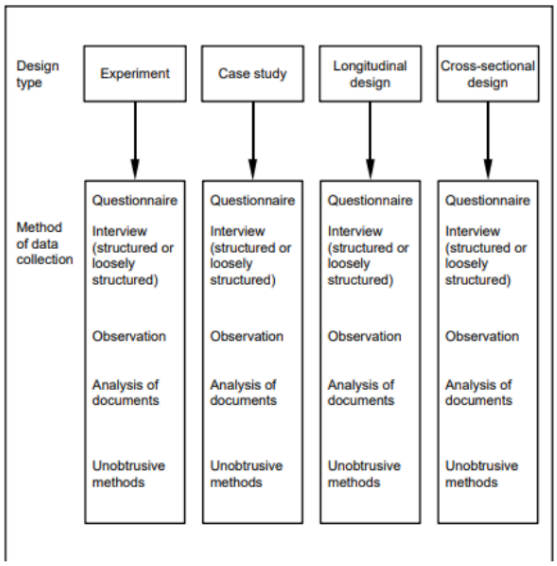


Figure 7.1 Relationship between Research design and Particular data collection Methods

7.3 Significance of Research Design

1. It is a plan that specifies objectives of the study and the hypotheses to be tested.
2. It is an outline that specifies the sources and types of information relevant to the research questions.

3. It is a blueprint specifying the methods to be adopted for gathering and analyzing the data.
4. It facilitates the smooth sailing of the various research operations, thereby making research as efficient as possible yielding maximal information with minimal expenditure of effort, time and money.
5. It has great bearing on the reliability of the results arrived at and as such constitutes the firm foundations of the entire edifice of the research work.

7.4 Advantages of Designing Research

The preparation of a research plan for a study aid in establishing direction to the study and in knowing exactly what has to be done and how and when it has to be done at every stage. Let us look at some more advantages of designingresearch.

1. It enables the researcher to consider beforehand the various decisions to be made.
2. The use of a research design prevents a blind search and indiscriminate gathering of data and guides her/him to proceed in the desired direction.
3. A research plan prescribes the boundaries of research activities and enables the researcher to channel the energies in the right work.
4. With clear research objectives in view, the researcher can proceed systematically towards their achievement.
5. A design also enables the researcher to anticipate potential problems of, operationalization of concepts, data collection measurement etc.
6. Research can be conducted in a scientific way as precise guidelines are provided that reduces inaccuracies.
7. Wastage of time and money is minimized
8. Optimum reliability is achieved.
9. Designing helps in giving useful conclusions and theories.

7.5 Designing Feminist Research

Researchers categorize research by the kind of data it relies upon, by the kind of analytical tools that are employed upon or by the method of data collection. This is a generalized way of approaching research. Butfeminists argue that this approach is guided by the method rather than the research question. Ackerly and True (2010, p.122) discusses feminist approach to research design that entails:

1. Being aware of ways of using different kinds of data, tools for analysis and methodologies of structured inquiry.
2. Designing research meaning selecting cases, deciding how to measure or assess the concepts under study, choosing best methods for data collection and data analysis.
3. Mapping research plan that is doable (keeping the constraints in mind).
4. Setting the plan to a reliable schedule.

7.6 Types of Research Design

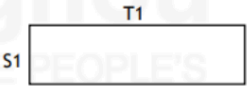
Manheim has pointed out differences in designing three types of research, viz, descriptive, explanatory and exploratory.

7.6.1 Design for Descriptive Research

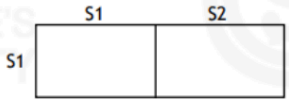
The major goal of a descriptive research is to describe events, phenomena and situations. Since description is made on the basis of scientific observation, it is expected to be more accurate and praise than causal.

Generally in a descriptive research, the data are collected in a single situation

(S) Pertaining to single period
(t). This is called 'One-Cell
Design 'which can be diagrammatically shown as below:



e.g. studying drug abuse among truck drivers in 2009 in Mumbai.
But the study pertaining to one situation or issue can be made in two time periods also as shown in below:



e.g. studying drug abuse among truck-drivers in 2009 and again in2010. It is known as 'ex-post facto design.'

7.6.2 Design for Explanatory Research

Explanatory or causal research is mainly concerned with causes or 'why' factor about some phenomenon. It does not involve comparison and factors of change.

The research design in explanatory study focuses on ascertaining the 'why' aspect of co-relationship. e.g. the study of voting behavior of people in parliamentary elections, held in March 2009 and September2010, were explanatory studies which explained how people so voted because of caste, language, and political ideology, image of candidates.

7.6.3 Design for Exploratory Research

Exploratory studies are conducted for the purpose of formulating a problem for more precise investigation or for developing hypotheses. An exploratory study, may however, have another function, e.g. Increasing the investigator's familiarity with the phenomena s/he wishes to study in a subsequent, more structured investigation or with the setting in which he plans to carry out such an investigation.

Exploratory research is necessary to obtain experience that will be helpful in formulating relevant hypotheses for more definitive investigation. For a general, area of problems about which little knowledge is available, an exploratory study is most appropriate.

So, exploratory research is mostly carried when there is not sufficient information available about the issue to be studied, or in other words, the researcher has either no knowledge or a limited knowledge., study of effect of TV Programmes on Youth.
According to Babbie (2010) exploratory studies are conducted for the following purposes:
To satisfy the researchers curiosity and desire for better understanding.
To test the feasibility of undertaking a more extensive study. • To develop the methods to be employed in any subsequent study.

7.7 Different Research Design

7.7.1 Exploratory Research

Exploratory research is most commonly unstructured, "informal" research that is undertaken to gain background information about the general nature of the research problem.

Exploratory research is usually conducted when the researcher does not know much about the problem and needs additional information or desires new or more recent information
Exploratory research is used in a number of situations:
– To analysis a problem
– To discover new ideas
– To develop concept more clearly
– To establish research priorities
A variety of methods are available to conduct exploratory research:

1. Secondary Data Analysis
2. Experience Surveys
3. Case Analysis

7.7.2 Descriptive Research Design

Descriptive research studies are those studies which are concerned with describing the characteristics of a particular individual, or of a group, whereas,

7.7.3 Diagnostic researchstudies determine the frequency with which something occurs or its association with something else.

7.7.4 Cross-sectional studies measure units from asample of the population at only one-pointIntime. Sample surveys are cross-sectional studies whose samples are drawn in such a way as to be representative of a specific population.

7.7.5 On-line survey research is being used to collect data for cross-sectional surveys at a faster rate of speed.

7.7.6 Longitudinal studies repeatedly draw sample units of a population over time.
One method is to draw different units from the same sampling frame.
A second method is to use a "panel" where the same people are asked to respond periodically.
On-line survey research firms recruit panel members to respond to online queries.

7.8 Summary

Research design is not related to any particular method of collecting data or any particular type of data. Any research design can, in principle, use any type of data collection method and can use either quantitative or qualitative data. Research design refers to the structure of an enquiry: it is a logical matter rather than a logistical one. It has been argued that the central role of research design is to minimize the chance of drawing incorrect causal inferences from data. Design is a logical task undertaken to ensure that the evidence collected enables us to answer questions or to test theories as unambiguously as possible. When designing research, it is essential that we identify the type of evidence required to answer the research question in a convincing way. This means that we must not simply collect evidence that is consistent with a particular theory or explanation. Research needs to be structured in such a way that the evidence also bears on alternative rival explanations and enables us to identify which of the competing explanations is most compelling empirically. It also means that we must not simply look for evidence that supports our favourite theory: we should also look for evidence that has the potential to disprove our preferred explanations.

7.9 Key words

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

Descriptive research- Descriptive research is to describe events, phenomena and situations. Since description is made on the basis of scientific observation, it is expected to be more accurate and praise than causal.

Explanatory Research-Explanatory or causal research is mainly concerned with causes or 'why' factor about some phenomenon. It does not involve comparison and factors of change.

Exploratory Research- Exploratory studies are conducted for the purpose of formulating a problem for more precise investigation or for developing hypotheses

On-line survey research is being used to collect data for cross-sectional surveys at afaster rate of speed

7.10 Self-Assessment Questions

1.Define the Research Design? Discuss the significance of Research Design?
2. Discuss the Types of Research Design?
3. Give a Outline on the Types of Research Design?
4. Elucidate the different Research Designs?

7.11 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009
2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.
3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners, Kumar, Dr Ranjit kumar Sage Publications 2015
5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja Selvamuthu, and Dipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Edu creation Publishing 2019.
7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019.

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LESSON 8

EXPERIMENTAL DESIGN

Learning Objectives

- ✓ To classify experimental research on the basis of applying various kinds of controls;
- ✓ To discuss various kinds of pre-experimental designs;
- ✓ To focus various kinds of true experimental designs;
- ✓ To study various types of quasi-experimental design;
- ✓ To enumerate the steps of experimental research;

Structure

8.0 Introduction

The purpose of experimentation is to study the effect of manipulated independent variable on the dependent variable. In educational setting, independent variable can be manipulated indifferent ways. An outline has to be drawn about the way a researcher would like to manipulate independent variable. The main objective of outlining the experimentations to find out the true effect of manipulated variable. Certain factors creep in while manipulating certain functions. These factors either come from the process of experimentation or from outside. Their presence interferes with the treatment. Under such circumstances true effect of the treatment cannot be achieved. In order to get true effect the researcher has to apply certain checks or controls so as to partial out the effect of intervening variables. Process of applying these controls is basic to the experimental design or lay out of the experimentation.

8.1 Types of Experimental Design

In order to apply the controls, the researcher may:

Assign subjects randomly to the groups Assign treatments to the groups randomly Equate the groups to the maximum extent with respect to various intervening variables
Have post-test of all the groups involved in the experiment.

Those designs where all the above mentioned four criteria are satisfied in toto are termed as 'True Experimental Designs'. These designs are very sophisticated involving rigorous controls and have limited practicability in educational settings. The researcher in educational settings may not be able to apply such rigorous controls. The reason being that the controls may take the researcher away from the reality and in that case the conclusions of the experiment may not be generalizable.

Under such circumstances the researcher may follow some of the above mentioned four criteria in order to apply required controls. Therefore, those experiments were. some of the above mentioned four criteria are met are termed as 'Quasi Experimental Designs'. These designs have greater applicability in education. Further the researcher may sometimes feel such a situation, where it is difficult to follow even one or two of these criteria. The experimental designs where criterion like post-testing is possible are designated as 'Pre-experimental Designs'. These designs have less scientific value for having inadequate controls.

According to the sophistication and the rigor of controls followed the designs may be arranged as:

1. pre-experimental designs
2. True experimental designs
3. Quasi-experimental designs

The designs resemble one another from point of view of purpose and their adherence to the principles of experimentation. They differ in the degree of accuracy with which they attack the problem or meet the essential criteria of control, manipulation, observation, and replication. No design solves all the problems. The nature of the problem determines which

type of design is most appropriate and applicable and how the design should be used to meet the requirements of the experiment.

8.1.1 Pre-Experimental Designs

Pre-experimental designs provide little or no control of extraneous or situation variables. They are, however, still being used in the study of educational problems. Suppose a researcher is interested in finding out the effect of educational television programmeon the general awareness of students. The programme is launched as mass mediaprogrammes in the public sector with a view to developing general awareness of school students. This programme is available to particular region of the country. In thiscase, the treatment is television programme that is already operative in the field. The researcher does not have to manipulate this programmme with a special objective and he has no control over this treatment. In order to achieve his research objective, the, researcher will take a group of students who are being exposed to this televisionprogramme. For comparing the effect of this television programme with conventional treatment, the researcher may take another group that has not been exposed to the televisionprogramme. Due to the field constraints the researcher will not be able to randomly assign the treatment to the groups. Further, he will be unable to equate the groups on intervening variables. He will be doing only one thing easily, that is he will be able to measure the general awareness (dependent variable) of subjects of both the groups after a particular period of time.

Note that in this experiment, the researcher has not formed the groups randomly, treatments have not been given to the groups randomly and the groups have not been equated on intervening variables. However, both the groups have been post-tested.

Thus the experimental designs where only the criterion of 'post-testing of all the groups ‘is met are called as 'Pre-experimental designs'.

There are three types of pre-experimental designs. These are One Shot Case Study, One group Pre-test Post-test Design, and Static Group Comparison Design.

8.1.1(a) One Shot Case Study Design

The researcher wants to study the effect of free lunch programme on disruptive classroom activity. The researcher selects a school. The free lunch programmeis launched for a period of six months. At the end of this period the teachers of the school are interviewed about the disruptive classroom activities. In this case, treatment (free lunch programme) is applied tb the institution. At the end of the treatment, the dependent variable (disruptive classroom activities) is measured. When such a procedure in experimentation is followed, the design is called as One-Shot Case Study design.

Strengths

In this design -

a) One group of subjects or a single subject or an institution is taken.

b) The treatment is applied for a particular period of time.

c) At the end of the treatment the dependent variable is measured.

Limitations

a) The design is not valid against the criterion of History. For example, on the basis of observations (interview of teachers) made at the end of the treatment the researcher may conclude that disruptive classroom activities curtailed because of the free lunch programme.

It is quite possible that curtailment of disruptive activities occurred because of change in administrative policy in the school or examination drawing near or school timings changed etc. In other words,such changes or occurrences of events might have affected the dependent variable rather than the treatment, hence the criterion of History is not met.
b) The design is not valid against the criterion of maturation. You know, in the example being discussed the free lunch programme continues for a period of six months. During this period some psychological and biological changes may take place amongst the students. That is students may become aware of the need to pay attention to the teachers' teaching or the students may develop positive attitude towards studying. Such types of psychological changes are called as Maturation and these may influence the dependent variable.

8.1.1(b)Experimental Research

The design is not valid against the criterion of Selection. In the example under discussion, the researcher took a school where free lunch programmewas launched. It is quite possible that the students in the school were having positive attitude towards studies or they might be the wards of educated parents etc. Such types of factors were existing in the group on which the experiment was conducted, there is every possibility that the findings of the experiment are not true.

The design is not valid against the criterion of Mortality. The treatment continued for a period of six months. It is quite possible that some mischievous students might have left the institution during the treatment period. Because of their leaving the institution, disruption in the classroom might have been curtailed. In such a situation if the researcher draws a conclusion on the basis of experimentation that disruption was curtailed due to treatment, it may not be true. The reason being that going away of some mischievous students from the school has affected the dependent variable.

The design cannot provide evidence of causal relationship and it cannot add to the body of knowledge with reliable and valid evidences.

Applicability:
The one-Shot Case Design can be applied in the following situations:
a) The researcher has to carry out the experiment with one group of subjects or an institution.
b) The researcher takes up a variable or experimentation that has already been launched by some agency say government or any NGO etc.

8.1.1 (c) One Group Pre-test Post-test Design

When an experimenter uses this design, he measures dependent variable, before the independent variable X is applied or withdrawn and then takes its measurement again afterwards. The difference in the measurements of dependent variable, if any, is computed and the amount of change is taken as a result of the application or withdrawing Educational Research of independent or treatment variable

Pre-test	Independent Variable	Post-test
T_1	X	T_2
Mean of the criterion test	Detailed correction on students' writing	Mean of the criterion test

Strengths

a) Only one group of subjects has been taken and they measured before and after the treatment.
b) The design is valid against the criterion of Selection and Mortality. In the example under study the researcher measured the writing efficiency at both the pre-test and the post-test stage. Suppose the group taken for experimentation consists of highly intelligent, motivated and creative individuals. These characteristics of the subjects will equally influence the measurement at the pre-test and post-test stages. Similarly, if some students drop out during experimentation, the process will be well taken care of at the pre-test and the post-test stages, that is, at the time of analysis the pre-test scores of the drop outs will not be taken into consideration. Thus, the design is valid against the internal validity criterion of selection and mortality.

Limitations

1. This design does not use any control group and, therefore, the experimenter cannot assume that the difference between the pre-test mean and the post-test mean was brought about by the experimental treatment or by some extraneous variables.

2. History and maturation are two major extraneous variables that are not controlled in this design. History refers to the specific events that can occur between thepre-test and the post-test other than the exposure of subjects to the experimental treatment. In the illustration, for example, the increase in writing efficiency at the post-test stage could be due to the events like practicing by the students at home, or reading extra material etc. Occurrence of such events can increase student achievement in this area. Maturation variable refers to changes in the subjects themselves that occur with the passage of time. For example, it is quite possible that during the period of treatment, subjects might have gained mental maturity, accustomed to writing in English etc. Such biological and psychological factors might have affected writing efficiency along with treatment. Thus, in a design like this history and maturation become potent sources of extraneous variance when the time interval between the pre-test and post-test is long.

3. This design does not provide any procedure for evaluating the effect of post-test Experimental ~esearch-11itself. There is practice effect when the subjects take a test a second time or even take a parallel form of the test. That is, subjects perform better at the posttest stage even without any teaching.

4. There is a problem of reactivity in the design due to a teaching between the subject and pre-test measure. It is this reaction rather than the treatment variable that produces the change in the post-test measures. For example, the novel or controversial content of a pre-test may motivate the subjects to react in a particular manner and it is this reaction that brings about the observed change in subjects at the post-test stage.

5. The instruments used for measuring writing efficiency at the pretest and post-test stage are the same. Various characteristics of the instrument such as interpretation of items, subjects, item difficulty etc. will remain unaltered at both the stages (pre-test and post-test stages). The experience gained in the interpretation of items at pre-test may be carried over to the post-test stage.

Thus improvement at the post-test stage may not be due to the treatment only. Therefore, it can be said that the design is not valid against the criterion of instrumentation.

6. The design is not valid against the external validity criteria of testing and treatment. In the example under discussion, the exposure to pre-test may make the students aware of the criterion required in writing efficiency like continuity of ideas, use of specific words etc. During the treatment of detailed correction, the same criteria are emphasized. So, the students who have been pre-tested become more attentive and responsive to the treatment of detailed correction. This in other words means that exposure of subjects to pre-test has interacted with treatment. This may ultimately affect the post-test performance. The conclusion drawn on the basis of such design therefore cannot be generalized to the group of students whohave not been pre-tested.

7. The design is not valid against the extremal validity criterion of interaction of selection and treatment. It is quite possible that the students selected in the group are highly intelligent, motivated and creative. Because of these characteristics, they may involve themselves more during the treatment of detailed correction.

Their remaining active and responsive during the treatment will affect their posttest scores. So, the improvement in the post-test may be because of the interaction of selection and treatment. The findings of such a study are limited to particular type of students and these cannot be generalized to the population.

8. This design is weak and cannot provide true evidence of causal relationship among the variables.

Applicability: One group pre-test post-test design is applicable to all those situations where :

a) The interval between pre-test and post-test is of short duration.
b) The equated groups are not available.
c) This design has an edge over the One-Shot Case Study design as the pre-test is added to it. The addition of pre-test provides information about the selected subjects.

8.1.1 (d) Static Group Comparison Design

In such designs two groups are selected and one of the groups is exposed to the experimental treatment and the other group is not exposed to any experimental treatment. The group not exposed to any treatment acts as the control group and the students of this group continue their usual classroom studies. The design permits the comparison that is required by a scientific investigation. The experimenter assumes the two groups to be equivalent in all relevant aspects at the start of the experimentation.

8.1.1 (e) Educational Research

There is no pre-test and the dependent variable is measured for the two groups after the treatment and then compared (post-test), to determine the effect of independentvariable or treatment variable. If the experimental group performs better on the posttest, the experimenter is more confident that the independent variable is more responsible for the change in the dependent variable.

Group	*Independent Variable*	*Post-test*
Experimental	Supervised Library Study	T_2
Control	Usual Classroom Study	T_2

Table 8.1 Educational research

Strengths

a) The design is valid against the internal validity criterion of History and Testing. Any special event occurring during the treatment will equally affect both the groups. For example, the institution may arrange some lectures by experts or arrange some debate, etc.; all these events will equally affect both the groups. Further since the students have not been exposed to the pre-test, there will be no learning experience to the students before the treatment. Thus, the treatment effect will not be mistaken for testing.

b) The design is valid against the internal validity criterion of Instrumentation. Since both the groups have been administered the same achievement test after the treatment of supervised library study, the characteristics of the measuring instrument will have a similar effect on both the groups. So, the effect of type of items or difficulty level of items in the test etc. will not change the nature and extent of post-test score.

C) The design has an edge over one group pre-test post-test design because in it control group has been introduced without the pre-test situation.

Limitations

a) Since neither randomization nor matching is used to assign subjects to the experimental and control groups, the experimenter cannot assume that the groups as equivalent with respect to relevant extraneous variables before they are exposed to the experimental treatment. This design, therefore, is also considered to be lacking in the necessary control.

b) The design is not valid against the internal validity criterion of selection. It is quite possible that (in the example being discussed), the subjects of one of the groups are more intelligent and creative than the subjects of the other group. Since all these variables affect the achievement, the differences between the post-test measures of the experimental and control groups may not be entirely due to the treatment.

The groups, in the example under discussion, are comparable but not equivalent Experimental Research on the variables of intelligence, aptitude, study habits, etc. If by chance some of the intelligent students of the group remain absent in the study, the post achievement will be affected. Thus, the experimental mortality may produce differences in the groups due to differential dropout of subjects from the groups. Therefore, the two groups once equivalent may differ later because of selective dropout of subjects.

d) The design is not valid against the criterion of interaction of Selection and Maturation. In the example given in the box, if by chance one of the groups having more intelligent students is exposed to some special events like lectures by experts or arrangement of excursions etc, there is every possibility that these students will fare better in the post-test than their counterparts in the other group. This means that the design is not valid against the internal validity criterion of selection and maturation.

e) The design is not valid against the external validity criterion of selection and treatment. In the example being discussed here, if by chance one of the groups has subjects with good study habits and this group is given treatment it is quite obvious that such subjects will benefit more from the supervised library study. In otherwords, the characteristics of the subjects will interact with the treatment. Because of this interaction the students of treatment

group are apt to achieve more on achievement test than their counterparts. The conclusions based on such a design cannot be generalized to those students who do not have good study habits.

Applicability:
The Static Group Comparison Design is applicable in all those situations
where:
a) The researcher does not have control over situations and is unable to alter natural settings in an educational institution.
b) The groups are comparable.
C) There are chances that the pre-test will sensitize the group and affect the dependent variable.

8.1.2 True Experimental Designs

True experimental designs are mostly used for experimental research in education because they seek to control the main effects of history, maturation, testing, measuring instruments, statistical regression, selection, and mortality (Koul, 1988). The researcher may be interested in comparing the self-instructional method with the conventional method in terms of achievement of IX grade students, in science. In order to pursue this objective, the researcher may form two groups of students.

Before proceeding further with the formation of groups he will try to find out those variables that may influence the achievement of students irrespective of the method of teaching. These variables can be - intelligence, motivation, sex,socio-economic status, previous achievement in science etc. The researcher will equate these groups of students on these variables and randomly assign the students to the groups. If the mean scores of students on these variables is computed, it will be found that the means of two groups will not differ significantly. That is to say, that the two groups are equated on the above-mentioned intervening variables.

After formation of groups, the researcher will administer the achievement test to the students of both the groups. This is termed as the pre-test. The pre-test scores will reveal initial differences, if any, with respect to achievement of students of the two groups. After this the researcher randomly exposes one of the groups to the self-instructional method and the other group to the conventional method.

The group exposed to the self-instructional method is designated as the experimental group and the group exposed to the conventional method is termed as the control group. The content of teaching and the time of exposure to treatment to both the groups remain similar.

It may be mentioned here that the experiment is conducted in the same institution, therefore the environmental variables like institutional climate, schedule in the school remain the same for both the groups. At the end of the treatment (teaching) both the groups are administered the same achievement test. The scores of students on this test constitute post-test scores. In this way the dependent variable (achievement of students) has been measured before and after the treatment in randomized equivalent groups. The layout of such designs is as follows:

8.1.2(a) Pre-test Post-test Control Group Design

This design is also called as 'Randomized Control-group Pre-test-Post-test Design'. From the example cited above, it may be observed that the researcher has undertaken a study with the objective of comparing the self-instructional method with the conventional method for teaching science at IX grade level. In pursuance of this objective two equated groups are

formed by randomly assigning subjects to the groups. Both groups are administered a similar achievement test as pre-test. The treatments are randomly assigned to the groups. The duration of the treatment has been similar. At the end of the treatment, both groups are administered the same achievement test. The scores on this test are termed as post-test scores. When a researcher follows this type of procedure during experimentation he employs Pre-test Post-test Control Group design for the research study. In this design the dependent variable (achievement test) has been measured before (pre-test) and after (post-test) the treatment (method of teaching) in the randomized equivalent groups. The difference between means of pre-test and posttest is found in order to ascertain whether the experimental treatment produced a significant effect.

The strengths and limitations of this may be enumerated as follow:

Randomly assigned group	*Pre-test*	*Independent Variable*	*Post-test*
Experimental group	T_{1E}	Teaching through Self-instructional Method	T_{2E}
Control group	T_{1C}	Teaching through Traditional Method	T_{2C}

Table 8.2 Pre-test and Post Test Control Group Design

Strengths

The main strengths of this design may be listed as:

1. The strength of this design lies in the random assignment of subjects at the initial stage, which assures equivalence between groups prior to experimentation.
2. The experimenter's control over the pre-test provides an additional check on the equality of the two groups on the dependent variable.
3. ' This design, with its randomization, seeks to control most of the extraneous variables, like the main effects of history, maturation, pre-testing, differential
selection of subjects, statistical regression and mortality that pose a threat to internal validity.

Limitations

The main limitation in using this design is a threat to its external validity due to the following reasons (Koul, 1988).

1. There is interaction between the pre-test and the experimental treatment. This interaction may change or sensitize the subjects in certain ways. Although the subjects of the experimental and control groups take the same pre-test and may experience the sensitizing effect, the subjects of the experimental group because of their increased sensitivity may respond to the experimental treatment in a particular way. For example, if attitudinal change were the dependent variable the problem would have been quite highlighted. When the first attitude scale is administered as the pre-test in such a study, it can sensitize both experimental and control subjects to the issues or the content included in the scale. But the subjects of the experimental group may not respond in the same way to the experimental treatment, given in the form of a lecture, film or the like, as the control group subjects. Therefore, the experimenter may only be able to generalize findings to pre-tested groups and not to pre-tested ones from which the experimental subjects were chosen.
2. There is also interaction of selection of subjects and experimental treatment. The cultural background, or some other characteristics of the subjects, who are selected to participate in an

experiment, may make the experimental treatment more effective for them than it would be for the subjects elsewhere.

3. The interaction of experimental variable with other factors, such as history, also makes it impossible to generalize the findings beyond the specific conditions or situations in which the experiment was conducted. To overcome this difficulty, the experimenter should replicate the study in different time and place settings so that generalizations concerning the findings can be made with greater confidence.

4. The reactive effects of the experimental procedures on the subjects of the experimental group or who administer the treatments may also create problems in making generalizations. For example, if the subjects of the experimental group know that they are participating in an experiment, they may not react normally to the experimental treatment. Keeping the experimental group subjects unaware of the fact that an experiment is being conducted can minimize the reactive effect of the experimental procedures.

8.1.2(b) Post-test only Control Group Design

In the foregoing paragraph we have studied pre-test-post-test control group design. From this design if we remove pre-test then it takes the shape of post-test only control group design. The illustration given in the box will explain that the available subjects are assigned to two groups through randomization that controls all possible relevant extraneous variables. No pre-test is used and the random assignment of subjects assures that any initial differences between the groups are attributable only to chance.

The two random samples from population are obtained in two ways: (i) The subjects may be drawn individually at random and assigned alternatively to the groups; or (ii)With different random samples may be selected first and the groups assigned randomly to the experimental or control condition. Only the experimental group is exposed to the experimental treatment. At the end of the experiment, subjects of both the groups are measured on the dependent variable. The means of the two groups are compared with the help of an appropriate statistical test of significance.

Randomly assigned group	*Independent Variable*	*Post-test*
Experimental	Teaching through New Method	T_2
Control	Teaching through Conventional Method	T_2

Table 8.3 Post test only control Group Design

The illustration given in the box shows that dependent variable reading speed has been measured at the end of the treatment (method of teaching) in randomized equivalent groups. Because of these features the design has been termed as post-test-only Control Group Design.

Strengths

1. The main advantage of this design is randomization, which assures statistical equivalence of the groups prior to the introduction of the experimental treatment.

2. Since no pre-test is used, this design controls for the main effects of history, Experimental research maturation, and pre-testing. Moreover, there can be no interaction effect of pretest and independent, or experimental variable. Hence, this design is especially recommended for the experiments in which pre-test sensitization is likely to occur.

3. This design is useful in the experimental studies, especially at kindergarten or primary stages, in which a pre-test is either not available or not appropriate.

Limitations

In spite of all the advantages mentioned above, this design suffers from the following limitations:

1. The use of this design seriously restricts the external validity of the experiment. The experiment can partially overcome this limitation by replicating the experiment with different groups.

2. There are some situations in which it is not possible for the experimenter to select subjects at random from the population of interest. In such cases, Ary et a1(1972, p. 243) suggest that the experimenter must begin with available subjects and assign them randomly to the groups.

3. The post-test only control group design can be applied in all those situations where:

a. A large number of subjects are available. From these subjects equivalent groups can be formed by randomly assigning the subjects to the groups.
b. Treatment can be randomly assigned to the groups.
c. The groups can be post-tested with the same instrument.

From the discussion presented in this paragraph it may be said that posttestonly control group design is very much similar to pre-test post-test control group design but for one difference that pre-test is not held in the post-test only control group design. The design is valid against all criteria of internal validity such as History, Maturation, Testing, Instrumentation, Regression, Selection, Mortality and Interaction of Selection and Maturation. Its findings can be generalized to the population because the design has external validity with respect to interaction of testing and treatment criterion. It has application to those situations where the researcher can afford to have rigorous controls.

8.1.2 (c) Solomon Four Groups Design

Till now you have studied pre-test post-test control group design and post-test only control group design. The researcher is interested in comparing the self-instructional method with the conventional method in terms of achievement of IX grade students in science. In order to achieve this objective, the researcher forms four equated groups by randomly assigning subjects to the groups. These groups are equated on the variables like intelligence, motivation, previous achievement in science, sex, socio-economic status,etc. Let these four groups be named as A, B, C, and D. Of these four groups any two groups are randomly selected and pre-tested by administering an achievement test. Let us say these groups are A and C. After this one pre-tested group (say A) and another un-pre-tested group (say B) receives the treatment that they are exposed to self-instructional material. The remaining two groups (say B and D) are exposed to the usual conventional method. Here it may benoted that the treatment is randomly. Given to the groups. The duration of treatment has been same to both the groups. At the end of the treatment all the four groups are given the same achievement test that was given at the pre-test stage. The scores on this test are termed as post-test scores.

From the illustration given in the box, it may be observed that the dependent variable Educational Research (achievement test) has been measured at the pre-test stage in case of two groups. All the four groups have been measured for the dependent variable at post-test

stage at the end of the treatment. The four groups were randomly formed and treatments were randomly given to the groups.

Randomly assigned	*Pre-test*	*Independent Variable*	*Post-test*
Experimental group (E)	T_{1E}	Teaching through Self-instructional Method	T_{2E}
Control group (C_1)	T_1C_1	Teaching through Conventional Method	T_2C_1
Control group (C_2)	No pre-test	Teaching through Self-instructional Method	T_2C_2
Control group (C_3)	No pre-test	Teaching through Conventional Method	T_2C_3

Table 8.4 Solomon Four Group Design

Strengths

1. This design provides control over any possible contemporary effects that may occur between pre-testing and post-testing.

2. This design actually involves conducting the experiment twice, once with pretests and once without pre-tests. If the results of these two experiments are in agreement, the experimenter can have much greater confidence in his findings.

Limitations

1. The design is difficult to carry out in practical situations. It involves more time and effort to conduct two experiments simultaneously and there is the problem of locating the increased number of identical subjects that would be required in the experiment.

2. Since this design involves four sets of measures for four groups and the researcher has to make comparisons between the experimental and first control group (Aand C) and between second and third control groups (B, and D), there is no single elementary statistical procedure that would make use of the six available measures simultaneously. In the light of this difficulty, this design is generally recommended for a more advanced level of research.

Applicability: The design can be applied in all situations where:
a) A large number of subjects are available and from these subjects four equivalent groups can be formed by randomly assigning subjects to the groups.
b) Of the four groups two randomly selected groups can be pre-tested.
C) Treatment can be so assigned to the groups that one pre-tested group and oneun-pretested group receives treatment randomly.
d) All the four groups are post-tested.
e) The same instrument or parallel form of the instrument can be used at pre-test and post-test stage.

In short, it may be inferred that the main features of Pre-test Post-test Control Group Design and Post-test only Control Group Design are simultaneously present in the Solomon Four Group Design. This design is valid against the criteria of internal validity like- History.

Maturation, Testing, Instrumentation, Regression, Selection, Mortality and Interaction of Selection and Mortality etc. The findings obtained by applying this design can be generalized to the population, as it is externally valid against the interaction of testing and treatment criterion.

The Solomon Four Group Design is a powerful experimental design

The Solomon Four Group Design is a powerful experimental design as there is inbuilt Experimental ~escarch-1mechanism of verification of results. Its main limitation is that it requires a rather large sample, more time and much effort on the part of the researcher.

8.1.2 (d)Factorial Designs

The discussion about the various designs thus far has been confined to classical singlevariable designs, which require that an experimenter manipulates one independent variable to produce an effect on the dependent variable. Human nature is complex and experimenter in educational situations cannot always fulfil these requirements. One independent variable alone may not produce the same effect as it might in interaction with another independent variable. The findings, therefore, from a one variable design may be meaningless. For example, the effectiveness of a teaching method depends upon a number of variables such as the intelligence level of students, the type of the teacher teaching the group, and so on. In such type of experiment, a classical one-variable design would not reveal any information about the interactive effect of the method of teaching and intelligence level or any other variable. The example given in the box below will clarify further.

A factorial design enables the experimenter to evaluate or manipulate two or more variables simultaneously in order to study the effects of number of independent factors singly as well as the effects due to interactions with one another. Factorial designs vary according to the degree of complexity depending upon the nature and purpose of the experiment. They include two or more independent variables, and each one is manipulated in two or more ways to assess both their separate (main) and their combined (interaction) effects.

Strengths

1. The differences in the effect of different levels or categories of more than one variable can be studied with factorial designs simultaneously. An experimenter, therefore, can accomplish in one experiment what otherwise might require two or more separate experiments.
2. While studying the significance of the differences in the dependent variableunder the effect of the levels of any of the factors the groups become alike with respect to the different levels of other factors and thus the groups get controlled as far as the levels of the other factors are concerned.
3. Besides studying the significance of the differences in the levels of the factors, the factorial designs provide an opportunity to study interactions between the factors.

Limitations

A factorial design may include any number of independent variables with any number of levels of each. However, when the experimenter manipulates or controls too many factors simultaneously, the experiment and the statistical analysis of the data sometimes become unmanageable. Moreover, the combinations of too many variables also become artificial (Koul, 1988).

Applicability:

The factorial designs have their applicability in all those situations where:

a) Along with the effect of each of the independent variable on dependent variable, the researcher is interested in finding out the effect of interactions of the factors (independent variables) on dependent variables.

b) The same group of subjects is to be utilized in estimating effects of two or more dimensions of independent variables, thus helping in economizing time and money as well as personnel.

C) The simultaneous use of independent variables makes it possible to bring out interactive effects of treatments and may have an accelerating effect on the action of some other independent variable on dependent variable.

8.1.3 Quasi Experimental Designs

The true experimental designs, as discussed earlier, provide full experimentalcontrol through the use of randomization procedures. However, in the field experiments, the researcher may have to take the whole group of subjects in an institution. It may not be possible for him to divide the group or randomly assign the subjects to the groups.

He may assign the treatments to the groups randomly. Further he may try to equate these groups up to the maximum extent under the existing circumstances. In such situations, the researcher has to depend upon quasi-experimental designs, that provideas much control as possible under the existing conditions. If an experimenter uses aquasi-experimental design, it is necessary for him to know which of the variables his design may fail to control. He must also be aware of the sources that represent threats to both internal and external validity and consider them while interpreting the results of the experiment. Thus, the designs that meet the criteria of random assigning of treatment to the groups, equating the groups to the maximum extent, and administration of the post-test are classified as Quasi Experimental designs or Compromise Designs. There are a large number of Quasi-experimental Designs. A few of these are explained in the paragraphs to follow.

8.1.3(a) Non-equivalent Control Group Design

In a school situation, it is sometimes practically not possible to upset class schedules like reorganizing the classes in order to employ randomization procedures for getting equivalent control and experimental groups. Under these circumstances an experimenter may use pre-assembled groups, such as intact classes, for framing experimental and control groups. The pre-assembled groups are selected and are administered pretest.

The pretest scores are analyzed to show that the means and standard deviations of the two groups do not differ significantly. After determining the groups, the experimental treatment is administered to the experimental pup and then the posttest is given to both the groups. The difference between the pre-and post-test scores are compared with the help of appropriate statistical test to ascertain the effect of the independent variable.

Group	*Pre-test*	*Independent Variable*	*Post-test*
Experimental	T_1	New teaching method	T_2
Control	T_1	Traditional teaching method	T_2

Table 8.5 Non-equivalent Control Group Design

Strengths

1. The design is valid against the internal validity criteria of History. Maturation, Testing, Instrumentation, Selection, and Mortality on the following counts:
a) If special events like debate, excursions, exhibitions etc. occur during the period of experimentation, these will equally effect both the groups.
b) The biological and psychological changes like fatigue, loss of interest etc. if any will manifest itself equally in experimental as well as control group. Thus, controlling the factor of Maturation.
c) Both the groups will have similar learning experiences from the pre-test.This experience will affect the post-test performance in a similar manner. So, the testing effect will be controlled.
d) Whatever way the students respond to the items on achievement test, it will remain similar at both the stages in both the groups. The instrument being fixed, its effect is controlled.
e) The individual differences if any, will affect the post-test scores in both the groups. The effect due to individual differences will be balanced when the groups are compared. In this way the effect. of selection is internally controlled in the design. f) In this design the data of all the students who have appeared in the pre-test and post-test are analyzed. The lost cases (Mortality), if any, are not taken up for consideration.
g) The reactive effects of experimentation are easily controlled. When the preassembled groups are used, subjects are less of the fact that they are subjected to the experimental treatment than when the subjects are drawn from the class through randomization and put into experimental sessions.
h) The experiments using this design are conveniently conducted in the school situations where the researcher has no control to manipulate the variables asper his design.

Limitations
1. The selection of subjects for the experimental and control groups may result in interaction effect between selection and certain extraneous variables like selection and maturation and testing and treatment.
a) It is quite possible that one of the groups taken for study has higher rate of maturation than the other group. Under such circumstances, the treatment given to such a group will show boosted results that may ultimately affect the dependent variable.
b) When unusual test procedures like pre-test and post-test are used, these affect the mental makeup of the subjects about the treatment. This perpetual change due to the pre-test in both the groups may hamper the effect of the treatment. Thus, the external validity criterion is vitiated because of the interaction of the testing procedure and the treatment.

Applicability: Non-equivalent Control Group Design can be applied in all those field settings where:
a) Subjects cannot be assigned randomly to the experimental and control groups.
b) The control group receives a conventional or usual treatment rather than not treatment.
C) The groups of subjects are available.
d) Both the groups can be pre-tested as well as post-tested
The design becomes more powerful when the experimental and control groups Experimental Research are similar with respect to pre-test. This makes the control more effective and provides valid effect of the treatment.

8.1.3 (b) Separate Sample Pre-test Post-test Design

Measurement of dependent variable in two randomly selected equivalent sub-groups where one subgroup is pre-tested and the other subgroup is given the treatment and post-tested is known as separate sample pre-test post-test design. Strengths

1. The separate sample pretest post-test design is valid against the internal validity criteria of Testing, Regression and Selection on the following counts:

a) All the subjects in the group have been exposed to the treatment. But only one subgroup has been pre-tested and the other group has been post-tested. There will not be any carry-over effect of testing, as the group that has beenpre-tested has not been post-tested.

b) The mean pre-test scores of one sub-groups and the mean post-test scores of another subgroup are compared. Thus, regression effect does not exist in the

c) As only one group of students has been taken, two subgroups form the part of this group. Randomization has been used while forming the subgroups where every student has equal chance of being selected to any of the subgroups. In this way the selection effect is inherently controlled in the design.

2. The design is valid against the external validity criteria of interaction of testing and treatment, interaction of selection and treatment and reactive arrangements.

a) In this design one of the treatment groups does not have any knowledge ofpre-test items. Thus, interaction of testing and treatment will not take place.

b) The two subgroups in the design have random equalization. One of the subgroups is pre-tested and the other subgroup is post-tested. When the pretest and post-test scores of these separate equivalent subgroups are compared, the effect of the characteristics of selected sub-groups will be balanced. Thus, the interaction of selection and treatment will not take place.

c) In the design the sensitization to pretest is absent, random equalization does not disturb the classroom setting (the whole class is involved in the experimentation process) and the treatment has been given to the whole class. Thus, it does not create unusual expectations in the subjects. In this way reactive arrangements do not vitiate the effect of the treatment.

3. The design is specifically useful for the large population that cannot be divided in separate groups for different types of treatments.

8.1.3 (c) Counter Balanced Design

When the random assignment of subjects to experimental and control groups is not possible, the counterbalanced design may be used. This design also uses intact classes and rotates the groups at periodic intervals during the experimentation. This design is also known as rotation group design, crossover design or switchover design. In this design each group of subjects is exposed to each experimental treatment at different times during the experiment.

In short it can be said that in the counterbalanced experimental design the groups of subjects are taken from different institutions in their natural setting. The number of treatments could be equal to the number of groups. The selected groups are comparable but non-equivalent. The treatments are administered to the groups in such a way that each group of subjects gets each treatment once and for once only at different points of time. The treatments are administered randomly. At the end of each treatment given to each group the dependent variable is measured with the same instrument

Replication	*Modular approach*	*Radio-vision approach*	*Conventional approach*
Chapter 1	Group A	Group B	Group C
Chapter 2	Group B	Group C	Group A
Chapter 3	Group C	Group A	Group B
	Column mean	Column mean	Column mean

Table 8.6 Counter Balanced Design

Strengths

This design overcomes and eliminates any differences that might exist between the groups. Since all the groups are exposed to all the treatments, the result obtained cannot be attributed to preexisting differences in the subjects.

1. The design is valid against the criteria of History, Maturation, Testing, Instrumentation, Regression, Selection and Mortality as well as Interaction of Selection and Maturation.
a) If some special event occurs during the treatment at one stage, then each treatment will also be exposed to the impact of that event.
b) If there are some biological or psychological changes in a particular group, these will be reflected in post-test and when such a group is exposed to another treatment the maturation effect will be taken care of.
C) Testing effect will be taken care of when different groups are compared as it will be counterbalanced.
d) Instrument effect, if any, will be equally present in all the groups and will be counterbalanced on comparison.
e) In this design the subjects are not pre-tested but only post-tested. So there is no question of Regression.
f) If by chance one group happens to be more intelligent than the other groups, then each treatment will profit from this superiority. The same will be balanced on comparison.
g) If some mortality occurs during the process of experimentation, it will equally affect all the treatments.
h) There is a possibility that all groups may get some fatigue when the experimentation is in progress. During replication, the factor of fatigue will affect the mean scores of each group. The counterbalance process implied in the design will take care of this factor.

Limitations
a) The design is not valid against the external validity criteria of multiple treatment interference. There is carry-over effect of the groups from one treatment to the next. Therefore, this design should be used only when the experimental treatments are such that administration of one treatment on a group will have no effect on the next treatment.
b) Since many replications are involved, it is not always possible to have equivalent learning material during various replications.
C) There is a possibility of boredom when students are exposed to various replications.

Applicability: This design is applicable to those field researches were

a) The researcher has little control over the assignment of subjects to the groups and has to use intact classes
b) The number of treatments is equal to the groups and treatments can be rotated Educational Research amongst the groups.
c) The interaction between the treatments, occasions and groups is not desired.
d) There is need to achieve consistency in findings by internal replication of the experiment.

8.1.3 (d)Time-series Designs

There are two types of time-series designs. One-group Time-series Design This design takes into account a series of measurement on the dependent variable before and after the group is exposed to experimental treatment. The experimenter takes a number of measurements on the independent variable, exposes the group to the experimental treatment, and then again takes additional measurements on the independent variable

Here in this design a single group of subjects has been taken. The subjects are measured periodically on dependent variable before and after the treatment. When such a procedure is followed, the design is called Time Series Design.

Y					Y			
				Experimental Treatment X				
T_1	T_2	T_3	T_4		T_5	T_6	T_7	T_8

Table 7.7 One-group Time Series Design

Strengths

1. This design is valid against the internal validity criteria of Maturation, Testing, Regression, Selection, Mortality and Interaction of Selection and Maturation.
a) The changes that occur due to biological and psychological changes in the subjects are easily controlled as the subjects are periodically measured beforeand after the treatment.
b) Continuous periodical measurement of the dependent variable controls the effect of testing as it is counted on different occasions.
C) The interval between different occasion of testing and observation is usually quite small for the regression effect to take place.
d) Since the testing takes place on many-occasions before the treatment and the same measurement is repeated on many occasions after the treatment the effect of selection is automatically taken care of.
e) The drop out or mortality factor does not affect the findings as the - measurement is taken on many occasions before and after the treatment. In case of the example being discussed here, it may be pointed out that the attendance of only those students will be counted who are regular. The attendance of dropouts will not matter as attendance of the students in the class has been counted for five days before the treatment and for five days after the treatment.
f) The interaction of selection and maturation will be balanced as the periodic observations made after the treatment are to be compared with the observations made before the treatment.
g) The multi-testing of students in this design provides more check on some sources of internal validity.

Limitations

1. This design fails to control the effects due to history. For example, the factors such as climatic changes and examinations may contribute to the observed change in the dependent variable. In the example under discussion some other teacher might have announced that the

students would be given an internal assessment test and it may affect the attendance of the students.

2. Because of the repeated tests, there may be kind of interaction effect of testing that would restrict the findings to those populations, which have been subjected to repeated testing.

3. The usual statistical tests of significance may not be appropriate with a time design (Koul, 1988).

Applicability:

Time series design can be applied to those field situations where: a) It is not feasible to form a control group.

b) This design is useful in the school settings to study the effects of a major changes in administrative policy upon various issues concerning discipline.

The researcher is interested in studying the effect of praise on students' participation during discussion. For this purpose, he takes students of X grade from two institutions of the same city. He observes student's participation during discussion in both the institutions for five times at fixed intervals. Later to one of the groups the researcher introduces praise. In another institution the discussion is organized in usual manner. Later both the groups are observed periodically for five times for their participation in discussion. In this way two groups of students are taken as intact groups from the field situation. They are non-equivalent groups. Both the groups are observed periodically for the variable under study (dependent variable). One of the groups isgiven treatment. At the end of the treatment both the groups are again tested on periodic intervals for dependent variable. The observation tool is the same for all the periodic observations. The observation tool is the same for both the groups.

c) It is also useful in the study of attitude change in the students as a result of the effect produced by the introduction of a documentary film designed to change attitudes.

d) There is no carry-over effect of testing.

e) The internal and external controls are not possible during experimentation.

f) The measuring Instrument is such that it can be used many times and its repeated use does not affect the variable under study.

Time series design can provide useful information because the use of additional measurements preceding and following the experimental treatment makes the design more powerful.

Group		*Independent Variable*	
Experimental	$T_1\ T_2\ T_3\ T_4$	Experimental treatment	$T_5\ T_6\ T_7\ T_8$
Control	$T_1\ T_2\ T_3\ T_4$	No experimental treatment	$T_5\ T_6\ T_7\ T_8$

Table 7.8 Control Group Time Series Design

Strengths

1. This design is valid against the internal validity criteria of History, Maturation, Testing, Instrumentation, Regression, Selection, Mortality and Interaction of Selection and Maturation.

a) If any special event like students strike etc. takes place during the observation or treatment period, it will equally affect both the groups. Thus, the design will overcome the effects due to history.

b) The maturation on the part of subjects like interest in studies, liking towards the teacher etc. if any, will be controlled by the presence of control group.
c) The testing effect if any, will be equally present at all the time intervals in both the groups.
d) The instrument effect will be controlled because of repeated measurements and the presence of control group.
e) The dependent variable has been measured at periodic intervals in both the groups. Even if the group comprised some specific subjects who may be more motivated or more intelligent it will be controlled as the repeated measurements have been taken.
f) The mortality will not affect the dependent variable because the data of only those subjects will be taken into consideration during analysis who are present during periodic observations.
g) If by chance, one of the groups taken has a higher rate of maturation and this group is given treatment, the effect will be balanced as in the experimental group and there will be general rate of gain that will be projected in the pretreatment observations.
h) The inclusion of a control group in this design is useful for the necessary comparison.

Limitations
1. There may be interaction effect due to repeated tests and this would restrict the findings to the populations, which have been subjected to repeated testing. The design therefore is not valid against the external validity criteria of Interaction
Testing and Treatment as well as interaction of Selection and treatment.
2. The usual statistical techniques may not be applicable with such designs.

Applicability: Control Group Time Series Design can be applied to those situations where:
a) Subjects cannot be assigned randomly to different groups.
b) One of the groups receives treatment and the other group is exposed to the usual situation.
c) Both the groups can be repeated measured at different time intervals before and after the treatment.
d) Measuring instrument is such that its repeated use does not affect the dependent variable
e) The design is particularly useful in institutions where repeated measurements on the part of students are required. Further it is more powerful than the Timeseries Design because of the presence of non-treatment group and repeated measurements.

In short it may be said that the experimental designs are basically of three types viz.pre-experimental designs, True experimental designs and Quasi-experimental designs. They have their own strengths and limitations. It depends upon the researcher and the nature of his research problem that the design can be selected.

8.2 Steps in Experimental Research

The steps of the experimental method are not different from those of a scientific method. For the sake of clarification, the major steps as given by Koul(1997) may be described as under:

8.2.1 Selecting and Defining the Problem

Experimental research starts with the selection of the problem, which is amenable to experimentation. It needs a rigorous logical analysis and definition of the problem imprecise terms. The variables to be studied should be defined in operational terms clearly and unambiguously. It helps the researcher to convert the problem precisely into a hypothesis that can be verified or refuted by the experimental data.

8.2.2 Stating of Hypotheses

The stating of problem hypotheses is one of the distinguishing characteristics of the experimental method. Hypotheses are the heart of experimental research. They suggest that an antecedent condition or phenomenon (independent variable) is related to the occurrence of another condition, phenomenon.; event, or effect (dependent variable). To test a hypothesis, the researcher attempts to control all the conditions except the independent 'variable, which he manipulates. Then he observes the effect on the dependent variable presumably because of the exposure to the independent variable.

The researcher, therefore, should not only be concerned primarily with experimental plans and statistical procedures, but should give sufficient attention to formulation of hypothesis. The experimental plans and statistical procedures merely help him in the testing of hypotheses and contribute little in the development of theories or advancement

8.3 Summary

To conclude it may be said that you have studied three types of pre-experimental designs. These are One Shot Case Study Design, One Group Pre-test Post-test Design and Static Group Comparison Design. These designs have two basic characteristics. One is that there are no matched groups. secondly groups are not randomly selected and treatments are not randomly assigned to the groups. Because of these internal weaknesses, the designs lack in internal and external validity. However, applicability of these designs will depend upon objectives of the study and fulfillment of essential requirements of the design. If the major purpose of research is to find out cause and effect relationship, more sophisticated designs should be opted for. In the next section, we will discuss true experimental designs.

8.4 Key words

Pre-experimental designs- pre-experimental designs provide little or no control of extraneous or situation variables.

True Experimental Designs- True experimental designs are mostly used for experimental research in education because they seek to control the main effects of history, maturation, testing, measuring instruments, statistical regression, selection, and mortality

Quasi Experimental Design -Quasi-experimental design, it is necessary to know which of the variables his design may fail to control. He must also be aware of the sources that represent threats to both internal and external validity and consider them while interpreting the results of the experiment.

8.5 Self-Assessment Questions

1. Define Experimental Design? Briefly Explain the types of Experimental Design?
2. Discuss the Pre-Experimental Design Process
3. Explain the steps in True Experimental Design
4. Give a Outline of Quasi Experimental Design?

8.6 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009

2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.
3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit kumar Sage Publications 2015
5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja Selvamuthu, and Dipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Edu creation Publishing 2019.
7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019.

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LESSON 9

SAMPLING: RANDOM, STRATIFIED RANDOM, CLUSTER AND PURPOSIVE SAMPLING

Learning Objectives

- ✓ The objective of this lesson is to explain sampling
- ✓ To know sampling method and types of sampling
- ✓ Examine the Sampling technique and limitations
- ✓ To assess the characteristics of good sampling

Structure

9.0 Introduction

Sampling is the selection of a subset of the population of interest in a research study. In the vast majority of research endeavors, the participation of an entire population of interest is not possible, so a smaller group is relied upon for data collection.

Before researchwork, theinvestigator has to decide whetherthe entire population is to be made subject for data collection or a particular group is to be selected as representative of the entire population. The former method when the entire population is taken into account, is called 'Census Method'. On the other hand, when a small group is taken into account, as representative of the whole, is called, sampling method.

When the field of inquiry is large, this method becomes difficult to adopt because of the resources involved. At times this method is practically beyond the reach of ordinary researchers. Many a time, it is not possible to examine every item in the population, and sometimes it is possible to obtain accurate results by studying only a part of total population. When the universe is a small one, it is no use resorting to a sample survey. When field studies are undertaken in practical life, consideration of time and cost lead to a selection of respondents i.e., selection of a few items. The respondents selected should be representative of the total, population. The selected respondents constitute what is called a 'sample' and the selection process is called sampling.

Sampling is a technique of selecting individual members or a subset of the population to make statistical inferences from them and estimate characteristics of the whole population. Different sampling methods are widely used by researchers in market research so that they do not need to research the entire population to collect actionable insights.

It is also a time-convenient and a cost-effective method and hence forms the basis of any research design. Sampling techniques can be used in a research survey software for optimum derivation.

For example**,** if a drug manufacturer would like to research the adverse side effects of a drug on the country's population, it is almost impossible to conduct a research study that involves everyone. In this case, the researcher decides a sample of people from each demographic and then researches them, giving him/her indicative feedback on the drug's behavior.

9.1Population and sample:

A) Population or universe:

Population or universe is the aggregate of all units possessing certain specified characteristics on which the sample seeks to draw inferences. All units in any field of enquiry constitute a 'universe' or 'population'. A complete enumeration of all items in the 'population' is known as a census inquiry. In such an inquiry, when all items are covered, there is no way of checking the element of bias except through a resurvey or use of sample checks. Besides this type of inquiry involves a great deal of time, money and energy.

The universe can be finite or infinite. In finite universe, the number of items is certain, but in case of an infinite universe, the number of items is infinite; We cannot have any idea of about the total number of items. The population of a city, the number of workers in a factory and the like are examples of finite universe, whereas the number of stars in the sky, listeners of a specific radio programme are examples of infinite universe.

B)Sample design:

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

C) Definition of sampling method:

Sampling method has been defined by various scholars in various ways, given below are a few definitions:

(1) Frank Yates – According to Frank Yates, "The term sample should be reserved for a set of unit or portion of a aggregate and material which has been selected in the belief that it will be representative of the whole aggregate.

(2) William J.George and Paul K.Hatt- "A sample, as the name implied, is smaller representative of a larger whole."

(3) P.V.Young : According to P.V.Young, " A sampling method is a miniature picture or cross-selection of the entire group or aggregate from which the sample is taken."

(4) Bogardus: Sampling is the selection of certain percentage of a group of items according to a pre-determined plan.

D) Uses or importance of sampling:

In social research, sampling method has acquired great importance. In these days, the sampling method is becoming quite popular in all important studies. Since, 'Census method' is difficult, sampling method is resorted to because of the convenience of getting reliable results. It has the following uses and its importance lies because of the following factors.

(a) Study of representative units:

In this method we do not concentrate our attention of the entire units, but select certain representative units. The results that are acquired after the study of these representative units, are considered as dependable and reliable. Due to this method, a lot of time, energy and resources are saved.

(b) Study of large area: Through this method, it is possible to study large area. If we select the whole area for our study, it shall become difficult for us to achieve maximum results in shorter possible time and to cover a large area.

(c) Scrutiny of available information:

In other methods it is not possible to test the accuracy of the results. It becomes difficult in other methods because of the large area and because of the large number of subjects involved. But in this method, representative units are studied. It is possible to scrutinize the available information.

(d) Intensive study of selected items:

In this method the whole attention is concentrated on the representative units. If we study the entire universe, intensive study is not possible. But in this method intensive study is possible.

(e) Facility in collecting information:

Because of selective nature of the study, it is easy to collect the information. In this method, we confine ourselves to the selected items. Thus this method has the advantage of easy and quick collection of information.

(f) Attainment of the same results as that of universe:

Though, we confine ourselves to the study of representative units, we get the same results as those of the Universe. Thus in this method we attain accuracy of results in short span of time.

9.2. Probability and Non-probability samples:

One of the steps in the sampling process is that researcher has to decide which of the two – probability and non-probability samples is to be chosen. Probability samples are also known as random samples and non-probability samples as non-random samples.

In probability sample, the probability or chance of every unit in the population being included in the sample is not known. There is probability that every unit in the population have equal chance of being included in the sample. Further, the selection of specific units in the sample depends entirely on chance. No substitution of one unit for another is permissible. This means that no human judgment is involved in the selection of the sample. On the other hand, in a non-probability sample, the probability of inclusion of any unit within a sample involves human judgments rather than mere chance.

In case of probability sample, it is possible to measure the sampling error and thereby determine the degree of precision in the estimates with the help of the theory of probability. This theory also enables us to consider, from amongst the various possible sample designs, the one that will give the maximum information. This is not possible when a non-probability sample is used.

Non-probability sampling does not yield these benefits; on account of its convenience and economy; it is often preferred to probability sampling. If the researcher is convinced that the risks involved in the use of a non-probability sample are more than offset by its being relatively cheap and convenient, his choice should be in favour of non-probability sampling.

There are various types of sample designs which can be covered under the two broad groups- random or probability samples and non-random or non-probability samples.

9.3. Types of samples:

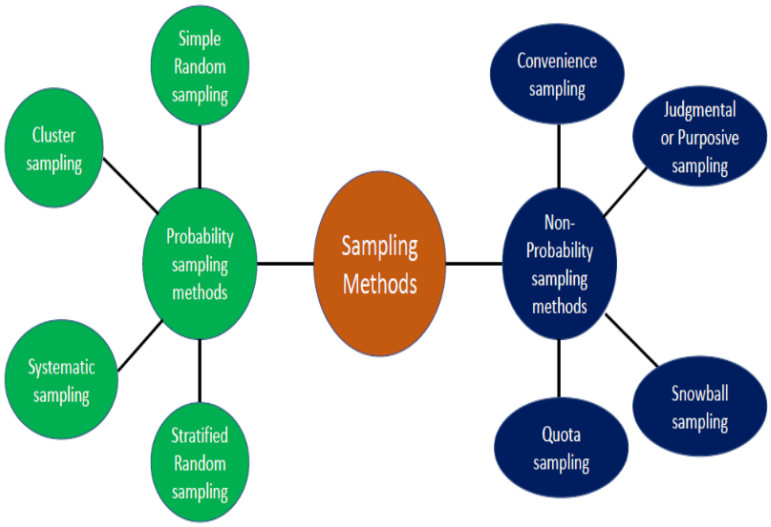
A) Accidental and purposive sample

In non-probability sampling, there is no way of estimating the probability that each element has of being included in the sample and no assurance that every element has some chance of being included(Wilkinson and Bandarkar, 1977). The four important types of non-probability sampling and purposive sampling.

B) Accidental Sampling:

Accidental sampling refers to methods of selecting respondents who happens to meet the researcher and are willing to be interviewed. Thus the researcher may take the first hundred people he/she meets who are willing to be interviewed.

For example, let us consider the situation where a programme director wishes to make some generalizations about the programme in progress, selects beneficiaries who have come to the agency for a service or a community organizer, trying to know how the people feel about health status in the community, interviews available community dwellers like shop keepers, daily wage earners, barbers and others who are presumed to reflect public opinion. In both the situations, those who are available for study are included in the samples. This is exactly what we call accidental sampling. It is very obvious that the samples so collected are biased and there is no known way (other than by doing a parallel study with a probability sample) of evaluating the biases introduced in such samples. However in the situation illustrated above, most probably, accidental sampling is the only way out because of the reason that the population parameters of the beneficiaries or the community people are not available with the researcher.



C) Purposive sampling:

Purposive sampling is based on the presumption that with good judgment can select the sample units that are satisfactory in relation to one's requirements. A common strategy of this sampling technique is to select cases that are judged to be typical of the population, in which one is interested , assuming that the errors of judgment in the selection will tend to counterbalance each other. For example, if a researcher attending out-patient department, it might be desirable to choose patients for the sample from among those who are frequently irregular. Because, the causes of irregularity can be described by irregular patients only. If he selects a random sample, he would have got patients who are regular and that might influence the findings of the study. It is also possible that in a truly random sample, the regular patients would nullify the effects of irregular patients.

D) Random sampling:

In this method all the units are given equal importance. Every unit has the possibility of being included in the sampling. It has been defined by Parten in the followings words:

" Random sampling is the form applied when the method of selection assures that each individual or element in universe has an equal chance of being chosen."

It may not be mistaken for a 'chance selection'. Chance selection may be a random selection but random sampling is different from chance selection. Random selection is done with the help of certain method, most important amongst them are

(a) Lottery Method
(b) Tipplets numbers method
(c) Selection from sequential list

(d) Grid system of random sampling

(i) Lottery Method:

In this method, a lottery is drawn by writing the numbers or the names of various units and putting them in a container. They are thoroughly mixed and certain numbers are picked up from the container, and those which are picked up are taken up for sampling.

(ii) Tipplet's numbers Method:

It is called, "Tippets numbers Method" because it was evolved by L.H.C Tippet who constructed a list of 10,400 four digit numbers written at random on every page. We can illustrate the procedure by an example.

2452	0280	0490	2370	0670	0160
3170	0560	0450	1396	0430	2720
0010	1112	0340	0370	1920	1160
0150	1300	6107	0420	2070	1540
0180	4167	5060	1270	0140	0140

From the above numbers, it is not very difficult to draw samples at random. For example if 50 persons are to be selected for study out of the total number of 500, then we can open any page of Tippet's numbers and select first 50 that are below 500 and take them up for study. On the basis of the experiments carried out through this technique, it has been found that the results are drawn on the basis of this method of random sampling are quite reliable.

(iii) Selection from the sequential list:

In this method, the names are arranged serially according to a particular order. The order may be alphabetical, geographical or only serial. Then out of the list any number may be taken up. Beginning of selection may be made from anywhere. For example, if we want to select ten persons, we can start right from the 10th and select 10, 20, 30 and so on.

(iv) Grid System:

This method is generally used for selecting the sample of an area and so in this method, a map of the entire area is drawn. After that a screen with the squares is placed upon the map and some of the squares are selected at random. And the area falling the selected squares is taken as samples. Bogardus has defined the 'Random Sampling' as given below.

"The common statistical procedure is called Random Sampling, that is choosing not according to personal interest or convenience but impersonally at random, choosing every fifth item, for example is random sampling."

E) Stratified Random Sampling:

Under the process, the entire universe or population is divided/sub-divided into homogeneous groups or types or classes called strata and a sample is drawn from each stratum at random. These samples are then combined to form a single sample of the universe. A stratified sample is thus equivalent to a set of random samples of a number of such populations, each representing a single type or stratum. The sample drawn will be typical of the whole population as it will represent all the different segments. Each stratum is based on a single criterion

A stratified sampling may be either proportionate or disproportionate. In a proportionate stratified sampling plan, the number of items drawn from each stratum is proportional to the size of the strata. On the other hand, if an equal number of units are drawn from each stratum regardless of how the stratum is represented in the universe, then such a plan is known as disproportionate stratified sampling. In the case of proportionate plan, total sample would properly represent all the strata. This eliminates difference between strata and thereby reduces the sampling error. Such a method adds to the precision of the sample estimate when within strata variability is the least.

This method is suitable for a large heterogeneous population. This method differs from the simple random sampling in as much as that all the members of the universe are not taken to be as equally important.

F) Cluster Sampling or Multi-stage or Area Sampling:

In case the area of study is marked by widespread, large expenses are involved, simple and stratified random sampling is used. For example in the preparation of sampling frame from the population and in covering the widespread areas by interviews, a large amount of expenditure is required. The more widely spread the area of the study, the greater are the travel expenses, the greater is the time spent in travelling, and hence expensive – and the tasks of administering, monitoring and supervision of the research project and in particular supervising the field staff become more complicated. For the reasons mentioned above and few other reasons, large – scale research studies make use of the cluster sampling methods.

In cluster sampling, first, the whole research is divided into sub-areas, more commonly known as clusters. The simple random or stratified method method is used to select clusters. Finally, the researcher arrives at the ultimate sample size to be studied by selecting sample from within the clusters, which is carried out on a simple or stratified random sampling basis.

Let us suppose, for example, that we want to conduct a survey of beggars in urban areas of a state, We may proceed as follows: prepare a list of districts and group them into clusters, and select a simple or stratified random sample from each cluster. For each of the districts included in the sample, list the cities/towns and take a simple or stratified random sample of them. If some or all of the towns/cities thus selected for the sample have more members of beggars that can be studied, we may take a sample of these towns/cities in each district. The questionnaires may then be administered to all the beggars in these towns/ cities or, if it is desirable and administratively feasible to do so, to a sample of the beggars.

Characteristically, the procedure moves through a series of stages-hence the common term, 'multi-stage' sampling from more inclusive to less inclusive sampling units until we finally arrive at the population elements that constitute the desired sample.

9.4. Sampling technique and limitations:

A) Less accuracy:

In comparison to census technique, the conclusions derived from sample are more liable to error. Therefore, sampling technique is less accurate than the census technique.

B) Changeability of units:

If the units in the field of survey are liable to change or if these are not harmonious, the sampling technique will be very hazardous. It is not scientific to extend the conclusions derived from one set of the sample to other sets which are unlike or are changeable.

C) Misleading conclusions:

If due care is not taken in the selection of samples or if they are arbitrarily selected, the conclusions derived from them will become misleading if extended to all units. For example, in assessing the monthly expenditure of university students, one selects for sample study only rich students, the results will be highly erroneous if extended to all students.

D) Need for specialized knowledge:

The sample technique can be successful only if a competent and able scientist makes the selection. If this is done by average scientist, the selection is liable to be wrong.

E) When sampling is not possible:

Under certain circumstances it is very difficult to use the sampling technique. If the time is very short and it is not possible to make selection of the sample, the technique cannot be used. Besides if one needs 100% accuracy, the sampling technique cannot be used. It cannot also be used if the material is of heterogeneous nature.

9.5 Essentials of good sampling:

The important features (essentials) of a good sampling (technique) is:

1) The sample should be true representative of the universe from where it has been taken, i.e., the sample must possess all the characteristics of the universe called representative sampling plan.
2) There should remain no bias in selecting sample.
3) All the items should be independent of each other.
4) Quality and time of the sample should be the same for all the individual items.
5) The 'regularity conditions' should be the same for all the individual items.
6) Sampling needs to be adequate. A sample is adequate when it is of sufficient size to allow confidence in the stability of its characteristics.
7) It should be possible to measure or estimate the sampling error.
8) The result of the sample study, in general, should be applicable to all items of the universe. Hence, a good sample that is not representative is known as a biased sample. Studies based on biased samples would be unreliable and misleading.

A) Criteria of a good sample design:

In practice, the sample design to be covered for a project would be multi-stage or multi – design involving a combination of several sampling techniques or procedures. A good sample design should satisfy four broad criteria.

i) Goal Orientation:

The sample design should be oriented to the research objective, tailored to the survey design and fitted to the survey conditions. These considerations should determine the choice of the sampling procedure. The sampling procedure to be selected should be relevant to the characteristics of the cases to be studied and ensure selection of representative sample.

ii) Measurability:

This denotes that the design should allow the computation from the sample itself of valid estimation of its sampling error. Probability sampling techniques, i.e., the various types of random sampling procedures make this possible. On the other hand, the selection of a sample in a hit and miss fashion does not provide a sound basis for estimating sampling error.

iii) Practicability:

The design should be feasible. It should capable of being implemented. It should be possible to construct properly the frame or the list of the population for applying appropriate sampling procedure. The researcher should be careful to use sample, straight forward, workable methods properly adopted to available facilities and personnel.

iv) Economy:

The sample design should be enabling the fulfillment of the survey objectives at a minimum cost. Every effort should be made to achieve maximum reliability of the result for the given cost.

The above criteria frequently conflict and, therefore, the researcher must judiciously balance and blend them to obtain a good sample design.

9.6 Characteristics of a good sample design:

We can list down the characteristics of a good sample design as under:

a) Sample design must result in a truly representative sample.
b) Sample design must be such which results in a small sampling error.
c) Sample design must be viable in the context of funds available for the research study.
d) Sample design must be such so that systematic bias can be controlled in a better way.
e) Sample should be such that the results of the sample study can be applied, in general, for the universe with a reasonable level of confidence.

9.7. Steps to be taken for selection of sample:

(A) Defining Universe:

The whole population, out of which the samples are selected, is known as 'universe'. It is this area in which the research is to be conducted. What is needed is to have a clear-cut definition of the 'universe'. If the universe has geographical limits, it is easy to locate and define it; but if the universe is dependent upon certain characteristics, it has to be properly defined. This task is not easy. For example, if it is to be found out that what is the percentage of education in a particular town, it shall not be difficult, because of the area in which the study is to be conducted is clearly and categorically defined. But if the opinion of the people about a particular problem is to be found out, then it would be difficult to define the universe. For this the investigator shall have, first of all to define the universe.

(B) Decision about the sampling units:

Before we proceed to select samples, we shall have to decide the units of the sample. It means that we shall have first of all to decide which shall be the unit of the sample. It may be a house, a family, a group of individuals etc. The unit which we take for study in the sampling method should be clearly defined in unambiguous terms. This would make the study easy and efficient.

(C) Source list:

Source list is another important factor that makes the representative selection possible. Source list is the list which contains the names of the units of the universe from which the sample may be selected. It may be existing before the project is drawn or it may have to be prepared afresh by the investigator himself.

(D) Size of the sample:

For proper study of the problem, it is necessary to have proper sampling. It means that the sample should be of proper size. If the sample is either too small or too big, it shall make the study difficult. What should be the size of the sample, is a question which should be answered only after taking into account the various factors of study and the sample. In this behalf patten has laid down that:

"An optimum sample in survey is one, which fulfils the requirements of efficiency, representativeness, reliability and flexibility. The sample should be small enough to avoid unnecessary expenses and large enough to avoid intolerable sampling error."

The size of the sample is determined by various factors. These factors relate to the study, the nature of the universe, the type of sample required etc.

9.8 Representative character of the sample:

In order to be useful, the study has to be representative in character. If it does not possess all the characteristics of the universe, it shall not be representative and so, it shall not be able to fulfil the object of the study. In social phenomenon, it is not possible to achieve absolute representativeness, because no two samples can be similar and alike. But in spite of these drawbacks, maximum degree of similarity should be there so that the generalizations and the principles drawn may be valid. For this, we have to take precautions so that biased samples may not be made available for study. A bias may be caused by purposive selection, imperfect stratification, incomplete source list, convenience sampling, faulty method of drawing random sample, nature of phenomenon, etc.

9.9 Reliability of sample:

Reliability of sample can be tested by the following tests:

(1) By drawing a parallel sample, the reliability may be tested.
(2) By comparing the measurement of the sample with those of the universe, the reliability of the sample can be tested.
(3) By drawing sub-sample from the main sample, we can test the reliability of sample.

9.10. Summary

A sample design is a definite plan for obtaining a sample from a given population. In social research, sampling method has acquired great importance. In this method, we do not concentrate on all units, but select certain representative units.

One of the steps in the sampling process is that researcher has to decide which of the two – probability and non-probability samples is to be chosen. Probability samples are also known as random samples and non-probability samples as non-random samples.

There are various types of sample designs which can be covered under the two broad groups- random or probability samples and non-random or non-probability samples.

Non-probability types include accidental and purposive sampling. Accidental sampling refers to methods of selecting respondents who happens to meet the researcher and are willing to be interviewed. Purposive sampling is based on the presumption that with good judgment can select the sample units according to the purpose of the study.

Random selection is done with the help of certain methods. Most important amongst them are (a) Lottery Method, (b) Tipplett's numbers method, (c) Selection from sequential list, (d) Grid system.

Under stratified Random Sampling, the entire universe or population is divided/sub-divided into homogeneous groups or types or classes called strata and a sample is drawn from each stratum at random. In cluster sampling, first, the whole research area is divided into sub-areas, more commonly known as clusters.

Sampling Method has some limitations

(1) Less accuracy

(2) Changeability of units

(4) Misleading conclusions

(4) Need for specialized knowledge etc.

In spite of limitations, the method has advantages

(1) It requires less time, less money

(2) Detailed study is possible

(3) The results of sampling technique are more reliable

(4) It is convenient from administrative point of view.

9.11. Key Words:

Universe or Population –The entire aggregation of items from which samples can be drawn is known as a population.

Probability sample -Probability sampling is more complex, more time-consuming and usually more costlythan non-probability sampling.

Non-probability sample -Non-probability sampling is a method of selecting units from a population using a subjective (i.e. non-random) method.

Cluster Sampling - Investigator divide a population into smaller groups known as clusters. They then randomly select among these clusters to form a sample.

9.12. Self-Assessment Questions:

1). Explain the uses and importance of sampling.
2).Analyze various types of sampling.
3). Distinguish between probability and non-probability samples.
4). Discuss the characteristics of good sampling.

9.13 Further Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009
2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.
3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit kumar Sage Publications 2015.
5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja Selvamuthu, and Dipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.
7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019.

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LESSON 10

DATA COLLECTION AND RESEARCH TOOLS

Learning Objectives

- ✓ To study the research tools for data
- ✓ To assess the interview method
- ✓ To examine the survey and schedule method
- ✓ To learn the interview guide

Structure

10.0 Introduction and Definition

There are various methods of data collection. As such the researcher must judicially select the method/methods for his own study, keeping in view some factors. The method selected should be such that it suits the type of enquiry that is to be conducted by the researcher. Availability of funds for the research project determines to a large extent the method to be used for the collection of data. Availability of time has also to be taken into account in deciding a particular method of data collection. Precision required is yet another important factor to be considered at the time of selecting the method of collection of data. But one must always remember that each method of data collection has its uses and none is superior in all situations.

Data collection is a methodical process of gathering and analyzing specific information to proffer solutions to relevant questions and evaluate the results. It focuses on finding out all there is to a particular subject matter. Data is collected to be further subjected to hypothesis testing which seeks to explain a phenomenon.Hypothesis testing eliminates assumptions while making a proposition from the basis of reason.For collectors of data, there is a range of outcomes for which the data is collected. But the key purpose for which data is collected is to put a researcher in a vantage position to make predictions about future probabilities and trends.

The core forms in which data can be collected are primary and secondary data. While the former is collected by a researcher through first-hand sources, the latter is collected by an individual other than the user.

Paneline V. Young has defined it in his book entitled, "Scientific social surveys and Research', as "a comprehensive study of a social unit, be that unit a person, a group, a social institution, a district or community."

H – odum has explained in his book entitled, "An introduction to Social Research', as " case study method is a technique by which individual factor whether it be an institution or just an episode in the life of an individual or a group is analyzed in its relationship to any other in the group."

Goode and Hatt have given their definition of case study method in their book: 'Methods in Social Research', According to them, 'It is a way of organizing social data so as to present the unitary character of the social object being studied."

Start a queen has stated that: case study is "the examination of a single situation, persons, groups, or institutions as complex wholes in order to identify types and process."

Burgers has defined in his book entitled: "Research methods in Sociology', He used the words," the Social Microscope" for the case study method.

Case study is a form of qualitative analysis. It is a careful and complete observation of an individual or a situation or an institution is done, efforts are made to study such and every aspect of the concerning unit in minute detail and then from the case data generalization and inferences can be drawn. In short, case study method is a study of a particular unit in detail.

10.1 Meaning

The case study method is a very popular form of qualitative analysis. It involves a careful and complete observation of a social unit, be that unit a person, a family, an institution, a cultural group or even the entire community. It is a method of study by depth rather than breadth. The case study places more emphasis on the full analysis of a limited number of events or conditions and their interrelations. The case study deals with the processes that take place and their interrelationship. Thus case study is essentially an intensive investigation of the particular unit under consideration. The object of the case study method is to locate the factors that account for the behaviour patterns of the given unit as an integrated totality.

The underlying need for Data collection is to capture quality evidence that seeks to answer all the questions that have been posed. Through data collection businesses or management can deduce quality information that is a prerequisite for making informed decisions.

To improve the quality of information, it is expedient that data is collected so that you can draw inferences and make informed decisions on what is considered factual.

At the end of this article, you would understand why picking the best data collection method is necessary for achieving your set objective.

10.2 Data Collection Tools

Data collection tools refer to the devices/instruments used to collect data, such as a paper questionnaire or computer-assisted interviewing system. Case Studies, Checklists, Interviews, Observation sometimes, and Surveys or Questionnaires are all tools used to collect data.

It is important to decide the tools for data collection because research is carried out in different ways and for different purposes. The objective behind data collection is to capture quality evidence that allows analysis to lead to the formulation of convincing and credible answers to the posed questions.

The following are the top 7 data collection methods for Academic, Opinion-based or product research. Also discussed in detail is the nature, pros and cons of each one. At the end of this segment, you will be best informed about which method best suits your research.

10.3 Interview method

An interview is a face-to-face conversation between two individuals with the sole purpose of collecting relevant information to satisfy a research purpose. Interviews are of different types namely; Structured, Semi-structured, and unstructured with each having a slight variation from the other.

A) Structured Interviews - Simply put, it is a verbally administered questionnaire. In terms of depth, it is surface level and is usually completed within a short period. For speed and efficiency, it is highly recommendable, but it lacks depth.
B) Semi-structured Interviews - In this method, there subsist several key questions which cover the scope of the areas to be explored. It allows a little more leeway for the researcher to explore the subject matter.
C) Unstructured Interviews - It is an in-depth interview that allows the researcher to collect a wide range of information with a purpose. An advantage of this method is the freedom it gives a researcher to combine structure with flexibility even though it is more time-consuming.

Pros

- In-depth information
- Freedom of flexibility
- Accurate data.

Cons

- Time-consuming
- Expensive to collect.

A)The best Data Collection Tools for Interviews

For collecting data through interviews, here are a few tools you can use to easily collect data.

Audio Recorder
An audio recorder is used for recording sound on disc, tape, or film. Audio information can meet the needs of a wide range of people, as well as provide alternatives to print data collection tools.

Digital Camera
An advantage of a digital camera is that it can be used for transmitting those images to a monitor screen when the need arises.

Camcorder
A camcorder is used for collecting data through interviews. It provides a combination of both an audio recorder and a video camera. The data provided is qualitative in nature and allows the respondents to answer questions asked exhaustively. If you need to collect sensitive information during an interview, a camcorder might not work for you as you would need to maintain your subject's privacy.

Want to conduct an interview for qualitative data research or special report? Use this online interview consent form template to allow the interviewee to give their consent before you use the interview data for research or report. With premium features like e-signature, upload fields, form security, etc., Formplus Builder is the perfect tool to create your preferred online consent forms without coding experience.

10.4 Questionnaire Method

This is the process of collecting data through an instrument consisting of a series of questions and prompts to receive a response from individuals it is administered to. Questionnaires are designed to collect data from a group. For clarity, it is important to note that a questionnaire isn't a survey, rather it forms a part of it. A survey is a process of data gathering involving a variety of data collection methods, including a questionnaire.

On a questionnaire, there are three kinds of questions used. They are; fixed-alternative, scale, and open-ended. With each of the questions tailored to the nature and scope of the research.

Pros

- Can be administered in large numbers and is cost-effective.
- It can be used to compare and contrast previous research to measure change.
- Easy to visualize and analyze.
- Questionnaires offer actionable data.
- Respondent identity is protected.

- Questionnaires can cover all areas of a topic.
- Relatively inexpensive.

Cons

- Answers may be dishonest or the respondents lose interest midway.
- Questionnaires can't produce qualitative data.
- Questions might be left unanswered.
- Respondents may have a hidden agenda.
- Not all questions can be analyzed easily.

The best Data Collection Tools for Questionnaire

A)Formplus Online Questionnaire

Formplus lets you create powerful forms to help you collect the information you need. Formplus helps you create the online forms that you like. The Formplus online questionnaire form template to get actionable trends and measurable responses. Conduct research, optimize knowledge of your brand or just get to know an audience with this form template. The form template is fast, free and fully customizable.

B)Paper Questionnaire

A paper questionnaire is a data collection tool consisting of a series of questions and/or prompts for the purpose of gathering information from respondents. Mostly designed for statistical analysis of the responses, they can also be used as a form of data collection.

C)Reporting Method

By definition, data reporting is the process of gathering and submitting data to be further subjected to analysis. The key aspect of data reporting is reporting accurate data because of inaccurate data reporting leads to uninformed decision making.

Pros

- Informed decision-making.
- Easily accessible.

Cons

- Self-reported answers may be exaggerated.
- The results may be affected by bias.
- Respondents may be too shy to give out all the details.
- Inaccurate reports will lead to uninformed decisions.

D)The best Data Collection Tools for Reporting

Reporting tools enable you to extract and present data in charts, tables, and other visualizations so users can find useful information. You could source data for reporting from

Non-Governmental Organizations (NGO) reports, newspapers, website articles, hospital records.

i)NGO Reports

Contained in NGO reports is an in-depth and comprehensive report on the activities carried out by the NGO, covering areas such as business and human rights. The information contained in these reports is research-specific and forms an acceptable academic base for collecting data. NGOs often focus on development projects which are organized to promote particular causes.

ii)Newspapers

Newspaper data are relatively easy to collect and are sometimes the only continuously available source of event data. Even though there is a problem of bias in newspaper data, it is still a valid tool in collecting data for Reporting.

iii)Website Articles

Gathering and using data contained in website articles is also another tool for data collection. Collecting data from web articles is a quicker and less expensive data collection Two major disadvantages of using this data reporting method are biases inherent in the data collection process and possible security/confidentiality concerns.

iv)Hospital Care records

Health care involves a diverse set of public and private data collection systems, including health surveys, administrative enrollment and billing records, and medical records, used by various entities, including hospitals, CHCs, physicians, and health plans. The data provided is clear, unbiased and accurate, but must be obtained under legal means as medical data is kept with the strictest regulations.

10.5 Existing Data Method

This is the introduction of new investigative questions in addition to/other than the ones originally used when the data was initially gathered. It involves adding measurement to a study or research. An example would be sourcing data from an archive.

Pros

- Accuracy is very high.
- Easily accessible information.

Cons

- Problems with evaluation.
- Difficulty in understanding.

A)The Best Data Collection Tools for Existing Data

The concept of Existing data means that data is collected from existing sources to investigate research questions other than those for which the data were originally gathered. Tools to collect existing data include:

- **Research Journals** - Unlike newspapers and magazines, research journals are intended for an academic or technical audience, not general readers. A journal is a scholarly publication containing articles written by researchers, professors, and other experts.

- **Surveys** - A survey is a data collection tool for gathering information from a sample population, with the intention of generalizing the results to a larger population. Surveys have a variety of purposes and can be carried out in many ways depending on the objectives to be achieved.

10.06 Observation Method

This is a data collection method by which information on a phenomenon is gathered through observation. The nature of the observation could be accomplished either as a complete observer, an observer as a participant, a participant as an observer, or as a complete participant. This method is a key base for formulating a hypothesis.

Pros

- Easy to administer.
- There subsists a greater accuracy with results.
- It is a universally accepted practice.
- It diffuses the situation of an unwillingness of respondents to administer a report.
- It is appropriate for certain situations.

Cons

- Some phenomena aren't open to observation.
- It cannot be relied upon.
- Bias may arise.
- It is expensive to administer.
- Its validity cannot be predicted accurately.

A)The best Data Collection Tools for Observation

Observation involves the active acquisition of information from a primary source. Observation can also involve the perception and recording of data via the use of scientific instruments. The best tools for Observation are:

- **Checklists** - state-specific criteria, allow users to gather information and make judgments about what they should know in relation to the outcomes. They offer systematic ways of collecting data about specific behaviors, knowledge, and skills.

- **Direct observation** - This is an observational study method of collecting evaluative information. The evaluator watches the subject in his or her usual environment without altering that environment.

B) The Best Survey Method Data Collections

- **Define the goal of your survey** - Once the goal of your survey is outlined, it will aid in deciding which questions are the top priority. A clear attainable goal would, for example, mirror a clear reason as to why something is happening. e.g. "The goal of this survey is to understand why Employees are leaving an establishment."

- **Use close-ended clearly defined questions** - Avoid open-ended questions and ensure you're not suggesting your preferred answer to the respondent. If possible offer a range of answers with choice options and ratings.

- **Survey outlook should be attractive and Inviting** - An attractive-looking survey encourages a higher number of recipients to respond to the survey. Check out Formplusbuilder for colorful options to integrate into your survey design. You could use images and videos to keep participants glued to their screens.

- **Assure Respondents about the safety of their data** - You want your respondents to be assured whilst disclosing details of their personal information to you. It's your duty to inform the respondents that the data they provide is confidential and only collected for the purpose of research.

- **Ensure your survey can be completed in record time** - Ideally, in a typical survey, users should be able to respond in 100 seconds. It is pertinent to note that they, the respondents, are doing you a favor. Don't stress them. Be brief and get straight to the point.

- **Do a trial survey** - Preview your survey before sending out your surveys to the intended respondents. Make a trial version which you'll send to a few individuals. Based on their responses, you can draw inferences and decide whether or not your survey is ready for the big time.

- **Attach a reward upon completion for users** - Give your respondents something to look forward to at the end of the survey. Think of it as a penny for their troubles. It could well be the encouragement they need to not abandon the survey midway.

10.7 Documents and records

Sometimes you can collect a considerable amount of data without asking anyone anything. Document- and records-based research uses existing data for a study. Attendance records, meeting minutes, and financial records are just a few examples of this type of research.

Using documents and records can be efficient and inexpensive because you're predominantly using research that has already been completed. However, since the researcher has less control over the results, documents and records can be an incomplete data source.

10.8 Schedule Method

This method of data collection is verymuch like the collection of data throughquestionnaire, with little difference is thatschedules (proforma containing a set ofquestions) are being filled in by theenumerators who are specially appointedfor the purpose.

A schedule is a structure of set of questions on a given topic which are asked by the interviewer or investigator personally.

These enumerators along with schedules, go to respondents, put to them the questions from the proforma in the order the questions are listed and record the replies in the space meant for the same in the proforma.

Enumerators explain the aims and objects of the investigation and also remove the difficulties which any respondent may feel in understanding the implications of a particular question or the definition or concept of difficult terms.

The enumerators should be trained to perform their job well and the nature and scope of the investigation should be explained to them thoroughly so that they may well understand the implications of different questions put in the schedule.

Schedule include open-ended questionsand close-ended questions. Open-ended questions allow the respondent considerable freedom in answering.

Close-ended questions has to be answered by the respondent by choosing an answer from the set of answers given under a question just by ticking.This method of data collection is very useful in extensive enquiries and can lead to fairly reliable results.

It is, however, very expensive and is usually adopted in investigations conducted by governmental agencies or by some big organisations.Population census all over the world is conducted through this method.

A)Difference Between Questionnaires And Schedules

The questionnaire is generally sent through mail to informants to be answered as specified in a covering letter. The schedule is generally filled out by the research worker or the enumerator, who can interpret questions when necessary.To collect data through questionnaire is relatively cheap and economical, to collect data through schedules is relatively more expensive, considerable amount of money has to be spent in appointing enumerators and in importing training to them.

Non-response is usually high in case of questionnaire. Non-response is generally very low in case of schedules because these are filled by enumerators. In case of questionnaire, it is not always clear as to who replies, but in case of schedule the identity of respondent is known.

Personal contact is generally not possible in case of the questionnaire method. But in case of schedules direct personal contact is established with respondents. Questionnaire method can be used only when respondents are literate and cooperative, but in case of schedules the information can be gathered even when the respondents happen to be illiterate.Wider and more representative distribution of sample is possible under the questionnaire method, but in respect of schedules there usually remains the difficulty in sending enumerators over a relatively wider area.

10.9 Interview Guide

Creating an interview guide helps interview research in a number of ways. An interview guide is simply a list of the high level topics that you plan on covering in the interview with the high level questions that you want to answer under each topic. We usually limit the guide to one page so that it's easy to refer to and to make sure that we're not getting too low level. The process of creating such a guide can help to focus and organize your line of thinking and therefore questioning.

When conducting the interview, we always bring a fresh copy of the guide so that we can easily cross off questions or topics as they are covered. Often we find that some questions are answered during the course of our conversation with the interviewee without even asking. Using the guide, I can check off the question on the guide so that we don't ask it explicitly later. It is important to remember that the interview guide really is only a guide. You don't have to follow the exact ordering and there's nothing wrong with "going off script" at times if a particular line of questioning that you hadn't anticipated seems worthwhile. You may also decide partway through that an entire line of questioning isn't appropriate for a particular interviewee. However, the guide can help you with pacing during an interview. If you're ten minutes into a thirty minute interview and you realize that you've only covered one topic out of the five on your guide, then you still have time to get back on track.

A)The benefits of using an interview guide

Using an interview guide during the hiring process has several benefits:

- **A structured process**. When all interviewers follow the same steps in the same order this creates structure. This, in turn, reduces the chances of people forgetting to ask candidates certain questions or give them certain information.

- **Candidate experience**. Using an interview guide ensures all candidates get the same experience. Of course, not all interviewers are the same so there will always be a difference, but at least the process and questions are the same for everyone.

- **Equal assessment**. When you use the same interview method and ask the same questions to every candidate, you can also use the same scoring to assess them. This reduces the risk of bias in the interview process.

An interview guide example

Ideally, your interview guide is part of a well-structured selection process. As such, it's aligned with every part of that process.

This means that, for instance, the requirements for a new position as specified in the job description (i.e. the required skills, personality, and capabilities of a suitable candidate) should be taken into account during the interview and, hence, included in the interview guide. Let's take a look at 7 key elements of an interview guide.

1. Invitation & Briefing

Make sure all candidates who make it to the interview round get the same invitation including a briefing of what to expect from the interview (how many people they'll talk to, how long

the interview will probably last, whether or not they need to prepare something beforehand, what documents they need to bring, etc.).

2. Setting the stage
This is a practical issue. Where do you want to interview people? Who will be interviewing the candidates? If it's a video interview, what's the best place to make the call? Here too, it's good to have the same setting for each candidate so that everybody gets the same experience. Include the 'setting' requirements, both online and offline, in your interview guide.
If interviewers should have a copy of the candidate's resume with them during the interview, or a copy of a work sample they had to make – or the interview guide they need to follow! – or any other kind of document, this should be in the interview guide too.

3. Welcome
Surely there are things you want to absolutely mention when welcoming candidates. They may be about the company, its history, the office, the job, you name it. Include the interview opening and everything it needs to cover in the interview guide.

4. Questions
In a structured interview, a standardized set of questions is used. This provides the interviewer with a uniform method of recording information and standardizing the rating of the candidate's qualifications. It also enables the interviewer to accurately compare applicants and to make the best decision based on data.
Besides having standardized questions, a common method used in interviews is the STAR method. This method offers a structured way to retrieve information from the candidate. STAR stands for:

- Situation. Ask the candidate to describe the situation that they were in.
- Task. What goal was the candidate working towards?
- Action. Ask the candidate to describe in detail what actions they took to make the best of the situation and to complete their task.
- Result. Ask the candidate to describe the outcome of the action and what they learned.

5. Candidate questions
Your interview guide should include a section on candidate questions. Usually, towards the end of the interview, the interviewer asks the applicant if they have any questions, about the job, the company, the team, you name it. The kind of question people asks – if any – can tell you a lot about their interest in working for your organization.

6. Wrap-up
Before saying goodbye to a candidate, there are a few things you should do. First of all, thank them for their time. Second, tell them what the next steps are. When will they know whether or not they made it to the next stage of the selection process, what is the next stage, and how will they hear from you (by email, phone, etc.). Third, ask them, if you haven't done so earlier on in the process, who their references are and how you can reach those people. This will help you with your reference check. Fourth, let them know who they can contact and

how if they have any questions after they leave. Make sure all of this is included in your interview guide.

7. Scoring

Once the actual interview is over and the candidate is gone it's time to rate them. How well did they score on each of the questions? The interviewer should fill in these scores right away (if they haven't done so during the interview), with the interview and the applicant's answers still fresh in their memory.

The interview questions can be divided into several categories such as person-job and person-organization fit. The former involves questions that aim to determine how compatible a candidate is with the requirements of the job they apply for, while the latter involves questions regarding a person's compatibility with the organization (its culture). The weight of each category will vary depending on your organizational requirements.

While questions around person-job fit will differ depending on the role you're hiring for, questions around person-organization fit won't or at least not as much. Therefore, you can decide to include those in your interview guide directly. Otherwise, you can opt for a link towards a Google Drive (or similar solution) where you store this kind of interview questions.

An interview guide template

We created a downloadable interview guide template you can use as a basis for your own interview guide. It covers the 7 sections we described in this article, including some of the elements to cover in those sections.

The template is just an example, of course. You can add or remove as many elements as necessary to create an interview guide that works for your organization.

B) The benefits of using an interview guide

The benefits of using an interview guide include

1) it creates a structured process

2) it provides all applicants with the same candidate experience and

3) it makes it easier to assess every candidate in the same way, hence reducing the risk of bias in the interview process.

10.10 Summary

Many different methodologies can be used for data collection and analysis. Most are based around a coreset of basic tools. These include interviews, focus group discussions, observation, photography, video,surveys, questionnaires and case studies. Data may also be generated through direct measurement,reviewing secondary data, and informal project / programme management processes.

Although there are many complex M&E methodologies thatcan be used to collect and analyseinformation, many, if notall, are based around the same core set of tools andmethods described.

For students new to M&E it is important to remember this. A quick search of the internet will reveal hundreds of different M&E methodologies with complicated names.Some are designed for very specific purposes and may require specialist skills to administer. But most are variants on a theme, or are old ideas re-packaged. If an M&Epractitioner can understand and apply the most basic tools of data collection then they should be able to apply almost any methodology for data collection and analysis.

10.11 Key Words

Questionnaire : A questionnaire is a research instrument that consists of a set of questions or other types of prompts that aims to collect information from a respondent.

Observation : Observational research is a research technique where you observe participants and phenomena in their most natural settings.

Documents and Records : Document- and records-based research uses existing data for a study. Attendance records, meeting minutes, and financial records are just a few examples of this type of research.

Schedule Method : A schedule is a structure of a set of questions on a given topic which are asked by the interviewer or investigator personally.

Interview Guide : An interview guide is simply a list of the high level topics that you plan on covering in the interview with the high level questions that you want to answer under each topic.

10.12Self Assessment Questions

1. Discuss about the data collection tools.
2. Examine the survey methods in social research.
3. Write about the difference between questionnaire and schedule.
4. Explain the observation method in social research.

10.13Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009
2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.
3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit kumar Sage Publications 2015
5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, and Dipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.
7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019.

Dr.K.MADHUBABU

LESSON 11

SCALING TECHNIQUES

Learning Objectives

- ✓ To learn the concepts of measurement and scaling
- ✓ discuss four levels of measurement scales
- ✓ classify and discuss different scaling techniques
- ✓ to know types of scaling techniques

Structure

11.0 Introduction

As we discussed earlier, the data consists of quantitative variables like price, income, sales etc., and qualitative variables like knowledge, performance, character etc. The qualitative information must be converted into numerical form for further analysis. This is possible through measurement and scaling techniques. A common feature of survey based research is to have respondent's feelings, attitudes, opinions, etc. in some measurable form. For example, a bank manager may be interested in knowing the opinion of the customers about the services provided by the bank. Similarly, a fast food company having a network in a city may be interested in assessing the quality and service provided by them.

11.1 Measurement and Scaling

Before we proceed further it will be worthwhile to understand the following two terms: (a) Measurement, and (b) Scaling.

a) **Measurement**: Measurement is the process of observing and recording theobservations that are collected as part of research. The recording of theobservations may be in terms of numbers or other symbols to characteristics of objects according to certain prescribed rules. The respondent's, characteristics are feelings, attitudes, opinions etc. For example, you may assign '1' for Male and '2' for Female respondents. In response to a question on whether he/she is using the ATM provided by a particular bank branch, the respondent may say 'yes' or 'no'. You may wish to assign the number '1' for the response yes and '2' for the response no. We assign numbers to these characteristics for two reasons. First, the numbers facilitate further statistical analysis of data obtained. Second, numbers facilitate the communication of measurement rules and results. The most important aspect of measurement is the specification of rules for assigning numbers to characteristics. The rules for assigning numbers should be standardised and applied uniformly. This must not change over time or objects.
b) **Scaling**: Scaling is the assignment of objects to numbers or semantics according to a rule. In scaling, the objects are text statements, usually statements of attitude, opinion, or feeling. For example, consider a scale locating customers of a bank according to the characteristic "agreement to the satisfactory quality of service provided by the branch". Each customer interviewed may respond with a semantic like 'strongly agree', or 'somewhat agree', or 'somewhat disagree', or 'strongly disagree'. We may even assign each of the responses a number. For example, we may assign strongly agree as '1', agree as '2' disagree as '3', and strongly disagree as '4'. Therefore, each of the respondents may assign 1, 2, 3 or 4

11.02 Levels of Measurement Scales

The level of measurement refers to the relationship among the values that are assigned to the attributes, feelings or opinions for a variable. For example, the variable 'whether the taste of fast food is good' has a number of attributes, namely, very good, good, neither good nor bad, bad and very bad. For the purpose of analysing the results of this variable, we may assign the values 1, 2, 3, 4 and 5 to the five attributes respectively. The level of measurement describes the relationship among these five values. Here, we are simply using the numbers as shorter placeholders for the lengthier text terms. We don't mean that higher values mean 'more' of something or lower values mean 'less' of something. We don't assume that 'good' which has a value of 2 is twice of 'very good' which has a value of 1. We don't even assume that 'very good' which is assigned the value '1' has more preference than 'good' which is assigned the value '2'. We simply use the values as a shorter name for the attributes, opinions, or feelings.

Typically, there are four levels of measurement scales or methods of assigning numbers: (a) Nominal scale, (b) Ordinal scale, (c) Interval scale, and (d) Ratio scale.

a)**Nominal Scale** is the crudest among all measurement scales but it is also the simplest scale. In this scale the different scores on a measurement simply indicate different categories. The nominal scale does not express any values or relationships between variables. For example, labelling men as '1' and women as '2' which is the most common way of labelling gender for data recording purpose does not mean women are 'twice something or other' than men. Nor it suggests that men are somehow 'better' than women. Another example of nominal scale is to classify the respondent's income into three groups: the highest income as group 1. The middle income as group 2, and the low-income as group 3. The nominal scale is often referred to as a categorical scale. The assigned numbers have no arithmetic properties and act only as labels. The only statistical operation that can be performed on nominal scales is a frequency count. We cannot determine an average except mode.

b)**Ordinal Scale** involves the ranking of items along the continuum of the characteristic being scaled. In this scale, the items are classified according towhether they have more or less of a characteristic. For example, you may wish to ask the TV viewers to rank the TV channels according to their preference and the responses may look like this as given below.

TV Channel	Viewerspreferences
Doordarshan-1	1
Star plus	2
NDTV News	3
AaajTak TV	4

The main characteristic of the ordinal scale is that the categories have a logical or ordered relationship. This type of scale permits the measurement of degrees of difference, (that is, 'more' or 'less') but not the specific amount of differences (that is, how much 'more' or 'less'). This scale is very common in marketing, satisfaction and attitudinal research.

c)**Interval Scale** is a scale in which the numbers are used to rank attributes such that numerically equal distances on the scale represent equal distance in the characteristic being measured. An interval scale contains all the information of an ordinal scale, but it also one allows to compare the difference/distance between attributes. For example, the difference between '1' and '2' is equal to the difference between '3' and '4'. Further, the difference between '2' and '4' is twice the difference between '1' and '2'. However, in an interval scale, the zero point is arbitrary and is not true zero. This, of course, has implications for the type of data manipulation and analysis. We can carry out on data collected in this form. It is possible to add or subtract a constant to all of the scale values without affecting the form of the scale but one cannot multiply or divide the values. Measuring temperature is an example of interval scale. We cannot say 400C is twice as hot as 200C. The reason for this is that 00C does not mean that there is no temperature, but a relative point on the Centigrade Scale. Due to lack of an absolute zero point, the interval scale does not allow the conclusion that 400C is twice as hot as 200C.

Interval scales may be either in numeric or semantic formats. The following are two more examples of interval scales one in numeric format and another insemantic format.

i) Example of Interval Scale in Numeric Format

Food supplied is:						*Indicate your score on the concerned blank and circle the appro-priate number on each line.*
Fresh	1	2	3	4	5	
Tastes good	1	2	3	4	5	
Value for money	1	2	3	4	5	
Attractive packaging	1	2	3	4	5	
Prompt time delivery	1	2	3	4	5	

ii) Example of Interval Scale in Semantic Format

Please indicate your views on the food supplied by XXX Fast Food Shop by scoring them on a five points scale from 1 to 5 (that is, 1=Excellent, 2=Very Good, 3=Good, 4=Poor, 5=Worst). Indicate your views by ticking the appropriate responses below:

Food supplied is:	Excellent	Very Good	Good	Poor	Worst
Fresh					
Tastes good					
Value for money					
Attractive packaging					
Prompt time delivery					

The interval scales allow the calculation of averages like Mean, Median and Mode and dispersion like Range and Standard Deviation.

d)**Ratio Scale** is the highest level of measurement scales. This has the properties of an interval scale together with a fixed (absolute) zero point. The absolute zero point allows us to construct a meaningful ratio. Examples of ratio scales include weights, lengths and times. In the marketing research, most counts are ratio scales. For example, the number of customers of a bank's ATM in the last
three months is a ratio scale. This is because you can compare this with previous three months. Ratio scales permit the researcher to compare both differences in scores and relative magnitude of scores. For example, the difference between 10 and 15 minutes is the same as the difference between 25 and 30 minutes and 30 minutes is twice as long as 15 minutes. Most financial research that deals with rupee values utilizes ratio scales. However, for most behavioural research, interval scales are typically the highest form of measurement. Most statistical data analysis procedures do not distinguish between the interval and ratio properties of the measurement scales and it is sufficient to say that all the statistical operations that can be performed on interval scale can also be performed on ratio scales.

It is important to recognise that there is a hierarchy implied in the levels of measurement. At lower levels of measurement, assumptions tend to be less restrictive and data analyses tend to be less sensitive. At each level up the hierarchy, the current level includes all the qualities of the one below it and adds something new. In general, it is desirable to have a higher level of measurement (that is, interval or ratio) rather than a lower one (that is, nominal or ordinal).

11.3Types of Scaling Techniques

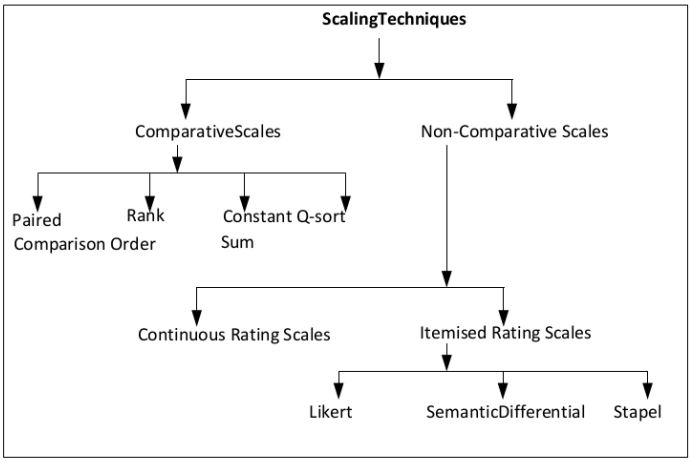
The various types of scaling techniques used in research can be classified into two categories:

(a) comparative scales

(b) Non-comparative scales.

In comparative scaling, the respondent is asked to compare one object with another. For example, the researcher can ask the respondents whether they prefer brand A or brand B of a detergent. On the other hand, in non- comparative scaling respondents need only evaluate a single object. Their evaluation is independent of the other object which the researcher is studying. Respondents using a non-comparative scale employ whatever rating standard seems appropriate to them. Non-comparative techniques consist of continuous and itemized rating scales. Figure 5.1 shows the classification of these scaling techniques.

Figure : Scaling Techniques



11.4Comparative Scales

The comparative scales can further be divided into the following four types of scaling techniques: (a) Paired Comparison Scale, (b) Rank Order Scale, (c) Constant Sum Scale, and (d) Q-sort Scale.

a)Paired Comparison Scale: This is a comparative scaling technique in which a respondent is presented with two objects at a time and asked to select one object (rate between two objects at a time) according to some criterion. The data obtained are ordinal in nature. For example, there are four types of cold drinks - Coke, Pepsi, Sprite, and Limca. The respondents can prefer Pepsi to Coke or Coke to Sprite, etc. In all we can have the following six comparisons.

Brand	Coke	Pepsi	Sprite	Limca
Coke	—	□		
Pepsi		—		
Sprite	□	□	—	
Limca	□	□	□	—
No. of times preferred	2	3	1	0

A□ in a particular box means that the brand in that column was preferred over the brand in the corresponding row. In the above recording, Coke was preferred over Sprite, Coke over Limca, in this case the number of times coke preferred was 2 times. Similarly, Pepsi over Coke, Pepsi over Sprite, Pepsi over Limca, in this case Pepsi was 3 time preferred. Thus, the number of times a brand was preferred is obtained by summing the □ □s in eachcolumn.

b)Rank Order Scale: This is another type of comparative scaling technique in which respondents are presented with several items simultaneously and asked to rank them in the order of priority. This is an ordinal scale that describes the favoured and unfavoured objects, but does not reveal the distance between the objects. For example, if you are interested in ranking the preference of some selected brands of cold drinks, you may use the following format for recording the responses.

c)Preference of cold drink brands using rank order scaling

Instructions: Rank the following brands of cold drinks in order of preference. Begin by picking out the one brand you like most and assign it a number1. Then find the second most preferred brand and assign it a number
2. Continue this procedure until you have ranked all the brands of cold drinks in order of preference. The least preferred brand should be assigned a rank of 4. Also remember no two brands receive the same rank order.

Brand	Rank
(a) Coke	3
(b) Pepsi	1
(c) Limca	2
(d) Sprite	4

d)Constant Sum Scale: In this scale, the respondents are asked to allocate a constant sum of units such as points, rupees, or chips among a set of stimulus objects with respect to some criterion. For example, you may wish to determine how important the attributes of price, fragrance, packaging, cleaning power, and lather of a detergent are to consumers. Respondents might be asked to divide a constant sum to indicate the relative importance of the attributes using the following format.

Importance of detergent attributes using a constant sum scale
Format

Attribute	**Number of Points**
(a) Price	50
(b) Fragrance	05
(c) Packaging	10
(d) Cleaning Power	30
(e) Lather	05
Total Points	100

e) Q-Sort Scale: This is a comparative scale that uses a rank order procedure to sort objects based on similarity with respect to some criterion. The important characteristic of this methodology is that it is more important to make comparisons among different responses of a respondent than the responses between different respondents. Therefore, it is a comparative method of scaling rather than an absolute rating scale. In this method the respondent is given statements in a large number for describing the characteristics of a product or a large number of brands of a product. For example, you may wish to determine the preference from among a large number of magazines.

11.5 Non-Comparative Scales
The non-comparative scaling techniques can be further divided into: (a) Continuous Rating Scale, and (b) Itemised Rating Scale.

a)Continuous Rating Scales
It is very simple and highly useful. In continuous rating scale, the respondent's rate the objects by placing a mark at the appropriate position on a continuous line that runs from one

extreme of the criterion variable to the other. Examples of continuous rating scale are given below:

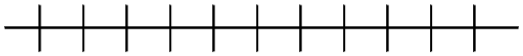
Question: How would you rate the TV advertisement as a guide for buying?

Scale Type A

strongly agree strongly disagree

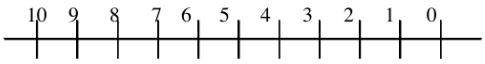
Scale B

Strongly disagree strongly agree



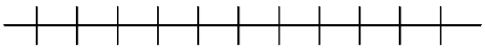
Scale C

Strongly agree strongly disagree



Scale D

strongly disagree 0 1 2 3 4 5 6 7 8 9 10 strongly agree



When scale type A and B are used, the respondents score is determined either by dividing the line into as many categories as desired and assigning the respondent a score based on the category into which his/her mark falls, or by measuring distance, in millimeters, centimeters, or inches from either end of the scale. Whichever of the above continuous scale is used, the results are normally analysed as interval scaled.

b)Itemised Rating Scales

Itemised rating scale is a scale having numbers or brief descriptions associated with each category. The categories are ordered in terms of scale position and the respondents are required to select one of the limited number of categories that best describes the product, brand, company, or product attribute being rated. Itemised rating scales are widely used in marketing research.

The itemised rating scales can be in the form of : (a) graphic, (b) verbal, or (c) numeric as shown below.

Itemised Graphic Scale	Itemised Verbal Scale	Itemised Numeric Scale
 Favourable	Completelysatisfied	–5 —
		–4 —
	Somewhat satisfied	–3 —
		–2 —
 Indifferent	Neither satisfied nor dissatisifed	–1 —
		0 —
	Somewhat dissatisfied	+1 —
		+2 —
 Unfavourable	Completely dissatisfied	+3 —
		+4 —
		+5 —

Some rating scales may have only two response categories such as : agree and disagree. Inclusion of more response categories provides the respondent more flexibility in the rating task. Consider the following questions:

1. How often do you visit the super market located in your area of residence?

   - Never
   - Rarely
   - Sometimes
   - Often
   - Very often

2. In your case how important is the price of brand X shoes when you buy them?

   - Veryimportant
   - Fairly important
   - Neutral
   - Not so important

Each of the above category scales is a more sensitive measure than a scale with only two responses since they provide more information.
Wording is an extremely important factor in the usefulness of itemized scales. Table 5.6 shows some common wordings for categories used in itemised scales.

Quality:				
Excellent	Good	Notdecided	Poor	Worst
VeryGood	Good	Neithergood nor bad	Fair	Poor
Importance:				
VeryImportant	Fairly important	Neutral	Notso important	Not at all important
Interest:				
Veryinterested	Somewhat interested	Neitherinterested nordisinterested	Somewhat uninterested	Not very interested
Satisfaction:				
Completely satisfied	Somewhat satisfied	Neithersatisfied nordissatisfied	Somewhat dissatisfied	Completely dissatisfied
Frequency:				
All of the time	Veryoften	Often	Sometimes	Hardly ever
Veryofetn	Often	Sometimes	Rarely	Never
Truth:				
Verytrue	Somewhat true	Notverytrue	Not at all true	
Purchase Interest:				
Definitely will buy	Probably will buy	Probablywill notbuy	Definitely will not buy	
Level of Agreement:				
Stronglyagree	Somewhat agree	Neitheragree nordisagree	Somewhat disagree	Strongly disagree
Dependability:				
Completely dependable	Somewhat dependable	Notvery dependable	Not at all dependable	
Style:				
Very stylish	Somewhat stylish	Notvery stylish	Completely unstylish	
Cost:				
Extremely expensive	Expensive	Neither expensivenorinexpensive inexpensive	Slightly inexpensive	Very
Ease of use:				
Veryeaseto use	Somewhat easytouse	Notveryeasy touse	Difficult to use	

Modernity: Verymodern	Some what modern	Neithermodern nor old-fashioned	Somewhat old fashioned	Very old fashioned
Alert: Veryalert	Alert	Notalert	Not at allalert	

Attitude measurement is an important parameter to understand the thoughts and opinions about a target sample. Attitude measurement surveys have been successful in gaining feedback on respondents attitudes about the topic under discussion. These surveys are carefully curated with structured question types and scales.

This is where attitude scales come into the picture. Scales are used to associate a numerical value with respondent behavior and thoughts. It is possible to have a number corresponding to attitudes only when the attitude is considered accountable on only one scale (uni-dimensional scale).

These scales can be classified into: Nominal, Ordinal or Interval scales and practically, there is a well-constructed process for attitude scaling such as Likert, Guttman, Bogardus or Thurstone. Thurstone and Guttman scales are two of the most distinctive attitude measurement scales of all used to refer respondent behavior in real-life phenomenon with observation-based research.

Thurstone scale was designed by psychologist Robert Thurstone in an attempt to equate interval scale of measurement with the attitude scale and introduce a scale with statements appearing at equal intervals. While Guttman scale is a cumulative scale developed by Louis Guttman in 1944 – 1950 used to analyze the continuum for the topic of research, i.e., if in a list of 10 questions, if the respondent agrees to the 8th statement – it depicts that he/she agrees with the preceding questions as well and does not agree with the 9th and 10th statements.

In this section we will discuss three itemised rating scales, namely (a) Likert scale, (b) Semantic Differential Scale, and (c) Stapel Scale.

a)Likert Scale: In business research, the Likert scale, developed by Rensis Likert, is extremely popular for measuring attitudes, because, the method is simple to administer. With the Likert scale, the respondents indicate their own attitudes by checking how strongly they agree or disagree with carefully worded statements that range from very positive to very negative towards the attitudinal object. Respondents generally choose from five alternatives (say strongly agree, agree, neither agree nor disagree, disagree, strongly disagree).

Consider the following example of a study or measuring attitudes towards cricket.

	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
It is more fun to play a tough, competitive cricket match than to play an easy one.	5	4	3	2	1

To measure the attitude, the researchers assign weights or scores to thealternative responses. In the above example the scores 5 to 1 are assigned to the responses. Strong agreement of the respondent indicates the most favourable attitudes on the statement, and the score 5 is assigned to it. On the other hand, strong disagreement of the respondent indicates the most unfavourable attitude on the statement, and the score 1 is assigned to it. If a negative statement towards the object is given, the corresponding scores would be reversed. In this case, the response ‘strongly agree’ will get a score of 1 and the response ‘strongly disagree’ will get a score of 5.

A Likert scale may include a number of items or statements. Each statement is assumed to represent an aspect of an attitudinal domain. For example, Table 5.7 shows the items in a Likert Scale to measure opinions on food products.

A Likert Scale for studying opinions on food products.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
If the price of raw materials fall, firms too should reduce the price of the food products.	1	2	3	4	5
There should be uniform price through out the country for food products	1	2	3	4	5
The food companies should concentrate more on keeping hygiene while manufacturing food products.	1	2	3	4	5
The expiry dates should be printed on the food products before they are delivered to consumers in the market.	1	2	3	4	5
There should be government regulations on the firms in keeping acceptable quality and on the prices	1	2	3	4	5
Now-a-days most food companies are concerned only with profit making rather than taking care ofquality.	1	2	3	4	5

Each respondent is asked to circle his opinion on a score against each statement. The final score for the respondent on the scale is the sum of their ratingsforalltheitems.TheverypurposeofLikert'sScaleistoensurethefinal items evoke a wide response and discriminate among those with positive and negativeattitudes.Itemsthatarepoor(becausetheylackclarityorelicitmixed responsepatterns)aredetectedfromthefinalstatementlist.Thiswillensureus todiscriminatebetweenhighpositivescoresandhighnegativescores.However, manybusinessresearchersdonotfollowthisprocedureandyoumaynotbeina position to distinguish between high positive scores and high negative scores becauseallscoreslookalike.HenceadisadvantageoftheLikertScaleisthatit is difficult to know what a single summated score means. Many patterns of response other various statements can produce the same total score. The other disadvantage of Likert Scale is that it takes longer time to complete than other item is edrating scales because respondent shave to readeachs tatement. Despite thea bove disadvantages, this scale has several advantages.Itiseasyto construct, administer and use.

a) **Semantic Differential Scale**: This is a seven point rating scale with end points associated with bipolar labels (such as good and bad, complex and simple) that have semantic meaning. The Semantic Differential scale is used for a variety of purposes. It can be used to find whether a respondent has a positive or negative attitude towards an object. It has been widely used in comparing brands, products and

company images. It has also been used to develop advertising and promotion strategies and in a new product development study.

11.6Thurstone Scale

Predicting results and setting comparison of various feedbacks is much more convenient than attempting to quantify something as intricate as respondent attitudes. Thurstone is a systematic technique to perform the process of differentiating and forecasting results.

Thurstone scale was traditionally implemented in sociology and psychology. It is constructed by taking multiple "agree-disagree" statements with values corresponding to each of these statements. Thus, Thurstone scale is used to ascertain respondent opinions and feelings and the intensities of those respective opinions.

11.7Guttman Scale

In many cases, the strength of respondent opinions is more important than the opinions themselves. Guttman scale, also popularly known as cumulative scale, has a series of statements chosen by a careful rating process. From this list of statements, it is subsumed that a respondent agrees particular item also chooses to agree with the preceding statements.

There are multiple grievous issues where it is important to know the strength of respondent opinions as opposed to just their opinions. Guttman scale project the severity of the opinion by including a list of dichotomous questions in terms of "agree-disagree" or "yes-no".

11.8Thurstone vs Guttman Scale

Thurstone Scale	Guttman Scale
The scale is decided by experts on a scale of 1-11 using mean/mode.	The scale is decided by experts as they submit their agreement with the various statements and the last agreed statement indicates that they agree with the previous statements.
Thurstone scale survey questions are decided by assigning relative values to the statements.	Guttman scale survey questions are decided by the average degree of agreement for each of the statements. In case of least agreement, the statements will not be a part of the survey.
The standard of deciding Thurstone scale is from extremely unfavorable to extremely favorable.	The standard of deciding Guttman scale is from agreement to disagreement or Yes/No.
Either median or mode is used for analyzing Thurstone scale	Average of opinions is considered for analyzing Guttman scale
The only limitation of the Thurstone scale is that as corresponding values are allotted as per the understanding of a judge or a group of judges are non-uniform, the mathematical calculations can be inaccurate.	The limitation of Guttman scale will be in terms of difficulty in execution and also similar to Thurstone scale, each judge or group of judges can interpret the statements differently – which can result in margin of error in the collected information.

11.9Summary

Scaling technique is a method of placing respondents in continuation of gradual change in the pre-assigned values, symbols or numbers based on the features of a particular object as per the defined rules. All the scaling techniques are based on four pillars, i.e.,

order, description, distance and origin.

There are four levels of measurements: nominal, ordinal, interval, and ratio.These constitute a hierarchy where the lower scale of measurement, nominal, has far fewer statistical applications than those further up this hierarchy of scales. Nominal scales yield data on categories; ordinal scales give sequences; interval scales begin to reveal the magnitude between points on the scale and ratio scales explain both order and the absolute distance between any two points on the scale.

The measurement scales, commonly used in marketing research, can be divided into two types; comparative and non-comparative scales. Comparative scales involve the respondent in signaling where there is a difference between two or more firms, brands, services, or other stimuli. The scales under this type are: (a) Paired Comparison, (b) Rank Order, (c) Constant Sum, and (d) Q-sort. Further, The non-comparative scales can be classified into: (a) Continuous Rating Scales and (b) Itemised Rating Scales. The Itemised Rating scales can further be classified into: (a) Likert Scale, (b) Semantic Differential Scale, and (c) Stapel Scale. A number of scaling techniques are available for measurement of attitudes. There is no unique way that you can use to select a particular scaling technique for your research study. A number of issues, such as problem defintion and statistical analysis, choice between comparative and noncomparative scales, type of category lables, number of categories etc., discussed in this unit should be considered before you arrive at a particular scaling technique.

11.10Key Words

Comparative Scales : In comparative scaling, the respondent is asked to compare one object with another.

Constant Sum Scale : In this scale, the respondents are asked to allocate a constant sum of units such as points, rupees, or chips among a set of stimulus objects with respect to some criterion. Continuous Rating Scales : Here the respondents rate the objects by placing a mark at the appropriate position on a continuous line that runs from one extreme of the criterion variable to the other.

Itemised Rating Scales : Itemised rating scale is a scale having numbers or brief descriptions associated with each category.

Interval Scale : In this scale, the numbers are used to rank attributes such that numerically equal distances on the scale represent equal distances in the characteristic being measured.

Likert Scale : With the Likert scale, the respondents indicate their own attitudes by checking how strongly they agree or disagree with carefully worded statements that range from very positive to very negative towards the attitudinal object.

Measurement : Measurement is the process of observing and recording the observations that are collected as part of research.

Non-comparative Scales : In non-comparative scaling, respondents need only evaluate a single object.

Nominal Scale : In this scale, the different scores on a measurement simply indicate different categories.

Ordinal Scale : In this scale, the items are ranked according to whether they have more or less of a characteristic.

Q-Sort Scale : This is a comparative scale that uses a rank order procedure to sort objects based on similarity with respect to some criterion.

Rank Order Scale : In this scale, the respondents are presented with several items simultaneously and asked to order or rank them according to some criterion.
Scaling : Scaling is the assignment of objects to numbers or semantics according to a rule.
Semantic Differential Scale : This is a seven point rating scale with end points associated with bipolar labels (such as good and bad, complex and simple) that have semantic meaning.

11.11Self – Assessment Questions:

1) Discuss briefly different issues you consider for selecting an appropriate scaling technique for measuring attitudes.
2) What are the different levels of measurement? Explain any two of them.
3) How do you select an appropriate scaling technique for a research study? Explain the issues involved in it.
4) Discuss briefly the issues involved in attitude measurement.
5) Differentiate between ranking scales and rating scales. Which one of these scales is better for measuring attitudes?
6) In what type of situation is the Q-sort technique more appropriate?
7) Name any four situations in commerce where you can use the Likert scale.

11.12Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009
2. . Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.
3. Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit kumar Sage Publications 2015
5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, and Dipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.

7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019.
8. Rodger, Lesile W. (1984) Statistics for Marketing, McGraw-Hill (UK),London.
9. Research Methodology- 2014 by R. Panneerselvam, PHI Learning, ISBN9788120349469.
10. Research Methodology and Statistical Analysis, January 2022, by Sai, SIA Publishers & Distributors Pvt Ltd.

Dr.K.MADHUBABU

LESSON 12

PILOT STUDY,PRE – TESTING, VALIDITY, RELIABILITY, QUALITATIVE AND QUANTITATIVE DATA ANALYSIS

Learning objectives

- ✓ To know the pilot study
- ✓ To evalute the per – testing
- ✓ To assess the validity and reliability
- ✓ To examine the qualitative and quantitative research methods

Structure

12.0 Introduction

A pilot study can be defined as a 'small study to test research protocols, data collection instruments, sample recruitment strategies, and other research techniques in preparation for a larger study. A pilot study is one of the important stages in a research project and is conducted to identify potential problem areas and deficiencies in the research

instruments and protocol prior to implementation during the full study. It can also help members of the research team become familiar with the procedures in the protocol, and can help them decide between two competing study methods, such as using interviews rather than a self-administered questionnaire.

Pilot studies are small-scale, preliminary studies which aim to investigate whether crucial components of a main study – usually a randomized controlled trial (RCT) – will be feasible. For example, they may be used in attempt to predict an appropriate sample size for the full-scale project and/or to improve upon various aspects of the study design. Often RCTs require a lot of time and money to be carried out, so it is crucial that the researchers have confidence in the key steps they will take when conducting this type of study to avoid wasting time and resources.

Thus, a pilot study must answer a simple question: "Can the full-scale study be conducted in the way that has been planned or should some component(s) be altered?"

The reporting of pilot studies must be of high quality to allow readers to interpret the results and implications correctly. This blog will highlight some key things for readers to consider when they are appraising a pilot study.

12.1 The main reasons to conduct a pilot study

Pilot studies are conducted to evaluate the feasibility of some crucial component(s) of the full-scale study. Typically, these can be divided into 4 main aspects:

Process: where the feasibility of the key steps in the main study is assessed (e.g. recruitment rate; retention levels and eligibility criteria)

Resources: assessing problems with time and resources that may occur during the main study (e.g. how much time the main study will take to be completed; whether use of some equipment will be feasible or whether the form(s) of evaluation selected for the main study are as good as possible)

Management: problems with data management and with the team involved in the study (e.g. whether there were problems with collecting all the data needed for future analysis; whether the collected data are highly variable and whether data from different institutions can be analyzed together).

12.2 Reasons for not conducting a pilot study

A study should not simply be labelled a 'pilot study' by researchers hoping to justify a small sample size. Pilot studies should always have their objectives linked with feasibility and should inform researchers about the best way to conduct the future, full-scale project.

A) How to interpret a pilot study

Readers must interpret pilot studies carefully. Below are some key things to consider when assessing a pilot study:

- The objectives of pilot studies must always be linked with feasibility and the crucial component that will be tested must always be stated.
- The method section must present the criteria for success. For example: "the main study will be feasible if the retention rate of the pilot study exceeds 90%". Sample size may vary in pilot studies (different articles present different sample size calculations) but the pilot study population, from which the sample is formed, must be the same as the main study. However, the participants in the pilot study should not be

entered into the full-scale study. This is because participants may change their later behaviour if they had previously been involved in the research.

- The pilot study may or may not be a randomized trial (depending on the nature of the study). If the researchers do randomize the sample in the pilot study, it is important that the process for randomization is kept the same in the full-scale project. If the authors decide to test the randomization feasibility through a pilot study, different kinds of randomization procedures could be used.
- As well as the method section, the results of the pilot studies should be read carefully. Although pilot studies often present results related to the effectiveness of the interventions, these results should be interpreted as "potential effectiveness". The focus in the results of pilot studies should always be on feasibility, rather than statistical significance. However, results of the pilot studies should nonetheless be provided with measures of variability (such as confidence intervals), particularly as the sample size of these studies is usually relatively small, and this might produce biased results.

12.3 Pre – Testing

The tool or instrument of data collection namely the schedule or the questionnaire should be pre-tested before adopted for data collection on the study. Pre-testing simply means, testing the validity, reliability, practicability and sensitivity of the tool before it is used for actual data collection. The only way to gain assurance that questions are unambiguous is to try them on a selected small group of prospective respondents.

a) Process of Pre-testing

Pre-testing can be done in parts. Different sub-parts in the main part of the questionnaire/schedule can be differently pre-tested. So a series of small pre-test on different units of the tool can be done. A full scale pre-test of the whole tool can be done if needed finally or in lieu of the series of pre-tests is small bits.

Pre-testing must be done on a sample that is representatives of the population. May be 10 to 12 respondents for pre-testing are good.

b) Importance of pre-testing

The following are the objectives of pre-testing of data collection tools:

- To detect discrepancies in the tool and rectify the same. This is needed to find where the shoe bites and making amends for the same.
- To detect the difficulties encountered by the respondents while filling up the questionnaire / schedule and make remedies for the same.
- To detect possible misunderstood, un-understood aspects of the tool and rectify the same.
- The sequence of questions is better ordered in the light of feedback received.
- To get now insights into the problem based on responses received through pre-test and incorporate them in the tool and thereby enriching the tool.
- To take note of flabby parts in the tool and remove them to make the tool slim and fit.
- To re-size the tool based on time taken for filling up the questionnaire. The tool is thus right sized.

Goode and Hatt (1952) indicated the following as signs or symptoms of defective schedule / questionnaire which may be seen during pre-testing:

- Lack of proper order in the responses,

- All are none responses,
- Large number of "do not know" or "do not understand" answers,
- Many qualified answers or irrelevant opinions,
- High proportion of refusals to answer,
- High degree of variance in answers when the questions order is changed,
- Similar type of people giving different types of replies,
- Answers differing known answers,
- In case of questionnaire refusal to answer it,
- Marginal comments of interviewers or respondents concerning particular questions.

c) Advantages of Pre-testing

The advantages of pre-testing of data collection tools are as follows:

- The strengths and weaknesses of the tool are known before-hand.
- The structure and contents of the tool are refined in the light of weaknesses spotted.
- Measurement problems like offensive questions, intrusive or invasive questions get rectified.
- Effectiveness of the tool is enhanced by rightly working certain questions, removing confusion causing questions and the like.
- An estimate of resources needed in terms of non-hours needed, enumerates needed, etc. to conduct the final survey can be made.

12.4 Reliability

Reliability refers to the consistency of a measure. Psychologists consider three types of consistency: over time (test-retest reliability), across items (internal consistency), and across different researchers (inter-rater reliability).

a) Test-Retest Reliability

When researchers measure a construct that they assume to be consistent across time, then the scores they obtain should also be consistent across time. Test-retest reliability is the extent to which this is actually the case. For example, intelligence is generally thought to be consistent across time. A person who is highly intelligent today will be highly intelligent next week. This means that any good measure of intelligence should produce roughly the same scores for this individual next week as it does today. Clearly, a measure that produces highly inconsistent scores over time cannot be a very good measure of a construct that is supposed to be consistent.

Assessing test-retest reliability requires using the measure on a group of people at one time, using it again on the same group of people at a later time, and then looking at test-retest correlation between the two sets of scores. This is typically done by graphing the data in a scatterplot and computing Pearson's r. Figure 12.1 shows the correlation between two sets of scores of several university students on the Rosenberg Self-Esteem Scale, administered two times, a week apart. Pearson's r for these data is +.95. In general, a test-retest correlation of +.80 or greater is considered to indicate good reliability.

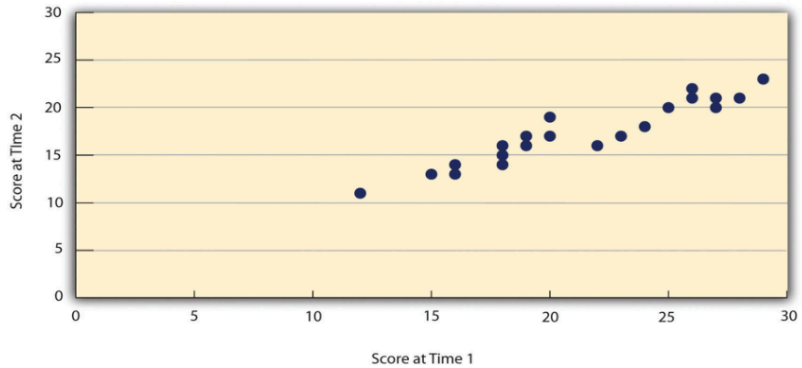


Figure 12.1Test-Retest Correlation Between Two Sets of Scores of Several College Students on the Rosenberg Self-Esteem Scale, Given Two Times a Week Apart

Again, high test-retest correlations make sense when the construct being measured is assumed to be consistent over time, which is the case for intelligence, self-esteem, and the Big Five personality dimensions. But other constructs are not assumed to be stable over time. The very nature of mood, for example, is that it changes. So a measure of mood that produced a low test-retest correlation over a period of a month would not be a cause for concern.

b) Internal Consistency

A second kind of reliability is internal consistency, which is the consistency of people's responses across the items on a multiple-item measure. In general, all the items on such measures are supposed to reflect the same underlying construct, so people's scores on those items should be correlated with each other. On the Rosenberg Self-Esteem Scale, people who agree that they are a person of worth should tend to agree that that they have a number of good qualities. If people's responses to the different items are not correlated with each other, then it would no longer make sense to claim that they are all measuring the same underlying construct. This is as true for behavioural and physiological measures as for self-report measures. For example, people might make a series of bets in a simulated game of roulette as a measure of their level of risk seeking. This measure would be internally consistent to the extent that individual participants' bets were consistently high or low across trials.

Like test-retest reliability, internal consistency can only be assessed by collecting and analyzing data. One approach is to look at a split-half correlation. This involves splitting the items into two sets, such as the first and second halves of the items or the even- and odd-numbered items. Then a score is computed for each set of items, and the relationship between the two sets of scores is examined. For example, Figure 12.2 shows the split-half correlation between several university students' scores on the even-numbered items and their scores on the odd-numbered items of the Rosenberg Self-Esteem Scale. Pearson's r for these data is +.88. A split-half correlation of +.80 or greater is generally considered good internal consistency.

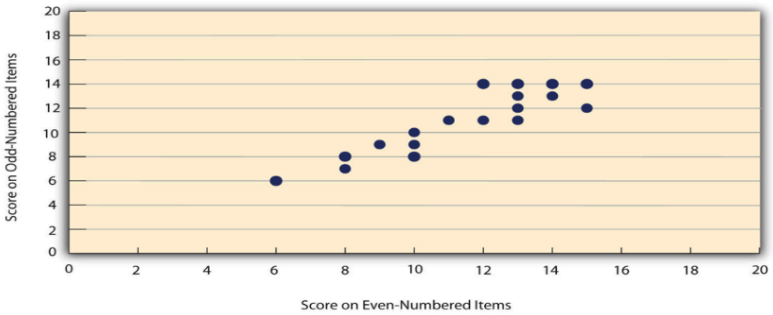


Figure 12.2 Split-Half Correlation Between Several College Students' Scores on the Even-Numbered Items and Their Scores on the Odd-Numbered Items of the Rosenberg Self-Esteem Scale

Perhaps the most common measure of internal consistency used by researchers in psychology is a statistic called Cronbach's α (the Greek letter alpha). Conceptually, α is the mean of all possible split-half correlations for a set of items. For example, there are 252 ways to split a set of 10 items into two sets of five. Cronbach's α would be the mean of the 252 split-half correlations. Note that this is not how α is actually computed, but it is a correct way of interpreting the meaning of this statistic. Again, a value of +.80 or greater is generally taken to indicate good internal consistency.

c) Interrater Reliability

Many behavioural measures involve significant judgment on the part of an observer or a rater. Inter-rater reliability is the extent to which different observers are consistent in their judgments. For example, if you were interested in measuring university students' social skills, you could make video recordings of them as they interacted with another student whom they are meeting for the first time. Then you could have two or more observers watch the videos and rate each student's level of social skills. To the extent that each participant does in fact have some level of social skills that can be detected by an attentive observer, different observers' ratings should be highly correlated with each other. Inter-rater reliability would also have been measured in Bandura's Bobo doll study. In this case, the observers' ratings of how many acts of aggression a particular child committed while playing with the Bobo doll should have been highly positively correlated. Interrater reliability is often assessed using Cronbach's α when the judgments are quantitative or an analogous statistic called Cohen's κ (the Greek letter kappa) when they are categorical.

12.5 Validity

Validity is the extent to which the scores from a measure represent the variable they are intended to. But how do researchers make this judgment? We have already considered one factor that they take into account—reliability. When a measure has good test-retest reliability and internal consistency, researchers should be more confident that the scores represent what they are supposed to. There has to be more to it, however, because a measure can be extremely reliable but have no validity whatsoever. As an absurd example, imagine someone who believes that people's index finger length reflects their self-esteem and therefore tries to measure self-esteem by holding a ruler up to people's index fingers. Although this measure

would have extremely good test-retest reliability, it would have absolutely no validity. The fact that one person's index finger is a centimetre longer than another's would indicate nothing about which one had higher self-esteem.

a) Face Validity

Face validity is the extent to which a measurement method appears "on its face" to measure the construct of interest. Most people would expect a self-esteem questionnaire to include items about whether they see themselves as a person of worth and whether they think they have good qualities. So a questionnaire that included these kinds of items would have good face validity. The finger-length method of measuring self-esteem, on the other hand, seems to have nothing to do with self-esteem and therefore has poor face validity. Although face validity can be assessed quantitatively—for example, by having a large sample of people rate a measure in terms of whether it appears to measure what it is intended to—it is usually assessed informally.

b) Content Validity

Content validity is the extent to which a measure "covers" the construct of interest. For example, if a researcher conceptually defines test anxiety as involving both sympathetic nervous system activation (leading to nervous feelings) and negative thoughts, then his measure of test anxiety should include items about both nervous feelings and negative thoughts. Or consider that attitudes are usually defined as involving thoughts, feelings, and actions toward something. By this conceptual definition, a person has a positive attitude toward exercise to the extent that he or she thinks positive thoughts about exercising, feels good about exercising, and actually exercises. So to have good content validity, a measure of people's attitudes toward exercise would have to reflect all three of these aspects. Like face validity, content validity is not usually assessed quantitatively. Instead, it is assessed by carefully checking the measurement method against the conceptual definition of the construct.

c) Criterion Validity

Criterion validity is the extent to which people's scores on a measure are correlated with other variables (known as criteria) that one would expect them to be correlated with. For example, people's scores on a new measure of test anxiety should be negatively correlated with their performance on an important school exam. If it were found that people's scores were in fact negatively correlated with their exam performance, then this would be a piece of evidence that these scores really represent people's test anxiety. But if it were found that people scored equally well on the exam regardless of their test anxiety scores, then this would cast doubt on the validity of the measure.

When the criterion is measured at the same time as the construct, criterion validity is referred to as concurrent validity; however, when the criterion is measured at some point in the future (after the construct has been measured), it is referred to as predictive validity (because scores on the measure have "predicted" a future outcome).

Criteria can also include other measures of the same construct. For example, one would expect new measures of test anxiety or physical risk taking to be positively correlated with existing measures of the same constructs. This is known as convergent validity.

d) Discriminant Validity

Discriminant validity, on the other hand, is the extent to which scores on a measure are not correlated with measures of variables that are conceptually distinct. For example, self-esteem

is a general attitude toward the self that is fairly stable over time. It is not the same as mood, which is how good or bad one happens to be feeling right now. So people's scores on a new measure of self-esteem should not be very highly correlated with their moods. If the new measure of self-esteem were highly correlated with a measure of mood, it could be argued that the new measure is not really measuring self-esteem; it is measuring mood instead.

12.6 Data collection method for qualitative data

The best data collection method for a researcher for gathering qualitative data which generally is data relying on the feelings, opinions and beliefs of the respondents would be Combination Research.

The reason why combination research is the best fit is that it encompasses the attributes of Interviews and Focus Groups. It is also useful when gathering data that is sensitive in nature. It can be described as all-purpose quantitative data collection method.

Above all, combination research improves the richness of data collected when compared with other data collection methods for qualitative data.

Figure 12.3

12.7 Data collection method for quantitative research data

The best data collection method a researcher can employ in gathering quantitative data which takes into consideration data that can be represented in numbers and figures that can be deduced mathematically is the Questionnaire.These can be administered to a large number of respondents, while saving cost. For quantitative data that may be bulky or voluminous in nature, the use of a Questionnaire makes such data easy to visualize and analyze.

Another key advantage of the Questionnaire is that it can be used to compare and contrast previous research work done to measure changes.

12.8 Qualitative Research Method

The qualitative research methods of data collection do not involve the collection of data that involves numbers or a need to be deduced through a mathematical calculation, rather it is based on the non-quantifiable elements like the feeling or emotion of the researcher. An example of such a method is an open-ended questionnaire.

Figure 12.4

12.9 Quantitative Method

Quantitative methods are presented in numbers and require a mathematical calculation to deduce. An example would be the use of a questionnaire with close-ended questions to arrive at figures to be calculated Mathematically. Also, methods of correlation and regression, mean, mode and median.

Figure 12.5

12.10 Qualitative vs quantitative data collection methods

Some of the methods covered here are quantitative, dealing with something that can be counted. Others are qualitative, meaning that they consider factors other than numerical values. In general, questionnaires, surveys, and documents and records are quantitative, while interviews, focus groups, observations, and oral histories are qualitative. There can also be crossover between the two methods.

Data analysis can take various formats. The method you choose depends on the subject matter of your research.

Quantitative methods, such as surveys, large-scale benchmarks, and prioritization, answer the question "How much?" But these methods can leave the question "Why?" unanswered. This is where qualitative data collection methods come into play.

Understanding qualitative data collection

Qualitative data collection looks at several factors to provide a depth of understanding to raw data. While qualitative methods involve the collection, analysis, and management of data, instead of counting responses or recording numeric data, this method aims to assess factors like the thoughts and feelings of research participants. Qualitative data collection methods go beyond recording events to create context.

With this enhanced view, researchers can

- Describe the environment. Understanding where observations take place can add meaning to recorded numbers.
- Identify the people involved in the study. If research is limited to a particular group of people, whether intentionally or as a function of demographics or other factors, this information can inform the results.
- Describe the content of the study. Sometimes, the specific activities involved in research and how messages about the study were delivered and received may illuminate facts about the study.
- Interact with study participants. Interactions between respondents and research staff can provide valuable information about the results.
- Be aware of external factors. Unanticipated events can affect research outcomes. Qualitative data collection methods allow researchers to identify these events and weave them into their results narrative, which is nearly impossible to do with just a quantitative approach.

a)Qualitative research methods

There are three commonly used qualitative data collection methods: ethnographic, theory grounded, and phenomenological.

Ethnography comes from anthropology, the study of human societies and cultures. Ethnography seeks to understand how people live their lives. Through this method, researchers veer away from the specific and practical questions that traditional market researchers use and instead observe the participants in a nondirected way. This approach is intended to reveal behaviors from a subject's perspective rather than from the view of the researchers.

Ethnography helps fill in the blanks when a participant may not be able to articulate their desires or the reasons for their decisions or behaviors. Instead of, or in addition to,

asking why a participant acts a certain way, researchers use observation to understand the why behind these desires, decisions, or behaviors.

Grounded theory arose when sociological researchers sought to provide a level of legitimacy to qualitative research — to ground it in reality rather than assumptions. Before this method, qualitative data analysis was actually done before any quantitative data was collected, so it was disconnected from the collection and analysis process.

Grounded theory uses the following methods:

- **Participant observation.** Researchers immerse themselves in the daily lives of subjects. Another term for this is "fieldwork."
- **Interviews.** These can vary in formality from informal chats to structured interviews.
- **Document and artifact collection.** Grounded theory often is about more than observation and interviews. Researchers can learn about a group of people from looking at materials the group used. For example, a local community's laws may shed light on opinions and provide a clearer picture of residents' sentiments.

Each of these qualitative data collection methods sheds light on factors that can be hidden in simple data analysis. Qualitative data is one way to add context and reality to raw numbers. Often, researchers find value in a hybrid approach, where qualitative data collection methods are used alongside quantitative ones.

b)Quantitative data collection methods

Marketers, scientists, academics, and others may start a study with a predetermined hypothesis, but their research often begins with the collection of data.

Initially, the collected data is unstructured. Various facts and figures may or may not have context. A researcher's job is to make sense of this data, and the choice of data collection method often helps.

1)Experimental research, also known as "true experimentation," uses the scientific method to determine the cause-and-effect relationship between variables. This method uses controls for all of the crucial factors that could potentially affect the phenomena of interest. Using the experimental method, researchers randomly assign participants in an experiment to either the control or treatment groups.

2)Quasi-experimental research, also known as "causal-comparative," is similar to experimental research. Since it's often impossible or impractical to control for all factors involved, quasi-experimental methods don't control for some factors but otherwise follow the scientific method to establish a cause-and-effect relationship.

In both of these types of studies, independent variables are manipulated. But experimental data collection methods use random assignment and sampling, whereas quasi-experimental methods don't randomize assignment or sampling or both.

Experimental methods are known for producing results that are both internally and externally valid, meaning that the study is conducted, or structured, well (internal validity) and the findings are applicable to the real world (external validity). Quasi-experimental methods, on the other hand, produce results of questionable internal validity.

Quantitative interviews are typically conducted face to face, over the phone, or via the internet. They enable researchers to not only collect information but also tailor the questions to the audience on the spot. This can help add some "why" to the "how much" collected through quantifiable means.

12.11Non-Comparative Scales

The non-comparative scaling techniques can be further divided into: (a) Continuous Rating Scale, and (b) Itemised Rating Scale.

A)Continuous Rating Scales

It is very simple and highly useful. In continuous rating scale, the respondent's rate the objects by placing a mark at the appropriate position on a continuous line that runs from one extreme of the criterion variable to the other.
In this section we will discuss three itemised rating scales, namely

(a) Likert scale

(b) Semantic Differential Scale

(c) Stapel Scale.

12.12Key words

- Psychological researchers do not simply assume that their measures work. Instead, they conduct research to show that they work. If they cannot show that they work, they stop using them.
- There are two distinct criteria by which researchers evaluate their measures: reliability and validity. Reliability is consistency across time (test-retest reliability), across items (internal consistency), and across researchers (interrater reliability). Validity is the extent to which the scores actually represent the variable they are intended to.
- Validity is a judgment based on various types of evidence. The relevant evidence includes the measure's reliability, whether it covers the construct of interest, and whether the scores it produces are correlated with other variables they are expected to be correlated with and not correlated with variables that are conceptually distinct.
- The reliability and validity of a measure is not established by any single study but by the pattern of results across multiple studies. The assessment of reliability and validity is an ongoing process.

12.13Self Assessment Questions

1. Discuss the Main reasons to conduct the pilot study
2. Explain the Data collection Method for qualitative data

3. Describe the Data collection Method for quantitative Research Data?

12.14 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009
2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.
3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit kumar Sage Publications 2015
5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, andDipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.
7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019

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LESSON 13

CONSTRUCTING OF HYPOTHESIS

Learning Objectives

- ✓ To study the nature of Hypothesis
- ✓ To Understand the Characteristics of Hypothesis
- ✓ To learn the Basic concepts of concerning testing of hypothesis

Structure

13.0 Introduction

Hypothesis is usually considered as the principal instrument in research. Its main function is to Suggest new experiments and observations. In fact, many experiments are carried out with the deliberate object of testing hypotheses. Decision-makers often face situations wherein they are interested in testing hypotheses on the basis of available information and then take decisions on thebasis of such testing. In social science, where direct knowledge of population parameter(s) is rare, hypothesis testing is the often used strategy for deciding whether a sample data offer such support for a hypothesis that generalization can be made. Thus hypothesis testing enables us to make probability statements about population parameter(s). The hypothesis may not be proved absolutely, but in practiceit is accepted if it has withstood a critical testing. Before we explain how hypotheses are testedthrough different tests meant for the purpose, it will be appropriate to explain clearly the meaning ofa hypothesis and the related concepts for better understanding of the hypothesis testing techniques.

Ordinarily, when one talks about hypothesis, one simply means a mere assumption or some suppositionto be proved or disproved. But for a researcher hypothesis is a formal question that he intends toresolve. Thus a hypothesis may be definedas a proposition or a set of proposition set forth as anexplanation for the occurrence of some specified group of phenomena either asserted merely as aprovisional conjecture to guide some investigation or accepted as highly probable in the light ofestablished facts. Quite often a research hypothesis is a predictive statement, capable of being testedby scientific methods, that relates an independent variable to some dependent variable. For example,consider statements like the following ones:"Students who receive counselling will show a greater increase in creativity than students notreceiving counselling" Or"the automobile A is performing as well as automobile B."

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

13.1. Definition of Hypothesis

"A hypothesis can be defined as a tentative explanation of the research problem, a possible outcome of the research, or an educated guess about the research outcome". Goode and Hatt have defined it as "a proposition which can be put to test to determine its validity". "Hypotheses are single tentative guesses, good hunches – assumed for use in devising theory or planning experiments intended to be given a direct experimental test when possible". According to Lundberg, "A hypothesis is a tentative generalisation, the validity of which remains to be tested. In its most elementary stage, the hypothesis may be any hunch, guess, imaginative idea, which becomes the basis for action or investigation". Hence, a hypothesis is a hunch, assumption, suspicion, assertion or an idea about a phenomenon, relationship or situation, the reality or truth of which you do not know. A researcher calls these assumptions/ hunches hypotheses and they become the basis of an enquiry. In most studies the hypothesis will be based upon your own or someone else's observation. Hypothesis brings clarity, specificity and focus to a research problem, but is not essential for a study. You can conduct a valid investigation without constructing formal hypothesis. The formulation of hypothesis provides a study with focus. It tells you what specific aspects of a research problem to investigate. A hypothesis tells you what data to collect and what not to collect, thereby providing focus to the study. As it provides a focus, the construction of a hypothesis enhances objectivity in a study. A hypothesis may enable you to add to the formulation of a theory. It enables you to specifically conclude what is true or what is false. Ludberg observes, quite often a research hypothesis is a predictive statement, capable of being tested by scientific methods, that relates an independent variable to some dependent variable.

13.2 Nature of Hypothesis

The hypothesis is a clear statement of what is intended to be investigated. It should be specified before research is conducted and openly stated in reporting the results. This allows to:

✓ Identify the research objectives.

✓ Identify the key abstract concepts involved in the research.

✓ Identify its relationship to both the problem statement and the literature review.

✓ A problem cannot be scientifically solved unless it is reduced to hypothesis form.

✓ It is a powerful tool of advancement of knowledge, consistent with existing knowledge and conducive to further enquiry.

✓ It can be tested – verifiable or falsifiable.

✓ Hypotheses are not moral or ethical questions.

✓ It is neither too specific nor to general

✓ It is a prediction of consequences.

✓ It is considered valuable even if proven false. Importance of Hypothesis: Hypothesis though an important part of research may not be required in all types of research. The research which are based on fact finding (historical or descriptive research) do not need hypothesis. Hillway also says that "When fact-finding alone is the aim of the study, a hypothesis is not required". Whenever possible, a hypothesis is recommended for all major studies to explain observed facts, conditions or behaviour and to serve as a guide in the research process

✓ Hypothesis facilitates the extension of knowledge in an area. They provide tentative explanations of facts and phenomena, and can be tested and validated. It sensitizes the investigator to certain aspects of the situations which are relevant from the standpoint of the problem in hand.

✓ Hypothesis provide the researcher with rational statements, consisting of elements expressed in a logical order of relationships which seeks to describe or to explain conditions or events, that have yet not been confirmed by facts. The hypothesis enables the researcher to relate logically known facts to intelligent guesses about unknown conditions. It is a guide to the thinking process and the process of discovery.

✓ Hypothesis provides direction to the research. It defines what is relevant and what is irrelevant. The hypothesis tells the researcher what he needs to do and find out in his study. Thus it prevents the review of irrelevant literature and provides a basis for selecting the sample and the research procedure to be used in the study.

✓ Hypothesis implies the statistical techniques needed in the analysis of data, and the relationship between the variables to be tested. It also helps to delimit his study in scope so that it does not become broad or unwieldy.

✓ Hypothesis provides the basis for reporting the conclusion of the study. It serves as a framework for drawing conclusions. In other word, we can say that it provides the outline for setting conclusions in a meaningful way.

✓ So, Hypothesis has a very important place in research although it occupies a very small place in the body of a thesis.

13.3 Characteristics of hypothesis

Hypothesis must possess the following characteristics:

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

(ii) Hypothesis should be capable of being tested. In a swamp of untestable hypotheses, manya time the research programmes have bogged down. Some prior study may be done byresearcher in order to make hypothesis a testable one. A hypothesis "is testable if otherdeductions can be made from it which, in turn, can be confirmed or disproved by observation."

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

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

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

(vi) Hypothesis should be consistent with most known facts i.e., it must be consistent with asubstantial body of established facts. In other words, it should be one which judges acceptas being the most likely.

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

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

Hypothesis is usually considered as an important mechanism in Research. Hypothesis is a tentative assumption made in order to test its logical or empirical consequences. If we go by the origin of the word, it is derived from the Greek word- 'hypotithenai' meaning 'to put under' or to 'to suppose'. Etymologically hypothesis is made up of two words, "hypo" and "thesis" which means less than or less certain than a thesis. It is a presumptive statement of a proposition or a reasonable guess, based upon the available evidence, which the researcher seeks to prove through his study. A hypothesis will give a plausible explanation that will be tested. A hypothesis may seem contrary to the real situation. It may prove to be correct or incorrect. Hypothesis need to be clear and precise and capable of being tested. It is to be

limited in scope and consistent with known or established facts and should be amenable to testing within the stipulated time. It needs to explain what it claims to explain and should have empirical reference.

13.4 Sources of Hypothesis

A good hypothesis can only be derived from experience in research. Though hypothesis should precede the collection of data, but some degree of data collection, literature review or a pilot study will help in the development and gradual refinement of the hypothesis. A researcher should have quality of an alert mind to derive a hypothesis and quality of critical mind of rejecting faulty hypothesis. The following sources can help the researcher in coming up with a good hypothesis:

✓ Review of literature.

✓ Discussion with the experts in the given field to understand the problem, its origin and objectives in seeking a solution.

✓ Intuition of the researcher also sometimes helps in forming a good hypothesis.

✓ Previous empirical studies done on the given area.

Understanding Types of Hypothesis

Research Problems are too general by themselves to enable us to carryout meaningful analysis. They need to be specified in a more focussed way. Hypotheses are specific statements that relate to the problem, the answers to which are likely to be yes or no, depending upon what is uncovered from the research. Examples of Hypothesis can be:

✓ Suicide is related to general level of religiosity/secularisation of society.

✓ Alienation and political participation are negatively related. Such statements specify links between different phenomena, in order to explain different patterns of behaviour that appear to occur. However, such patterns of association do not necessarily demonstrate that a causal relationship exists. We cannot for an instance say, 'socio-economic deprivation causes suicide.' If that was the case, then all those in Britain defined by various yardsticks as living in a state of relative poverty would inevitably commit suicide. This is very unlikely to happen.

13.5 Variables

So, to understand the types of hypothesis,
we need to understand the concept of variables first. The variables are empirical properties that take two or more values or in other words a variable is any entity that can take on different values. In simple terms, anything that can vary or that is not constant can be considered a variable. For instance, age can be considered a variable because age can take different values for different people or for the same person at different times. Similarly, country can be considered a variable because a person's country can be assigned a value. A

variable is a concept or abstract idea that can be described in measurable terms. In research, this term refers to the measurable characteristics, qualities, traits, or attributes of a particular individual, object or situation being studied. Variables differ in many respects, most notably in the role they are given in our research and in the type of measures that can be applied to them. The statement of problem usually provides only general direction for the research study. It does not include all the specific information. There is some basic terminology that is extremely important in how we communicate specific information about research problems and research in general. So, weight, height, income are all examples of variables. In Research, there is a need to make a distinction between various kinds of variables. There are many classifications given for variables. We will try to understand only the Dependent Variable and Independent Variable.

13.5.1 Independent Variables

The variables which are manipulated or controlled or changed. These are also known as manipulated variables. Researchers often mistake independent variable and assume that it is independent of any manipulation. It is called independent because variable is isolated from any other factor. In research, we try to determine whether there is a cause and effect relationship. In fact, when you are looking for some kind of relationship between variables you are trying to see if the independent variable causes some kind of change in the other variables, or dependent variables.

13.6 Basic Concepts Concerning Testing Of Hypotheses

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

13.6.1 Null hypothesis and alternative hypothesis

In the context of statistical analysis, we often talk about null hypothesis and alternative hypothesis. If we are to compare method A with method B about its superiority and if we proceed on the assumption that both methods are equally good, then this assumption is termed as the null hypothesis. As against this, we may think that the method A is superior or the method B is inferior, we are then stating what is termed as alternative hypothesis. The null hypothesis is generally symbolized as H0 and the alternative hypothesis as Ha.

Then we would say that the null hypothesis is that the population mean is equal to the hypothesised mean 100 and symbolically we can express as:

$$H_0 : \mu = \mu_{H_0} = 100$$

If our sample results do not support this null hypothesis, we should conclude that something elseis true. What we conclude rejecting the null hypothesis is known as alternative hypothesis. In otherwords, the set of alternatives to the null hypothesis is referred to as the alternative hypothesis. If weaccept*H*0, then we are rejecting *Ha* and if we reject *H*0, then we are accepting *Ha*.

$H_0 : \mu = \mu_{H_0} = 100$, we may consider three possible alternative hypotheses as follows*:

Table 9.1

Alternative hypothesis	*To be read as follows*
$H_a : \mu \neq \mu_{H_0}$	(The alternative hypothesis is that the population mean is not equal to 100 i.e., it may be more or less than 100)
$H_a : \mu > \mu_{H_0}$	(The alternative hypothesis is that the population mean is greater than 100)
$H_a : \mu < \mu_{H_0}$	(The alternative hypothesis is that the population mean is less than 100)

The null hypothesis and the alternative hypothesis are chosen before the sample is drawn (the researchermust avoid the error of deriving hypotheses from the data that he collects and then testing thehypotheses from the same data). In the choice of null hypothesis, the following considerations areusually kept in view:

(a) Alternative hypothesis is usually the one which one wishes to prove and the null hypothesisis the one which one wishes to disprove. Thus, a null hypothesis represents the hypothesiswe are trying to reject, and alternative hypothesis represents all other possibilities.

(b) If the rejection of a certain hypothesis when it is actually true involves great risk, it is takenas null hypothesis because then the probability of rejecting it when it is true is (the levelof significance) which is chosen very small.

(c) Null hypothesis should always be specific hypothesis i.e., it should not state about or approximately a certain value.Generally, in hypothesis testing we proceed on the basis of null hypothesis, keeping the alternativehypothesis in view. Why so? The answer is that on the assumption that null hypothesis is true, onecan assign the probabilities to different possible sample results, but this cannot be done if we proceedwith the alternative hypothesis. Hence the use of null hypothesis (at times also known as statisticalhypothesis) is quite frequent.

(d) *The level of significance:* This is a very important concept in the context of hypothesis testing.It is always some percentage (usually 5%) which should be chosen wit great care, thought andreason. In case we take the significance level at 5 per cent, then this implies that *H*0 will be rejectedwhen the sampling result (i.e., observed evidence) has a less than 0.05 probability of occurring if *H*0is true. In other words, the 5 per cent level of significance means that researcher is willing to take asmuch as a 5 per cent risk of rejecting the null hypothesis when it (*H*0) happens to be true. Thus thesignificance level is the maximum value of the probability of rejecting *H*0 when it is true and is usuallydetermined in advance before testing the hypothesis.

(e) *Decision rule or test of hypothesis:* Given a hypothesis *H*0 and an alternative hypothesis *Ha*,we make a rule which is known as decision rule according to which we accept *H*0 (i.e., reject *Ha*) orreject*H*0 (i.e., accept *Ha*). For instance, if (*H*0 is that a certain lot is good (there are very fewdefective items in it) against *Ha*) that the lot is not good (there are too many defective items in it),then we must decide the number of items to be tested and the criterion for accepting or rejecting thehypothesis. We might test 10 items in the lot and plan our decision saying that if there are none or only1 defective item among the 10, we will accept *H*0 otherwise we will reject *H*0 (or accept *Ha*). Thissort of basis is known as decision rule.(d)

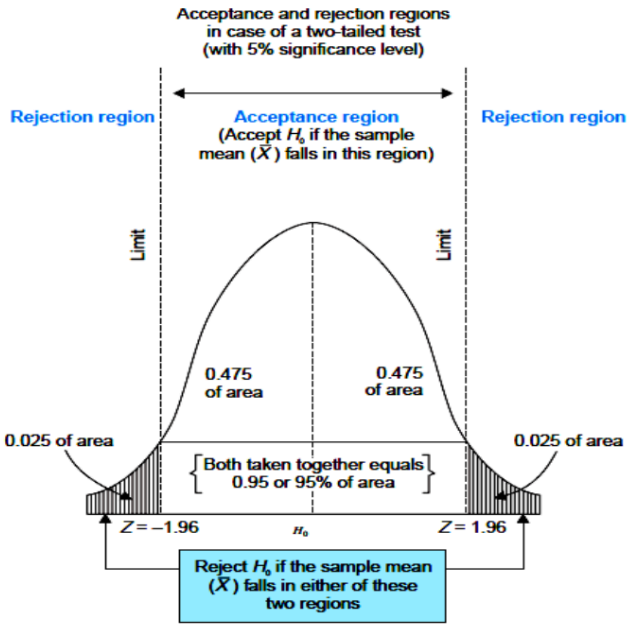
Type I and Type II errors: In the context of testing of hypotheses, there are basically two typesof errors we can make. We may reject *H*0 when *H*0 is true and we may accept *H*0 when in fact *H*0 is not true. The former is known as Type I error and the latter as Type II error. In other words, Type Ierror means rejection of hypothesis which should have been accepted and Type II error meansaccepting the hypothesis which should have been rejected. Type I error is denoted by (alpha)known as error, also called the level of significance of test; and Type II error is denoted by (beta) known as error. In a tabular form the said two errors can be presented as follows

	Decision	
	Accept H_0	Reject H_0
H_0 (true)	Correct decision	Type I error (α error)
H_0 (false)	Type II error (β error)	Correct decision

The probability of Type I error is usually determined in advance and is understood as the level ofsignificance of testing the hypothesis. If type I error is fixed at 5 per cent, it means that there areabout 5 chances in 100 that we will reject *H*0 when *H*0 is true. We can control Type I error just byfixing it at a lower level. For instance, if we fix it at 1 per cent, we will say that the maximumprobability of committing Type I error would only be 0.01.But with a fixed sample size, *n*, when we try to reduce Type I error, the probability of committingType II error increases. Both types of errors cannot be reduced simultaneously. There is a trade-offbetween two types of errors which means that the probability of making one type of error can onlybe reduced if we are willing to increase the probability of making the other type of error. To deal withthis trade-off in business situations, decision-makers decide the appropriate level of Type I error byexamining the costs or penalties attached to both types of errors. If Type I error involves the time andtrouble of reworking a batch of chemicals that should have been accepted, whereas Type II errormeans taking a chance that an entire group of users of this chemical compound will be poisoned, thenin such a situation one should prefer a Type I error to a Type II error. As a result one must set veryhigh level for Type I error in one's testing technique of a given hypothesis.

2. Hence, in the testing ofhypothesis, one must make all possible effort to strike an adequate balance between Type I and TypeII errors.

(e) *Two-tailed and One-tailed tests:* In the context of hypothesis testing, these two terms are quiteimportant and must be clearly understood. A two-tailed test rejects the null hypothesis if, say, the Sample mean is significantly higher or lower than the hypothesised value of the mean of the population.Such a test is appropriate when the null hypothesis is some specified value and the alternativehypothesis is a value not equal to the specified value of the null hypothesis. Thus, in a two-tailed test, there are two rejection regions, one on each tail of the curve

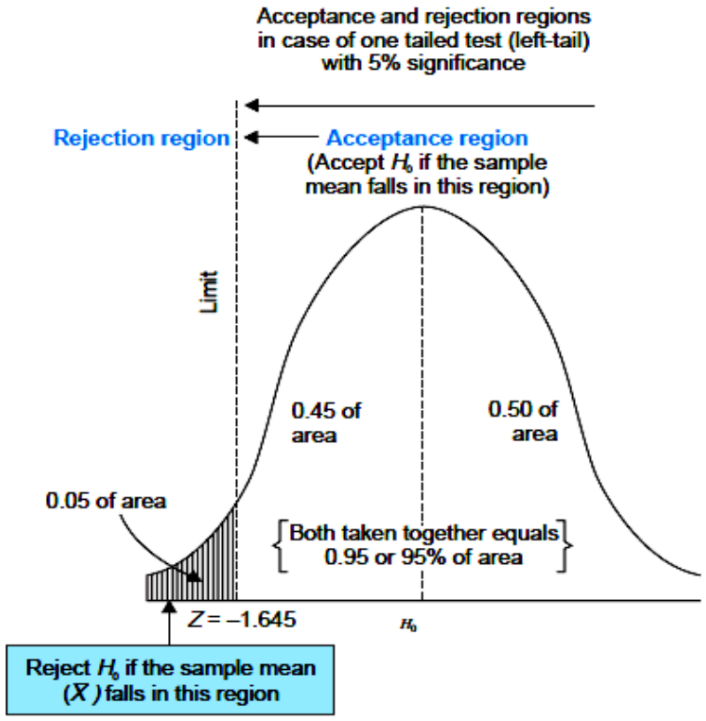


Mathematically we can state:

$$Acceptance\ Region\ \ A : |Z| \leq 1.96$$
$$Rejection\ Region\ \ R : |Z| \geq 1.96$$

If the significance level is 5 per cent and the two-tailed test is to be applied, the probability of therejection area will be 0.05 (equally splitted on both tails of the curve as 0.025) and that of theacceptance region will be 0.95 as shown in the above curve. If we take100 and if our samplemean deviates significantly from 100 in either direction, then we shall reject the null hypothesis; butif the sample mean does not deviate significantly from , in that case we shall accept the nullhypothesis.

But there are situations when only one-tailed test is considered appropriate. A *one-tailed test* would be used when we are to test, say, whether the population mean is either lower than or higherthan some hypothesised value.

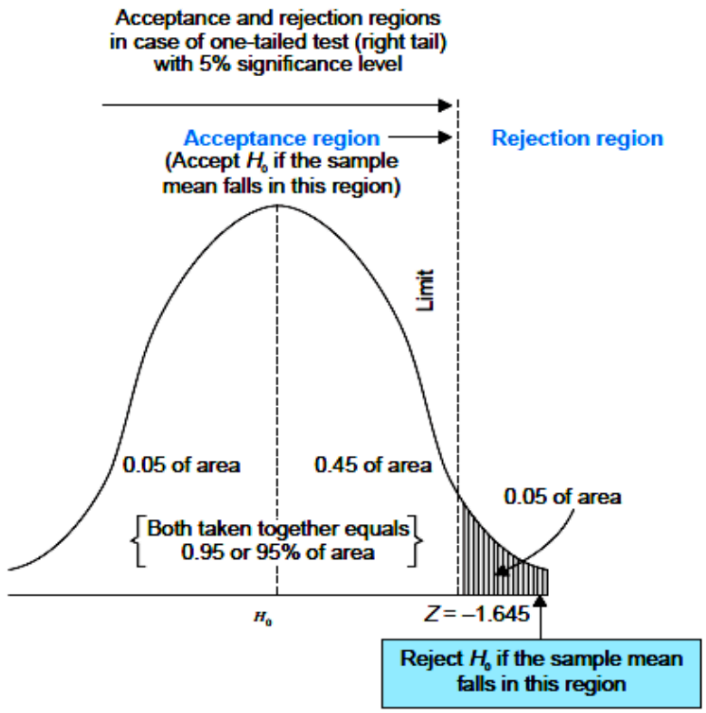


Mathematically we can state:

$$\textit{Acceptance Region}\quad A: Z > -1.645$$

$$\textit{Rejection Region}\quad R: Z \leq -1.645$$

If our 100 and if our sample mean deviates significantly from100 in the lower direction, weshall reject *H*0, otherwise we shall accept *H*0 at a certain level of significance. If the significancelevel in the given case is kept at 5%, then the rejection region will be equal to 0.05 of area in the lefttail as has been shown in the above curve.



Mathematically we can state:

$$\textit{Acceptance Region}\quad A: Z \leq 1.645$$

$$\textit{Rejection Region}\quad A: Z > 1.645$$

If our 100 and if our sample mean deviates significantly from 100 in the upward direction, weshall reject *H*0, otherwise we shall accept the same. If in the given case the significance level is keptat 5%, then the rejection region will be equal to 0.05 of area in the right-tail as has been shown in theabovecurve.It should always be remembered that accepting *H*0 on the basis of sample information does notconstitute the proof that *H*0 is true. We only mean that there is no statistical evidence to reject it, butwe are certainly not saying that *H*0 is true (although we behave as if *H*0 is true).

13.6.2 Procedure for Hypothesis Testing

To test a hypothesis means to tell (on the basis of the data the researcher has collected) whether ornot the hypothesis seems to be valid. In hypothesis testing the main question is: whether to accept thenull hypothesis or not to accept the null hypothesis?

Procedure for hypothesis testing refers to allthose steps that we undertake for making a choice between the two actions i.e., rejection andacceptance of a null hypothesis.

13.7 Summary

Hypothesis testing is a form of statistical inference that uses data from a sample to draw conclusions about a population parameter or a population probability distribution. First, a tentative assumption is made about the parameter or distribution. This assumption is called the null hypothesis and is denoted by H_0. An alternative hypothesis (denoted H_a), which is the opposite of what is stated in the null hypothesis, is then defined. The hypothesis-testing procedure involves using sample data to determine whether or not H_0 can be rejected. If H_0 is rejected, the statistical conclusion is that the alternative hypothesis H_a is true.

13.8 Key words

Hypothesis- A hypothesis can be defined as a tentative explanation of the research problem, a possible outcome of the research, or an educated guess about the research outcome.

The level of significance-This is a very important concept in the context of hypothesis testing.It is always some percentage (usually 5%) which should be chosen wit great care, thought andreason.

Null hypothesis-Null hypothesis should always be specific hypothesis i.e., it should not state about orapproximately a certain value.

Alternative hypothesis- Alternative hypothesis is usually the one which one wishes to prove and the null hypothesisis the one which one wishes to disprove.

Type I- Type I error means rejecting the null hypothesis when it's actually true,

Type II- Type II error means failing to reject the null hypothesis when it's actually false.

13.9 SelfAssessment Questions

1. Define Hypothesis? Discuss the Characteristics of Hypothesis?
2. Examine the Sources of Hypothesis?
3. Explain the Basic concepts concerning testing of hypothesis?

13.10 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009
2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.
3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit Kumar Sage Publications 2015

5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, and Dipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.
7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019.

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LESSON 14

TYPES OF HYPOTHESES

Learning Objectives

- ✓ To understand the Characteristics of Hypothesis
- ✓ To learn the Types of Hypothesis
- ✓ To Discuss the Difference Between the Hypothesis and Prediction

Structure

14.0 Introduction

A hypothesis is one of the essential elements of a scientific research paper. It is an assumption or idea built on your understanding of evidence and requires you to prove it via relevant facts and examples.

A hypothesis is an indication of the expected results of an experiment. In scientific methods, a hypothesis is used as a foundation for future research. Once you fully understand the concept behind the hypothesis and its appropriate structure, you will not find it harder to create. However, if it is the first time you are an early-stage researcher, then it might become an exhausting and frustrating task.

14.1 Hypothesis Definition

A hypothesis is an assumption or perhaps a tentative explanation for a specific process or phenomenon that has been observed during research. Very often, a hypothesis and a guess are treated the same. However, a hypothesis is a calculated and educated guess proven or disproven through research methods.

Based on the facts and evidence you gather during research, you can transform an initial research question into a logical & rational prediction i.e. the hypothesis. Every research is conducted to solve a specific problem. To fulfill that, one has to undertake the route of problem identification, conduct initial research and then, figure out the answer by performing various experiments and observing its outcome. However, before conducting the experiments or the surveys related to the research, you must understand and acknowledge what you expect from the results. At this point, you are supposed to make your educated and calculated hypothesis and translate it into a scientific statement that you will be either proving or refuting within the course of your study.

A hypothesis reflects your understanding of the problem statement and as a form of development of knowledge. Therefore, you need to articulate your hypothesis in a way that should appear as a justifiable assumption to study the properties and causes of the phenomenon in the research topic.

14.2 Characteristics and Sources of Hypotheses

Now that you have gained pretty much an idea about a hypothesis, it's time that you understand its characteristics.

1. A research hypothesis has to be simple yet clear to look reliable and justifiable enough.
2. It has to be precise about the results.

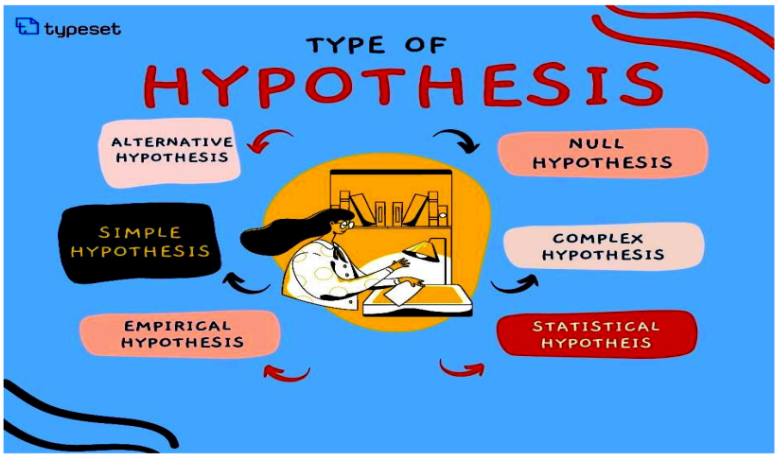
3. A research hypothesis should be written in a self-explanatory manner with its significance staying intact.
4. If you are developing a relational hypothesis, you need to include the variables and establish an appropriate relationship among them.
5. A hypothesis must keep and reflect the scope for further investigations and experiments.

Similar to the characteristics of a research hypothesis, there exist many sources through which you can hypothesize your research problem. The primary sources that you can refer to while creating a hypothesis for your research are:

1. Scientific paper and theories from the domain of your research topic.
2. Observations from previous experiments and recent theories
3. A general paradigm that runs through the research domain of a specific topic
4. Resemblance and relativity among various research topics

While going through these sources, you must ensure all the sources are credible and scholarly.

14.3 Types of Hypotheses



To create a good hypothesis, you need to understand the concept of hypotheses completely. Therefore, before starting to write, it is important that you first understand the different types of hypotheses.
Majorly, there exist only two types, i.e., the Alternative hypothesis and Null Hypothesis.

14.3.1. Alternative Hypothesis

In the academic domain, it is very often denoted as H1. The significance of this kind is to identify the expected outcome of your research procedure. Additionally, it is further classified into two subcategories:

14.3.1.a. Directional

A statement that defines the ways through which the expected results will be gathered. It is generally used in the cases where you need to establish a relationship between various variables rather than making any comparison between multiple groups. For example, **Attending physiotherapy sessions will improve the on-field performance of athletes.**

14.3.1.b. No directional:

As the name suggests, a non-directional alternative hypothesis doesn't suggest any direction for the expected outcomes. For example, **Attending physiotherapy sessions influence the on-field performance of athletes.**

Now in the above two examples, carefully observe the two statements. The directional statement specifies that physiotherapy sessions will improve or boost performance. On the other hand, the non-directional statement helps establish a correlation between the two variables (physiotherapy sessions and performance). However, it does not emphasize whether the performance will be good or bad due to physiotherapy sessions.

14.3.2. Null Hypothesis

A null hypothesis is denoted as H0. A null hypothesis exists as opposed to an alternative hypothesis. It is a statement that defines the opposite of the expected results or outcomes throughout your research. In simpler terms, a null hypothesis is used to establish a claim that no relationship exists between the variables defined in the hypothesis.

To give you an idea about how to write a null hypothesis, the last example can be stated as:

The physiotherapy sessions do not affect athletes' on-field performance..

Both the null and alternative hypotheses are written to provide specific clarifications and examination of the research problem. So, to clarify confusion, the difference between a research problem statement and a hypothesis is that the former is just a question that can't be validated or tested. In contrast, the latter can be tested, validated, or denied.

14.3.3. Simple Hypothesis

It is a statement that is made to reflect the relation between the dependent and independent variables. Follow through the example, and you will understand

a. Smoking is a prominent cause of lung cancer

b. Intake of sugar-rich foods can lead to obesity

14.3.4. Complex Hypothesis

A complex hypothesis implies the relationship between multiple dependent or independent variables stated in the research problem. Follow through the below examples for better clarity on this:

a. Individuals who eat more fruits tend to have higher immunity, lesser cholesterol, and high metabolism.

b. Including short breaks during work hours can lead to higher concentration and boost productivity.

14.3.5. Empirical Hypothesis

It is also referred to as the "Working Hypothesis." This type of claim is made when a theory is being validated through an experiment and observation. This way, the statement appears justifiable enough and different from a wild guess.
Here are a few examples through which you can learn to create an empirical hypothesis:

a. Women who take iron tablets face a lesser risk of anemia than those women who take vitamin B12.

b. Canines learn faster if they are provided with food immediately after they obey a command.

14.3.6. Statistical Hypothesis

A statement claiming an explanation after studying a sample of the population is called a statistical hypothesis. It is a type of logic-based analysis where you research a specific population and gather evidence through a particular sample size.

Below are some hypothetical statistical statements to understand how you can conduct your research leveraging statistical data :

a. 44% of the Indian population belong in the age group of 22-27

b. 47% of the rural population in India is involved in agro-based activities.

14.4 Difference between Hypothesis and Prediction

Hypothesis and prediction are very often used interchangeably, and that creates confusion. Although both the hypothesis and prediction can be treated as guesses, there lies much difference between the two terms. Since we are talking about research hypotheses and in the context of the academic domain, the words bear much relevance here. Therefore it is forbidden to use hypotheses for prediction or otherwise. So, the significant difference between a hypothesis and a prediction is that the first is predominantly used in the academic

world related to research on various topics. In contrast, prediction can be used anywhere and need not be validated, defined, or tested.

In simpler terms, a hypothesis is a calculated, intelligent assumption tested and validated through research. It aims to analyze the gathered evidence and facts to define a relationship between variables and put forth a logical explanation behind the nature of events.

On the other hand, predictions are vague assumptions or claims made without backing data or evidence. You can test it and have to wait to check if the prediction will become true or not. Although a prediction can be even scientific majorly, it is seen that predictions are somewhat fictional, not based on data or facts. Predictions are more often observed as a foretelling of any future event that may or may not ever happen.

To emphasize in a better manner the difference between a hypothesis and a prediction, follow through the below-mentioned example:

14.4.1 Hypothesis: Having smaller and frequent meals can lead to a higher metabolism rate.

This is a pure scientific hypothesis based on previous knowledge and the trends that have been observed in many individuals. Additionally, it can be tested by putting some individuals under observation.

14.4.2 Prediction: There will be zero COVID-19 cases in the world by 2030.

Now, this is a prediction. Even though it is based on definite facts and the trends of past results, it can't be tested with certainty for success or failure. So the only way this gets validated is to wait and watch if the covid cases end by 2030.

14.5 How to Write a Hypothesis?

Attentively follow through the below-mentioned steps that you can leverage to create a compelling hypothesis for your research.

14.5.1. Identify and Clearly Describe your Research Question

A hypothesis should be written in a way that should address the research question or the problem statement. You first need to understand the constraints of your undertaken research topic and then formulate a clear, simple, and topic-centered problem statement. Once you have the problem statement, you can ask the right question to test the validity of the problem statement or research question. For answering a research question, there should be a hypothetical statement that you should prove through your research.

For example: How do attending physiotherapy sessions can affect an athlete's on-field performance?

14.5.2. Carry Out an Initial Preliminary Research

At this stage, you need to go through the previous theories, academic papers, and previous studies and experiments to start curating your research hypothesis. Next, you must gather evidence and prepare a research methodology to carry out your experiments. Here itself, try figuring out the answer to the research question.

You need to design a conceptual and rational framework to identify which variables.(both dependent and independent) over which your hypothesis will focus. Additionally, you need to discover the relationship between various variables.

14.5. 3. Make the First Draft of your Hypothesis

After undertaking and finalizing the initial research, you will get an idea about the expected outcomes and results. Leveraging this, you need to create a simple, concise, and first version of your hypothesis.

Depending upon the chosen research domain and its topic, you can rephrase the answer to the problem statement via a hypothesis in specific ways.
For example:

a. Non- directional: Attending physiotherapy sessions will influence the on-field performance of athletes.

b. Directional: Attending physiotherapy sessions will boost the on-field performance of athletes.

c. Null: Attending physiotherapy sessions will not affect the on-field performance of athletes.

14.5.4. Skim your Hypothesis

After preparing the first draft of your hypothesis, you need to check whether the hypothesis addresses the problem statement or not. You need to ensure that the hypothesis statement is straightforward-focused on the research topic and is testable. To further refine your first draft of the hypothesis, you must check the presence of some aspects in your hypothesis:
a. It has clear, relevant, and defined variables.
b. An appropriate relationship exists between the variables.
c. It is accurate and signifies its capacity to go under testing and validation.
d. It must showcase a specific result or outcome through certain experiments.
14.5.5. Create a 3-Dimensional Phrase of your Hypothesis Statement

To appropriately recognize the various variables to be used, you can write the hypothetical assumption in the "if then" form. Here, you must ensure that the first part of the hypothesis should contain the independent variable and the second part should contain the dependent variable.

For example, **if athletes start attending physiotherapy sessions, then their on-field performance will improve.**

It's common in the academic domain to present the hypothesis in terms of correlation and its effects. If you choose to use this form of phrase as a research hypothesis, make sure that you state the predefined relationship between the variables.
For example, **attending physiotherapy sessions lead to the better on-field performance of athletes.**

In another way, you can choose to present your hypothesis as a comparison between two variables. Also, you must specify the difference that you expect to observe in the results.

For example, **Athletes attending physiotherapy sessions will have better on-field performance than those who never attend any physiotherapy sessions.**

14.5.6. Create a Null Hypothesis

If your research procedure involves some statistical hypothesis testing, you need to provide a null hypothesis statement. As previously discussed, a null hypothesis is used to represent or show no relation between different variables.

For example, **attending physiotherapy sessions does not affect the on-field performance of athletes.**

14.6 Quick Tips on How to Write a Hypothesis

Follow the below-mentioned points to find some pro tips that you must keep in mind for writing a good hypothesis.

1. Always try to create a hypothesis that interestingly addresses the problem statement.
2. Keep the hypothesis statement short yet entirely focused over the problem statement phrased in an utmost clear and concise manner.
3. Make sure the initial research has been done thoroughly, and you have gone through all the relevant scholarly sources related to your chosen research topic.
4. Accurately define the variables that you will be using in the hypothesis, and through the course of the research,
5. Always keep your audience in your mind while creating any statements or paraphrasing any related theories. In academia, the audience being the researchers and scholars, bear the knowledge of the relationship that exists between various phenomena and experiments.

A hypothesis is just a statement representing your understanding of the answer to the problem statement of the research. It showcases how you will proceed with the experiments to test the hypothesis and interpret the expected outcome.

14.7 Summary

Hypothesis testing is a form of statistical inference that uses data from a sample to draw conclusions about a population parameter or a population probability distribution. First, a tentative assumption is made about the parameter or distribution. This assumption is called the null hypothesis and is denoted by H_0. An alternative hypothesis (denoted H_a), which is the opposite of what is stated in the null hypothesis, is then defined. The hypothesis-testing procedure involves using sample data to determine whether or not H_0 can be rejected. If H_0 is rejected, the statistical conclusion is that the alternative hypothesis H_a is true.

14.8 Key words

Hypothesis- A hypothesis is an assumption or perhaps a tentative explanation for a specific process or phenomenon that has been observed during research.

Directional Hypothesis A statement that defines the ways through which the expected results will be gathered. It is generally used in the cases where you need to establish a relationship between various variables rather than making any comparison between multiple groups.

Empirical Hypothesis- It is also referred to as the "Working Hypothesis." This type of claim is made when a theory is being validated through an experiment and observation. This way, the statement appears justifiable enough and different from a wild guess.

Complex Hypothesis- A complex hypothesis implies the relationship between multiple dependent or independent variables stated in the research problem

14.9 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009
2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.
3. Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.
4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit Kumar Sage Publications 2015
5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, and Dipayan Das, Springer Publications, 2018.
6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.
7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019.

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LESSON 15

ERRORS IN HYPOTHESIS TESTING

Learning Objectives

- ✓ To understand the Hypothesis testing Process
- ✓ To Learn the One Tailed and Two tailed Hypothesis test
- ✓ To Discuss the Decision Errors

Structure

15.0 Introduction

Hypothesis testing is a form of statistical inference that uses data from a sample to draw conclusions about a population parameter or a population probability distribution. First, a tentative assumption is made about the parameter or distribution. This assumption is called the null hypothesis and is denoted by H0. An alternative hypothesis (denoted Ha), which is the opposite of what is stated in the null hypothesis, is then defined. The hypothesis-testing procedure involves using sample data to determine whether or not H0 can be rejected. If H0 is rejected, the statistical conclusion is that the alternative hypothesis Ha is true.

Ideally, the hypothesis-testing procedure leads to the acceptance of H0 when H0 is true and the rejection of H0 when H0 is false. Unfortunately, since hypothesis tests are based on sample information, the possibility of errors must be considered. A type I error corresponds to rejecting H0 when H0 is actually true, and a type II error corresponds to accepting H0 when H0 is false. The probability of making a type I error is denoted by α, and the probability of making a type II error is denoted by β.

In using the hypothesis-testing procedure to determine if the null hypothesis should be rejected, the person conducting the hypothesis test specifies the maximum allowable probability of making a type I error, called the level of significance for the test. Common choices for the level of significance are $\alpha = 0.05$ and $\alpha = 0.01$. Although most applications of hypothesis testing control the probability of making a type I error, they do not always control the probability of making a type II error. A graph known as an operating-characteristic curve can be constructed to show how changes in the sample size affect the probability of making a type II error.

A concept known as the p-value provides a convenient basis for drawing conclusions in hypothesis-testing applications. The p-value is a measure of how likely the sample results are, assuming the null hypothesis is true; the smaller the p-value, the less likely the sample results. If the p-value is less than α, the null hypothesis can be rejected; otherwise, the null hypothesis cannot be rejected. The p-value is often called the observed level of significance for the test.

A hypothesis test can be performed on parameters of one or more populations as well as in a variety of other situations. In each instance, the process begins with the formulation of null and alternative hypotheses about the population. In addition to the population mean, hypothesis-testing procedures are available for population parameters such as proportions, variances, standard deviations, and medians.

Hypothesis tests are also conducted in regression and correlation analysis to determine if the regression relationship and the correlation coefficient are statistically significant (see below Regression and correlation analysis). A goodness-of-fit test refers to a hypothesis test in which the null hypothesis is that the population has a specific probability distribution, such as a normal probability distribution. Nonparametric statistical methods also involve a variety of hypothesis-testing procedures.

before moving onwards we should know the related concepts of Type I and Type II Errors. The concepts that need to be understood include the following:

1) Hypothesis testing

2) The hypothesis – testing process

3) Null Hypothesis

4) Population

5) Sample

6) Rejecting and accepting null hypothesis

7) One-tailed and two-tailed hypothesis

8) Decision errors

15.1 Hypothesis Testing

Hypothesis testing has a vital role in psychological measurements. By hypothesis wemean the tentative answer to any questions. Hypothesis testing is a systematicprocedure for deciding whether the results of a research study, which examines asample, support a particular theory or practical innovation, which applies to apopulation. Hypothesis testing is the central theme in most psychology research.Hypothesis testing involves grasping ideas that make little sense. Real life psychologyresearch involves samples of many individuals. At the same time there are studieswhich involve a single individual.

15.2 The Core Logic of Hypothesis Testing

There is a standard kind of reasoning researchers use for any hypothesis/testingproblem. For this example, it works as follows. Ordinarily, among the population ofbabies that are not given the specially purified vitamin, the chance of a baby's startingto walk at age 8 months or earlier would be less than 2% Thus, walking at 8 monthsor earlier is highly unlikely among such babies. But what if the randomly selectedsample of one baby in our study does start walking by 8 months? If the speciallypurified vitamin had no effect on this particular baby's walking age (which means thatthe baby's walking age should be similar to that of babies that were not given thevitamin), it is highly unlikely (less than a 2% chance) that the particular baby wedoes in fact start walking by 8 months, that allows us to reject the idea that the specially purified vitamin has no effect. And if we reject the idea that the specially purified vitamin has no effect, then we must also accept the idea that the specially purified vitamin does have an effect. Using the same reasoning, if the baby starts walking by 8 months, we can reject the idea that this baby comes from a populationof babies with a mean walking age of 14 months. We therefore conclude that babiesgiven the specially purified vitamin will start to walk before 14 months. Our explanationfor the baby's early walking age in the study is that the specially purified vitaminspeeded up the baby's development.

The researchers first spelled out what would have to happen for them to concludethat the special purification procedure makes a differences. Having laid this out inadvance the researchers could then go on to carry out their study. In this example,carrying out the study means giving the specially purified vitamin to a randomlyselected baby and watching to see how early that baby walks. Suppose the resultof the study is that the baby starts walking before 8 months. The researchers wouldthen conclude that it is unlikely the specially purified vitamin makes no difference andthus also conclude that it does make a difference.

This kind of testing the opposite-of-what-you-predict, roundabout reasoning is at the heart of inferential statistics in psychology. It is something like a double negative. One reason for this approach is that we have the information to figure the probability of getting a particular experimental result if the situation of there being no difference is true. In the purified vitamin example, the researchers know what the probabilities are of babies walking at different ages if the specially purified vitamin does not have any effect. It is the probability

of babies walking at various ages that is already knownfrom studies of babies in general – that is, babies who have not received the specially purified vitamin. (Suppose the specially purified vitamin has no effect. In that situation, the age at which babies start walking is the same whether or not they receive the specially purified vitamin.)

Without such a tortuous way of going at the problem, in most cases you could just not do hypothesis testing at all. In almost all psychology research, we base our conclusions on this question: What is the probability of getting our research results. If the opposite of what we are predicting were true? That is, we are usually predicting an effect of some kind. However, we decide on whether there is such an effect by seeing if it is unlikely that there is not such an effect. If it is highly unlikely that we would get our research results if the opposite of what we are predicting were true, that allows us to reject that opposite prediction. If we reject that opposite prediction, we are able to accept our prediction. However, if it is likely that we would get our research results if the opposite of what we are predicting were true, we are not able
to reject that opposite prediction. If we are not able to reject that opposite prediction,we are not able to accept our prediction.

15.3 The Hypothesis – Testing Process

Let's look at example in this time going over each step in some detail. Along the way, we cover the special terminology of hypothesis-testing. Most important, we introduce five steps of hypothesis testing you use for the rest of the course.

15.3.1 Step 1: Restate the question as a research Hypothesis and Null Hypothesis about the populations

Our researchers are interested in the effects on babies in general (not just this particular baby). That is, the purpose of studying samples is to know about populations thus, it is useful to restate the research question in terms of populations. In our example, we can think of two populations of babies.
Population 1: Babies who take the specially purified vitamin.

Population 2: Babies who do not take the specially purified vitamin

Population 1 comprises those babies who receive the experimental treatment. In our example, we use a sample of one baby to draw a conclusion about the age that babies in Population 1 start to walk. Population 2 is a kind of comparison baseline of what is already known.

. The prediction of our research team is that Population 1 babies (those who take the specially purified vitamin) will on the average walk earlier than population 2 babies(those who do not take the specially purified vitamin) $\mu 1 < \mu 2$

The opposite of the research hypothesis is that the populations are not different in the way predicted. Under this scenario, population 1 babies (those who take the specially purified vitamin) will on the average not walk earlier than Population 2babies (those who do not take the specially purified vitamin). That is, this predictions that there is no difference in when population 1 and Population 2 babies start walking. They start at the same time. A statement like this, about a lack of difference between populations, is the crucial opposite of the research hypothesis. It is called null hypothesis. It has this name because it states the situation

in which there is nodifference (the difference is “null”) between the between the populations. In symbols,the null hypothesis is 1 μ 1 2 < μ .

The research hypothesis and the null hypothesis are complete opposites: if one istrue, the other cannot be. In fact, the research hypothesis is sometimes called thealternative hypothesis – that is, it is the alternative to the null hypothesis. This is a bitironic. As researchers, we care most about the research hypothesis. But when doingthe steps of hypothesis so that we can decide about its alternative (the researchhypothesis).

15.3.2 Step 2: Determine the Characteristics of the comparison Distribution

Recall that the overall logic of hypothesis testing involves figuring out the probabilityof getting a particular result if the null hypothesis is true. Thus, you need to knowwhat the situation would be if the null hypothesis were true. Population 2 we knowμ = = 14, 3, σ and it is normally distributed. If the null hypothesis is true,
Population 1 and Population 2 are the same – in our example, this would mean
Populations 1 and 2 both follow a normal curve, μ = = 14, 3 σ .

In the hypothesis-testing process, you want to find out the probability that you couldhave gotten a sample score as extreme as what you got (say, a baby walking veryearly) if your sample were from a population with a distribution of the sort you would have if the null hypothesis were true. Thus, in this book we call this distribution comparison distribution. (The comparison distribution is sometimes called a statistical model or a sampling distribution – an idea.) That is, in the hypothesis-testing process, you compare the actual sample’s score to this comparisondistribution.In our vitamin example, the null hypothesis is that there is no difference in walking age between babies that take the specially purified vitamin (Population 1) and babies that do not take the specially purified vitamin (Population 2). The comparisondistribution is the distribution for Population 2, since this population represents thewalking age of babies if the null hypothesis is true. In later chapters, you will learnabout different types of comparison distributions, but the same principle applies in allcases: The comparison distribution is the distribution that represents the populationsituation if the null hypothesis is true.

15.3.3 Step 3-Determine the Cutoff Sample Score on the comparison

Distribution at Whichthe null hypothesis should be rejected.Ideally, before conducting a study, researchers set a target against which they willcompare their result – how extreme a sample score they would need to decideagainst the null hypothesis: that is, how extreme the sample score would have to beforeit to be too unlikely that they could get such an extreme score if the null hypothesiswere true. This is called the cutoff sample score. (The cutoff sample score is alsoknown as the critical value.)

15.3.4 Step 4: Determine your sample’s Score on the Comparison Distribution

The next step is to carry out the study and get the actual result for your sample. Once you have the results for your sample, you figure the Z score for the sample’s raw score based on the population mean and standard deviation of the comparison distribution.

15.3.5 Step 5: Decide Whether to reject the null hypothesis

To decide whether to reject the null hypothesis, you compare your actual sample's score (from Step 4) to the cutoff Z score (from Step 3). In our example, the actual result was – 2.67. Let's suppose the researchers had decided in advance that they would reject the null hypothesis if the sample's Z score was below – 2. Since – 2.67is below – 2, the researchers would reject he null hypothesis. Or, suppose the researchers had used the more conservative 1% significance level. The needed Z score to reject the null hypothesis would then have been – 2.33 orlower. But, again, the actual Z for the randomly selected baby was – 2.67 (a more extreme score than – 2.33). Thus, even with this more conservative cutoff, theywould still reject the null hypothesis implications of Rejecting or Failing to Reject the Null Hypothesis

It is important to emphasize two points about the conclusions you can make from the hypothesis-testing process. First, suppose you reject the null hypothesis. Therefore, your result supports the research hypothesis (as in our example). You would still not say that the results prove the research hypothesis or that the results show that the research hypothesis is true. This would be too strong because the results of research studies are based on probabilities. Specifically, they are based on the probability being low of getting your result if the null hypothesis were true. Proven and true are okay in logic and mathematics, but to use these worlds in conclusions from scientific research is quite unprofessional. (It is okay to use true when speaking hypothetically)– for example, "if this hypothesis were true, then…" – but not when speaking of conclusions about an actual result.) what you do say when you reject the nullhypothesis is that the results are statistically significant.Second, when a result is not extreme enough to reject the null hypothesis, you donot say that the result supports the null hypothesis. You simply say the result is not statistically significant.inconclusive. The results may not be extreme enough to reject the null hypothesis, butthe null hypothesis might still be false (and the research hypothesis true). Suppose inour example that the specially purified vitamin had only a slight but still real effect.In that case, we would not expect to find a baby given the purified vitamin to bewalking a lot earlier than babies in general. Thus, we would not be able to reject thenull hypothesis, even though it is false. (You will learn more about such situations inthe Decision Errors section later in this chapter).

Showing the null hypothesis to be true would mean showing that there is absolutely no difference between the populations it is always possible that there is a difference between the populations, but that the difference is much smaller than what the particular study was able to detect. Therefore, when a result is not extreme enough to reject the null hypothesis, the results are inconclusive. Sometimes, however, if studies have been done using large samples and accurate measuring procedures, evidence may build up in support of something close to the null hypothesis – that there is at most very little difference between the populations.

15.4 One-Tailed and Two-Tailed Hypothesis Tests

In our examples so far, the researchers were interested in only one direction of result. In our first example, researchers tested whether babies given the specially purified vitamin would walk earlier than babies in general. In the happiness example, the personality psychologists predicted the person who received $10 million would be happier than other people. The researchers in these studies were not interested in the possibility that giving the specially purified vitamin would cause babies to start walking later or that people getting $10 million might become less happy.

15.5 Directional hypotheses and One-Tailed tests

The purified vitamin and happiness studies are examples of testing directional hypotheses. Both studies focused on a specific direction of effect. When a researcher makes a directional hypothesis, the null hypothesis is also, in a sense, directional. Suppose the research hypothesis is that getting $10 million will make a person happier. The null hypothesis, then, is that the money will either have no effect or make the person less happy (in symbols, if the research hypothesis is $\mu > \mu$ 2, then the null hypothesis is $\mu \mu$ 1 2 $\leq \leq$ is the symbol for less than or equal to.) thus to reject the null hypothesis, the sample had to have a score in one particular tail of thecomparison distribution – the upper extreme or tail (in this example, the top 5%) of the comparison distribution. (When it comes to rejecting the null hypothesis with adirectional hypothesis, a score at the other tail would be the same as a score in themiddle – that is, it would not allow you to reject the null hypothesis). For this reason,the test of a directional hypothesis is called a one-tailed test. A one-tailed test canbe one-tailed in either direction. In the happiness study example, the tail for the predicted effect was at the high end. In the baby study example, the tail for thepredicted effect was at the low end (that is, the prediction tested was that babies given the specially purified vitamin would start walking unusually early).

15.6 Non-directional hypotheses and two-tailed tests

Sometimes, a research hypothesis states that an experimental procedure will have an effect, without saying whether it will produce a very high score or a very low score. Suppose an organizational psychologist is interested in how a new social skills programwill affect productivity. The program could improve productivity by making the working environment more pleasant. Or, the program could hurt productivity by encouraging people to socialise instead of work. The research hypothesis is that the social skills program changes the level of productivity; the null hypothesis is that the program does not change productivity one way or the other. In symbols, the research hypothesizes ì 1 ≠ ì2 the null hypothesis is ì 1= ì2

When a research hypothesis predicts an effect but does not predict a particular direction for the effect, it is called a non-directional hypothesis. To test the significanceof a non-directional hypothesis, you have to take into account the possibility chanceof non-directional hypothesis, you have to take into account the possibility that thesample could be extreme at either tail of the comparison distribution. Thus this iscalled a two-tailed test.

15.7 Decision Errors

Another crucial topic for making sense of statistical significance is the kind of errorsthat are possible in the hypothesis-testing process. The kind of errors we consider here are about how, in spite of doing all your figuring correctly, your consider hereare about how, in spite of doing all your figuring correctly, your conclusions fromhypothesis-testing can still be incorrect. It is not about making mistakes in calculations or even about using the wrong procedures. That is, mistakes in calculations or even about using the wrong procedures. That is, decision errors are situations in which the right procedures lead to the wrong decisions.

Decision errors are possible in hypothesis testing because you are making decisions about populations based on information in samples. The whole hypothesis testing process is based on probabilities. The hypothesis-testing process is set up to make the probability of decision errors as small as possible. For example, we only decideto reject the null hypothesis if a sample's mean is so extreme that there is a very small probability (say, less than 5%) that

we could have gotten such an extreme sample if the null hypothesis is true. But a very small probability is not the same as a zero probability! Thus, in spite of your best intentions, decision errors are always IIerrors.

15.8 Type I Error

Type I error if you reject the null hypothesis when in fact the null hypothesis is true. Or, to put it in terms of the research hypothesis, you make a TypeI error when you conclude that the study supports the research hypothesis when inreality the research hypothesis is false. Suppose you carried out a study in which you had set the significance level cut offat a very lenient probability level, such as 20%. This would mean that it would nottake a very extreme result to reject the null hypothesis. If you did many studies likethis, you would often (about 20% of the time) be deciding to consider the researchhypothesis supported when you should not. That is, you would have a 20% chanceof making a Type I error.

Even when you set the probability at the conventional .05 or .01 levels, you will still make a Type I error sometimes (5% or 1% of the time). Consider again the exampleof giving the new therapy to a depressed patient. Suppose the new therapy is notmore effective than the usual therapy. However, in randomly picking a sample of onedepressed patient to study, the clinical psychologists might just happen to pick apatient whose depression would respond equally well to the new therapy and theusual therapy. Randomly selecting a sample patient like this is unlikely, but suchextremesamples are possible, and should this happen, the clinical psychologists would reject the null hypothesis and conclude that the new therapy is different thanthe usual therapy.

Type I error.

Of course, the researchers could not know they had made a decisionerror of this kind. What reassures researchers is that they know from the logic ofhypothesis testing that the probability of making such a decision error is kept low(less than 5% if you use the .05 significance level).Still, the fact that Type I errors can happen at all is of serious concern to psychologists,who might construct entire theories and research programs, not to mention practicalapplications, based on a conclusion from hypothesis testing that is in fact mistaken.

It is because these errors are of such serious concern that they are called Type I.As we have noted, researchers cannot tell when they have made a Type I error. However, they can try to carry out studies so that the chance of making a Type Ierror is as small as possible.

What is the chance of making a Type I error? It is the same as the significance levelyou set. If you set the significance level at $p < .05$, you are saying you will reject the null hypothesis if there is less than a 5% (.05) chance that you could have gotten your result if the null hypothesis were true. When rejecting the null hypothesis in thisway, you are allowing up to a 5% chance that you got your results even though the null hypothesis was actually true. That is, you are allowing a 5% chance of a TypeI error.

The significance level, which is the chance of making a Type I error, is called alpha(the Greek letter Ü). The lower the alpha, the smaller the chance of a Type I error. Researchers who do not want to take a lot of risk set alpha lower than .05 such ap<.001 in this way the result of a study has to be very extreme in order for thehypothesis testing process to reject the null hypothesis.

Using a .001 significance level is like buying insurance against making a Type I error. However, when buying insurance, the better the protection, the higher the cost. There is a cost in setting the significance level at too extreme a level. We turn to that costnext.

15.9 Type II Error

With a very stringent significance level, you may carry out a study in which in reality the research hypothesis is true, but the result does not come out extreme enough to reject the null hypothesis. Thus, the decision error you would make is in not rejecting the null hypothesis when in reality the null hypothesis is false to put this in terms of the research hypothesis, you make this kind of decision error when the hypothesis-testing procedure leads you to decide that the results of the study are inconclusive when in reality the research hypothesis is true. This is called a Type IIerror. The probability of making a Type II error is called beta (the Greek letter β).

15.10 Relationship Between Type I And Type II Errors

When it comes to setting significance levels, protecting against one kind of decisionerror increases the chance of making the other. The insurance policy against Type Ierror (setting a significance level of, say, .001) has the cost of increasing the chanceof making a Type II error. (This is because with a stringent significance level like .001, even if the research hypothesis is true, the results have to be quite strong tobe extreme enough to reject the null hypothesis.) The insurance policy against TypeII error (setting a significance level of say .20) has the cost of increasing the chanceof making a Type I error. (This is because with a level of significance like .20, evenif the null hypothesis is true, it is fairly easy to get a significant result just by accidentallygetting a sample that is higher or lower than the general population before doing thestudy.)

15.11. Power of the Test

A Type IIerror (β) is the probability of failing to reject a false null hypothesis. It follows that 1-β is the probability of rejecting a false null hypothesis. This probability is identified as the power of the test, and is often used to gauge the test's effectiveness in recognizing that a null hypothesis is false.

The probability that at a fixed level α significance test will reject H0, when a particular alternative value of the parameter is true is called the power of the test.

Power is also directly linked to sample size. For example, suppose the null hypothesis is that the mean fish weight is 8.7 lb. Given sample data, a level of significance of 5%, and an alternative weight of 9.2 lb., we can compute the power of the test to reject $\mu = 8.7$ lb. If we have a small sample size, the power will be low. However, increasing the sample size will increase the power of the test. Increasing the level of significance will also increase power. A 5% test of significance will have a greater chance of rejecting the null hypothesis than a 1% test because the strength of evidence required for the rejection is less. Decreasing the standard deviation has the same effect as increasing the sample size: there is more information about μ.

15.12Summary

Hypothesis testing considers the probability that the result of a study could have come about even if the experimental procedure had no effect. If this probability is low, the scenario of no effect is rejected and the theory behind the experimental procedure is supported. The expectation of an effect is the research hypothesis, and the hypothetical situation of no effect is the null hypothesis. When a result (that is, a sample score) is so extreme that the result

would be very unlikely if the null hypothesis were true, the null hypothesis is reject and the research hypothesis supported. If the result is not that extreme, the null hypothesis is not rejected and the study is inconclusive. Psychologists usually consider a result too extreme if it is less likely than 5% (thatis, a significance level of .05) to have come about, if the null hypothesis were true. Psychologists sometimes use a more stringent 1% (.01 significance level), or even.01% (.001) significance level), cutoff. The cutoff percentage is the probability of the result being extreme in a predicted direction in a directional or one-tailed test. The cutoff percentages are the probability of the result being extreme in either direction in a non-directional or two-tailed test. There are two kinds of decision errors one can make in hypothesis testing. A TypeI error is when a researcher rejects the null hypothesis, but the null hypothesis is actually true. A Type II error is when a researcher does not reject the null hypothesis, but the null hypothesis is actually false. There has been much controversy about significance tests, including critiques of the basic logic and, especially, that they are often misused. One major way significance tests are misused is when researchers interpret not rejecting the null hypothesis as demonstrating that the null hypothesis is true. Research articles typically report the results of hypothesis testing by saying a result was or was not significant and giving the probability level cutoff (usually 5% or 1%) the decision was based on. Research articles rarely mention decision errors.

15.13Key words

Hypothesis Testing- Hypothesis testing has a vital role in psychological measurements. By hypothesis wemean the tentative answer to any questions

Type I Error- Type I error if you reject the null hypothesis when in fact the null hypothesis is true. Or, to put it in terms of the research hypothesis, you make a TypeI error when you conclude that the study supports the research hypothesis when inreality the research hypothesis is false.

Type II Error-The decision error you would make is in not rejecting the null hypothesis when in reality the null hypothesis is false to put this in terms of the research hypothesis, you make this kind of decision error when the hypothesis-testing procedure leads you to decide that the results of the study are inconclusive when in reality the research hypothesis is true. This is called a Type IIerror. The probability of making a Type II error is called beta (the Greek letter β).

Decision Error- The kind of errors we consider here are about how, in spite of doing all your figuring correctly, your consider hereare about how, in spite of doing all your figuring correctly, your conclusions fromhypothesis-testing can still be incorrect

15.14 Self Assessment Questions

1. Define Hypothesis Testing?Discuss the Hypothesis Testing process ?
2. Describe the Relationship Between the Type I and Type II Error

15.15 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009

2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.

3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.

4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit kumar Sage Publications 2015

5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, andDipayan Das, Springer Publications, 2018.

6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.

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LESSON 16

QUALITATIVE RESEARCH QUESTIONS AND HYPOTHESES

Learning Objectives

- ✓ To understand the Qualitative Research
- ✓ To learn the Types of Qualitative Research
- ✓ To Discuss Characteristics of Qualitative Research

Structure

16.0 Introduction

Qualitative researchers are interested in understanding the meaning people have constructed, that is, how people make sense of their world and the experiences they have in the world. Qualitative research is research using methods such as participant observation or case studies which result in a narrative, descriptive account of a setting or practice. Sociologists using these methods typically reject positivism and adopt a form of interpretive sociology.

Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that makes the world visible. These practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations, photographs, recordings, and memos to the self. At this level, qualitative research involves an interpretive, naturalistic approach to the world. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them.

"Qualitative research involves any research that uses data that do not indicate ordinal values.

Qualitative research aims to study things in their natural setting to make sense of a phenomenon in terms of meanings people bring to them. It doesn't involve any form of intervention or a method to manipulate the studied environment. Unlike Randomized Clinical Trials (RCT) where the study is meant to measure an intervention. For example, qualitative research can study experiences or people's perspectives in which case the study is conducted without any influence on the environment to get naturally occurring data within the natural setting. So as best we can, we won't influence the environment aiming to make sense of phenomena, an event, a case, an object, or experience.

For some qualitative research can be seen as a simple data collection method but for others can be a complex, deep and meaningful insight into the world.

Qualitative Research is

Inductive: it means starting with collecting data and then looking for patterns or drawing some kinds of theories from it. Whereas if we look at quantitative research, sometimes it uses a deductive approach where the theories are already established and being tested. In qualitative research, theories and patterns are formed from the collected data.

Iterative: an iterative process is a sequence of steps that could be repeated usually to improve something. This process is generally convergent meaning that a topic is approached from a broad point of view then gets limited and refined to get a closer look. Iteration can also mean incorporating a factor or an element in the research, not necessarily from the beginning, that could continue to the end of the study if found to be insightful which means that this method of research is flexible and adaptable.

16.1 Qualitative Research: Now and Then

The word qualitative stems back to around the 15th century from the Latin word "qualitas" which means quality, an attribute, or a property. So it would make sense that qualitative research looks at the properties, the qualities or attributes of something as opposed to quantities of something.

The first Now qualitative researcher remains unknown, however, looking back to the 19th and 20th centuries the cultural anthropologists influenced the research field by their observational studies of non-literate societies. Sigmund Freud's and Piaget, well known key figures in the field of psychology, relied on case studies on interviewing in their work and observation techniques.

Qualitative research prospered at the end of the 20th century, A nice study by Rene et al. in 2002 looked at the incidence of how many times qualitative research terms were used in research papers in the field of psychology within the 20th century. They found the term qualitative research almost didn't exist until the 1980s, This has changed dramatically in the 1990s when there was a huge sharp rise in its popularity and use.

The increased popularity could be credited to a number of reasons:

The Grounded theory, an influential approach in qualitative research, was introduced in the 1960s followed by newly published academic journals with a focus on qualitative research over the following two decades, This has created a platform for publishing and access to readers who can spread the word and contribute to the discussion and the debate about the findings.

As with quantitative research and statistical analysis software, there are some computer software programs that started to be developed for qualitative researchers to help manage their data. And more recently, programs developed to help with data interpretation and analysis.

It was debatable at one point that qualitative research might not be as compatible as the quantitative methods. the findings and contributions of qualitative research have now gained huge momentum which shifted the way of thinking and convinced researchers that both methods can complement one another, adding strength and value to the studied field.

16.2 Differences Between Qualitative and Quantitative

Although the two methods are often seen as antagonists, there is a growing recognition that the distinctions between the methods are unnecessary. They cannot be compared side by side but for the purposes of trying to understand some key characteristics of each of the types of research, we will look at qualitative and quantitative methods and how they might complement one another.

In terms of objectives, qualitative research is inductive and aims to explore new things, insights, generate theories, patterns, themes, and hypotheses. On the other hand, quantitative research is deductive so it investigates the validity of facts, estimates relationships, and predicts outcomes, It controls, describes, or confirms hypotheses. There's a lot more breadth to quantitative methods, whereas there's a lot more depth to qualitative[7].

Qualitative research is subjective, flexible, and naturalistic. Quantitative on the other hand is experimental and uses statistics.

In terms of design, qualitative research in its design can be flexible, adaptable, can evolve over time. and can also be emergent. Whereas quantitative research is a lot more structured, fixed and predetermined.

The sample size is another area where the two research methods differ. The sample tends to be smaller in qualitative research and the data saturation can be reached quicker. But in quantitative research, larger samples are needed to generalize the results and ensure the reliability of the intervention,

The researcher can be considered an actual instrument in qualitative research and their own biases and opinion can influence the data collection because they determine the questions, often open-ended or semi-structured, to guide interviews and set the tools to be utilized then observe the whole process and recognize the patterns. Whereas in quantitative research, outcome measures should be standardized for the statistical analysis so we use structured objective tools like questionnaires and lab tests.

The analysis utilized in qualitative research is iterative, A report or transcript can be read many times, a video can be watched several times to draw conclusions and highlight key terms. In quantitative research, the analysis depends on modeling and statistical testing.

Finally, data reporting in qualitative research is done by the language of the researchers and their interpretation which means that if the same study was repeated we might get different results. It can often be helpful to get an independent researcher to look into the findings and conclusions of the study to see if they would agree or provide different insights and this can eliminate subjectivity and ensures flexibility of the study. Quantitative research is more objective and can be generalized because the data is reported through statistical analysis, so it's numerical data and can be organized in tables or graphs or charts

Qualitative research is defined as a market research method that focuses on obtaining data through open-ended and conversational communication.

This method is not only about "what" people think but also "why" they think so. For example, consider a convenience store looking to improve its patronage. A systematic observation concludes that the number of men visiting this store are more. One good method to determine why women were not visiting the store is to conduct an in-depth interview of potential customers in the category.

For example, on successfully interviewing female customers, visiting the nearby stores and malls, and selecting them through random sampling, it was known that the store doesn't have enough items for women and so there were fewer women visiting the store, which was understood only by personally interacting with them and understanding why they didn't visit the store, because there were more male products than female ones.

Qualitative research is based on the disciplines of social sciences like psychology, sociology, and anthropology. Therefore, the qualitative research methods allow for in-depth and further probing and questioning of respondents based on their responses, where the interviewer/researcher also tries to understand their motivation and feelings. Understanding how your audience takes decisions can help derive conclusions in market research.

16.3Types of qualitative research methods with examples

Qualitative research methods are designed in a manner that help reveal the behavior and perception of a target audience with reference to a particular topic. There are different types of qualitative research methods like an in-depth interview, focus groups, ethnographic research, content analysis, case study research that are usually used.

The results of qualitative methods are more descriptive and the inferences can be drawn quite easily from the data that is obtained.

Qualitative research methods originated in the social and behavioral sciences. Today our world is more complicated and it is difficult to understand what people think and perceive. Online qualitative research methods make it easier to understand that as it is more communicative and descriptive.

The following are the qualitative research methods that are frequently used. Also, read about qualitative research examples:

16.4Types of Qualitative Research

16.4.1. One-to-one interview:

Conducting in-depth interviews is one of the most common qualitative research methods. It is a personal interview that is carried out with one respondent at a time. This is

purely a conversational method and invites opportunities to get details in depth from the respondent.

One of the advantages of this method provides a great opportunity to gather precise data about what people believe and what their motivations are. If the researcher is well experienced asking the right questions can help him/her collect meaningful data. If they should need more information the researchers should ask such follow up questions that will help them collect more information.

These interviews can be performed face-to-face or on phone and usually can last between half an hour to two hours or even more. When the in-depth interview is conducted face to face it gives a better opportunity to read the body language of the respondents and match the responses.

16.4.2. Focus groups:

A focus group is also one of the commonly used qualitative research methods, used in data collection. A focus group usually includes a limited number of respondents (6-10) from within your target market.

The main aim of the focus group is to find answers to the "why" "what" and "how" questions. One advantage of focus groups is, you don't necessarily need to interact with the group in person. Nowadays focus groups can be sent an online survey on various devices and responses can be collected at the click of a button.

Focus groups are an expensive method as compared to the other online qualitative research methods. Typically they are used to explain complex processes. This method is very useful when it comes to market research on new products and testing new concepts.

16.4.3. Ethnographic research:

Ethnographic research is the most in-depth observational method that studies people in their naturally occurring environment.

This method requires the researchers to adapt to the target audiences' environments which could be anywhere from an organization to a city or any remote location. Here geographical constraints can be an issue while collecting data.

This research design aims to understand the cultures, challenges, motivations, and settings that occur. Instead of relying on interviews and discussions, you experience the natural settings first hand.

This type of research method can last from a few days to a few years, as it involves in-depth observation and collecting data on those grounds. It's a challenging and a time-consuming method and solely depends on the expertise of the researcher to be able to analyze, observe and infer the data.

16.4.4. Case study research:

The case study method has evolved over the past few years and developed into a valuable qual research method. As the name suggests it is used for explaining an organization or an entity.

This type of research method is used within a number of areas like education, social sciences and similar. This method may look difficult to operate, however, it is one of the simplest ways of conducting research as it involves a deep dive and thorough understanding of the data collection methods and inferring the data.

16.4.5. Record keeping:

This method makes use of the already existing reliable documents and similar sources of information as the data source. This data can be used in new research. This is similar to going to a library. There one can go over books and other reference material to collect relevant data that can likely be used in the research.

16.4.6. Process of observation:

Qualitative Observation is a process of research that uses subjective methodologies to gather systematic information or data. Since, the focus on qualitative observation is the research process of using subjective methodologies to gather information or data. Qualitative observation is primarily used to equate quality differences.

Qualitative observation deals with the 5 major sensory organs and their functioning – sight, smell, touch, taste, and hearing. This doesn't involve measurements or numbers but instead characteristics.

16.5A. Qualitative data collection

Qualitative data collection allows collecting data that is non-numeric and helps us to explore how decisions are made and provide us with detailed insight. For reaching such conclusions the data that is collected should be holistic, rich, and nuanced and findings to emerge through careful analysis.

Whatever method a researcher chooses for collecting qualitative data, one aspect is very clear the process will generate a large amount of data. In addition to the variety of methods available, there are also different methods of collecting and recording the data.

For example, if the qualitative data is collected through a focus group or one-to-one discussion, there will be handwritten notes or video recorded tapes. If there are recording they should be transcribed and before the process of data analysis can begin.

As a rough guide, it can take a seasoned researcher 8-10 hours to transcribe the recordings of an interview, which can generate roughly 20-30 pages of dialogues. Many researchers also like to maintain separate folders to maintain the recording collected from the different focus group. This helps them compartmentalize the data collected.

In case there are running notes taken, which are also known as field notes, they are helpful in maintaining comments, environmental contexts, nonverbal cues etc. These filed notes are helpful and can be compared while transcribing audio recorded data. Such notes are usually informal but should be secured in a similar manner as the video recordings or the audio tapes.

16.5.1 . Qualitative data analysis

Qualitative data analysis such as notes, videos, audio recordings images, and text documents. One of the most used methods for qualitative data analysis is text analysis.

Text analysis is a data analysis method that is distinctly different from all other qualitative research methods, where researchers analyze the social life of the participants in the research study and decode the words, actions, etc.

There are images also that are used in this research study and the researchers analyze the context in which the images are used and draw inferences from them. In the last decade,

text analysis through what is shared on social media platforms has gained supreme popularity.

16.5.2 Characteristics of qualitative research methods

Qualitative research methods usually collect data at the sight, where the participants are experiencing issues or problems. These are real-time data and rarely bring the participants out of the geographic locations to collect information.

Qualitative researchers typically gather multiple forms of data, such as interviews, observations, and documents, rather than rely on a single data source.

This type of research method works towards solving complex issues by breaking down into meaningful inferences, that is easily readable and understood by all.

Since it's a more communicative method, people can build their trust on the researcher and the information thus obtained is raw and unadulterated.

16.5.3 Qualitative research method case study

Let's take the example of a bookstore owner who is looking for ways to improve their sales and customer outreach. An online community of members who were the loyal patrons of the bookstore were interviewed and related questions were asked and the questions were answered by them.

At the end of the interview, it was realized that most of the books in the stores were suitable for adults and there were not enough options for children or teenagers.

By conducting this qualitative research the bookstore owner realized what the shortcomings were and what were the feelings of the readers. Through this research now the bookstore owner can now keep books for different age categories and can improve his sales and customer outreach.

Such qualitative research method examples can serve as the basis to indulge in further quantitative research, which provides remedies.

16.5.4 When to use qualitative research

Researchers make use of qualitative research techniques when they need to capture accurate, in-depth insights. It is very useful to capture "factual data". Here are some examples of when to use qualitative research.

1. Developing a new product or generating an idea.
2. Studying your product/brand or service to strengthen your marketing strategy.
3. To understand your strengths and weaknesses.
4. Understanding purchase behavior.
5. To study the reactions of your audience to marketing campaigns and other communications.
6. Exploring market demographics, segments, and customer groups.
7. Gathering perception data of a brand, company, or product.

16.6Advantages of qualitative research

Qualitative research often tries to preserve the voice and perspective of participants and can be adjusted as new research questions arise. Qualitative research is good for:

Flexibility

The data collection and analysis process can be adapted as new ideas or patterns emerge. They are not rigidly decided beforehand.

Natural settings

Data collection occurs in real-world contexts or in naturalistic ways.

Meaningful insights

Detailed descriptions of people's experiences, feelings and perceptions can be used in designing, testing or improving systems or products.

Generation of new ideas

Open-ended responses mean that researchers can uncover novel problems or opportunities that they wouldn't have thought of otherwise.

16.7Disadvantages of qualitative research

Researchers must consider practical and theoretical limitations in analyzing and interpreting their data. Qualitative research suffers from:

Unreliability

The real-world setting often makes qualitative research unreliable because of uncontrolled factors that affect the data.

Subjectivity

Due to the researcher's primary role in analyzing and interpreting data, qualitative research cannot be replicated. The researcher decides what is important and what is irrelevant in data analysis, so interpretations of the same data can vary greatly.

Limited generalizability

Small samples are often used to gather detailed data about specific contexts. Despite rigorous analysis procedures, it is difficult to draw generalizable conclusions because the data may be biased and unrepresentative of the wider population.

Labor-intensive

Although software can be used to manage and record large amounts of text, data analysis often has to be checked or performed manually.

Qualitative data analysis

Qualitative data can take the form of texts, photos, videos and audio. For example, you might be working with interview transcripts, survey responses, fieldnotes, or recordings from natural settings.

16.8 Most types of qualitative data analysis share the same five steps:

Prepare and organize your data. This may mean transcribing interviews or typing up fieldnotes.
Review and explore your data. Examine the data for patterns or repeated ideas that emerge.
Develop a data coding system. Based on your initial ideas, establish a set of codes that you can apply to categorize your data.

Assign codes to the data. For example, in qualitative survey analysis, this may mean going through each participant's responses and tagging them with codes in a spreadsheet. As you go through your data, you can create new codes to add to your system if necessary.

16.8.1 Identify recurring themes

Link codes together into cohesive, overarching themes

A hypothesis is a statement that can be tested by scientific research. If you want to test a relationship between two or more variables, you need to write hypotheses before you start your experiment or data collection.

16.8.2 Hypothesis

A hypothesis states your predictions about what your research will find. It is a tentative answer to your research question that has not yet been tested. For some research projects, you might have to write several hypotheses that address different aspects of your research question.

A hypothesis is not just a guess – it should be based on existing theories and knowledge. It also has to be testable, which means you can support or refute it through scientific research methods (such as experiments, observations and statistical analysis of data).

16.8.3 Variables in hypotheses

Hypotheses propose a relationship between two or more variables. An independent variable is something the researcher changes or controls. A dependent variable is something the researcher observes and measures.
Example: Hypothesis

16.8.4 Daily exposure to the sun leads to increased levels of happiness.

In this example, the independent variable is exposure to the sun – the assumed cause. The dependent variable is the level of happiness – the assumed effect.

16.8.5 Developing a hypothesis (with example)

16.9 Steps in Hypothesis

Step 1. Ask a question

Writing a hypothesis begins with a research question that you want to answer. The question should be focused, specific, and researchable within the constraints of your project.

Example: Research question
Do students who attend more lectures get better exam results?

Step 2. Do some preliminary research

Your initial answer to the question should be based on what is already known about the topic. Look for theories and previous studies to help you form educated assumptions about what your research will find.

At this stage, you might construct a conceptual framework to identify which variables you will study and what you think the relationships are between them. Sometimes, you'll have to operationalise more complex constructs.

Step 3. Formulate your hypothesis

Now you should have some idea of what you expect to find. Write your initial answer to the question in a clear, concise sentence.
Attending more lectures leads to better exam results.

Step 4. Refine your hypothesis

You need to make sure your hypothesis is specific and testable. There are various ways of phrasing a hypothesis, but all the terms you use should have clear definitions, and the hypothesis should contain:
The relevant variables
The specific group being studied
The predicted outcome of the experiment or analysis

Step 5. Phrase your hypothesis in three ways

To identify the variables, you can write a simple prediction in if…then form. The first part of the sentence states the independent variable and the second part states the dependent variable.
If a first-year student starts attending more lectures, then their exam scores will improve.

In academic research, hypotheses are more commonly phrased in terms of correlations or effects, where you directly state the predicted relationship between variables.

The number of lectures attended by first-year students has a positive effect on their exam scores.

If you are comparing two groups, the hypothesis can state what difference you expect to find between them.

First-year students who attended most lectures will have better exam scores than those who attended few lectures.

Step 6. Write a null hypothesis

If your research involves statistical hypothesis testing, you will also have to write a null hypothesis. The null hypothesis is the default position that there is no association between the variables. The null hypothesis is written as H0, while the alternative hypothesis is H1 or Ha.
H0: The number of lectures attended by first-year students has no effect on their final exam scores.

H1: The number of lectures attended by first-year students has a positive effect on their final exam scores.

16.10 Summary

Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that makes the world visible. These practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations, photographs, recordings, and memos to the self. At this level, qualitative research involves an interpretive, naturalistic approach to the world. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them.

16.11 Key words

Qualitative research- Qualitative research aims to study things in their natural setting to make sense of a phenomenon in terms of meanings people bring to them.

Qualitative Research (Inductive): it means starting with collecting data and then looking for patterns or drawing some kinds of theories from it

Qualitative Research (Iterative): an iterative process is a sequence of steps that could be repeated usually to improve something.

Focus group- A focus group is also one of the commonly used qualitative research methods, used in data collection.

Ethnographic Research -Ethnographic research is the most in-depth observational method that studies people in their naturally occurring environment.

16.12 Self Assessment questions

1. Discuss the Difference between the Qualitative and Qunatitative Research
2. Describe the types of Qualitative Research
3. Explain the Characteristics of Qualitative Research

16.13 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009

2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.

3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.

4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit kumar Sage Publications 2015

5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, andDipayan Das, Springer Publications, 2018.

6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.

7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019

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LESSON-17

DATA INTERPRETATION

Learning Objectives

- ✓ To understand the Processing operations
- ✓ To discuss the Tabulation
- ✓ To Learn the Element and types of Analysis

Structure

17.0 Introduction

The data, after collection, has to be processed and analyzed in accordance with the outline laid downfor the purpose at the time of developing the research plan. This is essential for a scientific study andfor ensuring that we have all relevant data for making contemplated comparisons and analysis.Technically speaking, processing implies editing, coding, classification and tabulation of collecteddata so that they are amenable to analysis. The term analysis refers to the computation of certainmeasures along with searching for patterns of relationship that exist among data-groups. Thus, "inthe process of analysis, relationships or differences supporting or conflicting with original or newhypotheses should be subjected to statistical tests of significance to determine with what validity datacan be said to indicate any conclusions". But there are persons (Selltiz, Jahoda and others) who donot like to make difference between processing and analysis. They opine that analysis of data in ageneral way involves a number of closely related operations which are performed with the purposeof summarizing the collected data and organizing these in such a manner that they answer theresearch question(s). We, however, shall prefer to observe the difference between the two terms asstated here in order to understand their implications more clearly.

17.1 Processing Operations

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

17.1.1 Editing

Editing of data is a process of examining the collected raw data (specially in surveys) todetect errors and omissions and to correct these when possible. As a matter of fact, editing involvesa careful scrutiny of the completed questionnaires and/or schedules. Editing is done to assure that thedata are accurate, consistent with other facts gathered, uniformly entered, as completed as possibleand have been well arranged to facilitate coding and tabulation.
With regard to points or stages at which editing should be done, one can talk of field editing andcentral editing.

Field editing

It consists in the review of the reporting forms by the investigator forcompleting (translating or rewriting) what the latter has written in abbreviated and/or in illegible form at the time of recording the respondents' responses. This type of editing is necessary in view of thefact that individual writing styles often can be difficult for others to decipher. This sort of editingshould be done as soon as possible after the interview, preferably on the very day or on the next day.

While doing field editing, the investigator must restrain himself and must not correct errors of omissionby simply guessing what the informant would have said if the question had been asked.

Central editing

It should take place when all forms or schedules have been completed and returnedto the office. This type of editing implies that all forms should get a thorough editing by a single editorin a small study and by a team of editors in case of a large inquiry. Editor(s) may correct the obviouserrors such as an entry in the wrong place, entry recorded in months when it should have beenrecorded in weeks, and the like. In case of inappropriate on missing replies, the editor can sometimesdetermine the proper answer by reviewing the other information in the schedule. At times, therespondent can be contacted for clarification. The editor must strike out the answer if the same isinappropriate and he has no basis for determining the correct answer or the response. In such a casean editing entry of 'no answer' is called for. All the wrong replies, which are quite obvious, must bedropped from the final results, especially in the context of mail surveys

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Editors must keep in view several points while performing their work:

(a) They should be familiar with instructions given to the interviewers and coders as well as with the editing instructions suppliedto them for the purpose.

(b) While crossing out an original entry for one reason or another, theyshould just draw a single line on it so that the same may remain legible.

(c) They must make entries (if any) on the form in some distinctive color and that too in a standardized form. (d) They shouldinitial all answers which they change or supply. (e) Editor's initials and the date of editing should beplaced on each completed form or schedule.

17.1.2. Coding

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

Coding is necessary for efficient analysis and through it the several replies may be reduced to small number of classes which contain the critical information required for analysis. Coding decisionsshould usually be taken at the designing stage of the questionnaire. This makes it possible to precodethe questionnaire choices and which in turn is helpful for computer tabulation as one can straightforward key punch from the original questionnaires. But in case of hand coding some standardmethod may be used. One such standard method is to code in the margin with a colored pencil. Theother method can be to transcribe the data from the questionnaire to a coding sheet. Whatevermethod is adopted, one should see that coding errors are altogether eliminated or reduced to the minimum level.

17.1.3. Classification

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

17.1.3(a) Classification according to attributes:

As stated above, data are classified on the basis of common characteristics which can either be descriptive (such as literacy, sex, honesty, etc.) or numerical (such as weight, height, income, etc.). Descriptive characteristics refer to qualitative phenomenon which cannot be measured quantitatively; only their presence or absence in an individual item can be noticed. Data obtained this way on the basis of certain attributes are known as *statistics of attributes* and their classification is said to be classification according to attributes.

Such classification can be simple classification or manifold classification. In simpleclassification we consider only one attribute and divide the universe into two classes—oneclass consisting of items possessing the given attribute and the other class consisting ofitems which do not possess the given attribute. But in manifold classification we considertwo or more attributes simultaneously, and divide that data into a number of classes (totalnumber of classes of final order is given by 2^n, where n = number of attributes considered).Whenever data are

classified according to attributes, the researcher must see that theattributes are defined in such a manner that there is least possibility of any doubt/ambiguity concerning the said attributes.

17.1.3(b) Classification according to class-intervals

Unlike descriptive characteristics, thenumerical characteristics refer to quantitative phenomenon which can be measured through some statistical units. Data relating to income, production, age, weight, etc. come under thiscategory. Such data are known as *statistics of variables* and are classified on the basis ofclass intervals. For instance, persons whose incomes, say, are within Rs 201 to Rs 400 canform one group, those whose incomes are within Rs 401 to Rs 600 can form another groupand so on. In this way the entire data may be divided into a number of groups or classes orwhat are usually called, 'class-intervals.' Each group of class-interval, thus, has an upperlimit as well as a lower limit which are known as class limits. The difference between thetwo class limits is known as class magnitude. We may have classes with equal classmagnitudes or with unequal class magnitudes. The number of items which fall in a givenclass is known as the frequency of the given class. All the classes or groups, with theirrespective frequencies taken together and put in the form of a table, are described as groupfrequency distribution or simply frequency distribution. Classification according to classintervals usually involves the following three main problems:

(i) How may classes should be there? What should be their magnitudes?There can be no specific answer with regard to the number of classes. The decisionabout these calls for skill and experience of the researcher. However, the objectiveshould be to display the data in such a way as to make it meaningful for the analyst.

Typically, we may have 5 to 15 classes. With regard to the second part of the question,we can say that, to the extent possible, class-intervals should be of equal magnitudes,but in some cases unequal magnitudes may result in better classification. Hence the researcher's objective judgement plays an important part in this connection. Multiplesof 2, 5 and 10 are generally preferred while determining class magnitudes. Somestatisticians adopt the following formula, suggested by H.A. Sturges, determining thesize of class interval:

$$i = R/(1 + 3.3 \log N)$$

where

i = size of class interval;

R = Range (i.e., difference between the values of the largest item and smallest item among the given items);

N = Number of items to be grouped.

It should also be kept in mind that in case one or two or very few items have very high or verylow values, one may use what are known as open-ended intervals in the overall frequency distribution.

Such intervals may be expressed like under Rs 500 or Rs 10001 and over. Such intervals are generallynot desirable, but often cannot be avoided. The researcher must always remain conscious of this factwhile deciding the issue of the total number of class intervals in which the data are to be classified.

(ii) How to choose class limits?

While choosing class limits, the researcher must take into consideration the criterionthat the mid-point (generally worked out first by taking the sum of the upper limit andlower limit of a class and then divide this sum by 2) of a class-interval and the actualaverage of items of that class interval should remain as close to each other as possible.

Consistent with this, the class limits should be located at multiples of 2, 5, 10, 20, 100and such other figures. Class limits may generally be stated in any of the followingforms:

Exclusive type class intervals: They are usually stated as follows:

10–20
20–30
30–40
40–50

The above intervals should be read as under:

10 and under 20
20 and under 30
30 and under 40
40 and under 50

Thus, under the exclusive type class intervals, the items whose values are equal to theupper limit of a class are grouped in the next higher class. For example, an item whosevalue is exactly 30 would be put in 30–40 class interval and not in 20–30 class interval.In simple words, we can say that under exclusive type class intervals, the upper limit ofa class interval is excluded and items with values less than the upper limit (but not lessthan the lower limit) are put in the given class interval.

Inclusive type class intervals*:* They are usually stated as follows:

11–20
21–30
31–40
41–50

In inclusive type class intervals, the upper limit of a class interval is also included in theconcerning class interval. Thus, an item whose value is 20 will be put in 11–20 classinterval. The stated upper limit of the class interval 11–20 is 20 but the real limit is20.99999 and as such 11–20 class interval really means 11 and under 21.

When the phenomenon under consideration happens to be a discrete one (i.e., can be measuredand stated only in integers), then we should adopt inclusive type classification. But when thephenomenon happens to be a continuous one capable of being measured in fractions as well, we canuse exclusive type class intervals.

(iii) How to determine the frequency of each class?

This can be done either by tally sheets or by mechanical aids. Under the technique oftally sheet, the class-groups are written on a sheet of paper (commonly known as thetally sheet) and for each item a stroke (usually a small vertical line) is marked againstthe class group in which it falls. The general practice is that after every four small vertical lines in a class group, the fifth line for the item falling in the same group, isindicated as horizontal line through the said four lines and the resulting flower (𝍸) represents five items. All this facilitates the counting of items in each one of the classgroups. An illustrative tally sheet can be shown as under:

Table 7.1: An Illustrative Tally Sheet for Determining the Number of 70 Families in Different Income Groups

Income groups (Rupees)	*Tally mark*	*Number of families or (Class frequency)*
Below 400	𝍸 𝍸 III	13
401–800	𝍸 𝍸 𝍸 𝍸	20
801–1200	𝍸 𝍸 II	12
1201–1600	𝍸 𝍸 𝍸 III	18
1601 and above	𝍸 II	7
Total		70

Alternatively, class frequencies can be determined, specially in case of large inquires and surveys,by mechanical aids i.e., with the help of machines viz., sorting machines that are available for thepurpose. Some machines are hand operated, whereas other work with electricity. There are machineswhich can sort out cards at a speed of something like 25000 cards per hour. This method is fast butexpensive.

17.1.4. Tabulation: When a mass of data has been assembled, it becomes necessary for the researcherto arrange the same in some kind of concise and logical order. This procedure is referred to astabulation. Thus, tabulation is the process of summarizing raw data and displaying the same in compactform (i.e., in the form of statistical tables) for further analysis. In a broader sense, tabulation is anorderly arrangement of data in columns and rows.

Tabulation is essential because of the following reasons.

1. It conserves space and reduces explanatory and descriptive statement to a minimum.
2. It facilitates the process of comparison.
3. It facilitates the summation of items and the detection of errors and omissions.
4. It provides a basis for various statistical computations.

Tabulation can be done by hand or by mechanical or electronic devices. The choice depends onthe size and type of study, cost considerations, time pressures and the availability of tabulatingmachines or computers. In relatively large inquiries, we may use mechanical or computer tabulationif other factors are favorable and necessary facilities are available. Hand tabulation is usuallypreferred in case of small inquiries where the number of questionnaires is small and they are ofrelatively short length. Hand tabulation may be done using the direct tally, the list and tally or the cardsort and count methods. When there are simple codes, it is feasible to tally directly from thequestionnaire. Under this method, the codes are written on a sheet of paper, called tally sheet, and foreach response a stroke is marked against the code in which it falls. Usually after every four strokesagainst a particular code, the fifth response is indicated by drawing a diagonal or horizontal linethrough the strokes. These groups of five are easy to count and the data are sorted against each code conveniently. In the listing method, the coded responses may be transcribed onto a large work-sheet,allowing a line for each questionnaire. This way a large number of questionnaires can be listed onone work sheet. Tallies are then made for each question. The card sorting method is the most flexiblehand tabulation. In this method the data are

recorded on special cards of convenient size and shapewith a series of holes. Each hole stands for a code and when cards are stacked, a needle passethrough particular hole representing a particular code. These cards are then separated and counted.

In this way frequencies of various codes can be found out by the repetition of this technique. We canas well use the mechanical devices or the computer facility for tabulation purpose in case we wantquick results, our budget permits their use and we have a large volume of straight forward tabulationinvolving a number of cross-breaks.

Tabulation may also be classified as simple and complex tabulation. The former type of tabulationgives information about one or more groups of independent questions, whereas the latter type oftabulation shows the division of data in two or more categories and as such is designed to giveinformation concerning one or more sets of inter-related questions. Simple tabulation generally resultsin one-way tables which supply answers to questions about one characteristic of data only. Asagainst this, complex tabulation usually results in two-way tables (which give information about twointer-related characteristics of data), three-way tables (giving information about three interrelatedcharacteristics of data) or still higher order tables, also known as manifold tables, which supplyinformation about several interrelated characteristics of data. Two-way tables, three-way tables ormanifold tables are all examples of what is sometimes described as cross tabulation.

Generally accepted principles of tabulation:Such principles of tabulation, particularly ofconstructing statistical tables, can be briefly states as follows:

1. Every table should have a clear, concise and adequate title so as to make the table intelligiblewithout reference to the text and this title should always be placed just above the body of the table.
2. Every table should be given a distinct number to facilitate easy reference.
3. The column headings (captions) and the row headings (stubs) of the table should be clearand brief.
4. The units of measurement under each heading or sub-heading must always be indicated.
5. Explanatory footnotes, if any, concerning the table should be placed directly beneath thetable, along with the reference symbols used in the table.
6. Source or sources from where the data in the table have been obtained must be indicatedjust below the table.
7. Usually the columns are separated from one another by lines which make the table morereadable and attractive. Lines are always drawn at the top and bottom of the table andbelow the captions.
8. There should be thick lines to separate the data under one class from the data underanother class and the lines separating the sub-divisions of the classes should be comparativelythin lines.
9. The columns may be numbered to facilitate reference.
10. Those columns whose data are to be compared should be kept side by side. Similarly,percentages and/or averages must also be kept close to the data.
11. It is generally considered better to approximate figures before tabulation as the same would reduce unnecessary details in the table itself.
12. In order to emphasize the relative significance of certain categories, different kinds of type, spacing and indentations may be used.

13. It is important that all column figures be properly aligned. Decimal points and (+) or (–)signs should be in perfect alignment.
14. Abbreviations should be avoided to the extent possible and ditto marks should not be used in the table.
15. Miscellaneous and exceptional items, if any, should be usually placed in the last row of thetable.
16. Table should be made as logical, clear, accurate and simple as possible. If the data happen to be very large, they should not be crowded in a single table for that would make the tableunwieldy and inconvenient.
17. Total of rows should normally be placed in the extreme right column and that of columns should be placed at the bottom.
18. The arrangement of the categories in a table may be chronological, geographical, alphabetical or according to magnitude to facilitate comparison. Above all, the table must suit the needs and requirements of an investigation.

17.2 Some Problems in Processing

We can take up the following two problems of processing the data for analytical purposes:

(a) *The problem concerning "Don't know" (or DK) responses:* While processing the data, theresearcher often comes across some responses that are difficult to handle. One category of suchresponses may be 'Don't Know Response' or simply DK response. When the DK response group is small, it is of little significance. But when it is relatively big, it becomes a matter of major concernin which case the question arises: Is the question which elicited DK response useless? The answer depends on two points viz., the respondent actually may not know the answer or the researcher mayfail in obtaining the appropriate information. In the first case the concerned question is said to be right and DK response is taken as legitimate DK response. But in the second case, DK responses more likely to be a failure of the questioning process.

How DK responses are to be dealt with by researchers? The best way is to design better type ofquestions. Good rapport of interviewers with respondents will result in minimizing DK responses.But what about the DK responses that have already taken place? One way to tackle this issue is toestimate the allocation of DK answers from other data in the questionnaire. The other way is to keepDK responses as a separate category in tabulation where we can consider it as a separate replycategory if DK responses happen to be legitimate, otherwise we should let the reader make his owndecision. Yet another way is to assume that DK responses occur more or less randomly and as suchwe may distribute them among the other answers in the ratio in which the latter have occurred.Similar results will be achieved if all DK replies are excluded from tabulation and that too withoutinflating the actual number of other responses.

(b) Use or percentages*:* Percentages are often used in data presentation for they simplify numbers,reducing all of them to a 0 to 100 range. Through the use of percentages, the data are reduced in thestandard form with base equal to 100 which fact facilitates relative comparisons. While usingpercentages, the following rules should be kept in view by researchers:

1. Two or more percentages must not be averaged unless each is weighted by the group sizefrom which it has been derived.

2. Use of too large percentages should be avoided, since a large percentage is difficult tounderstand and tends to confuse, defeating the very purpose for which percentages areused.
3. Percentages hide the base from which they have been computed. If this is not kept in view,the real differences may not be correctly read.

4. Percentage decreases can never exceed 100 per cent and as such for calculatingpercentage of decrease, the higher figure should invariably be taken as the base.

5. Percentages should generally be worked out in the direction of the causal-factor in case oftwo-dimension tables and for this purpose we must select the more significant factor out of the two given factors as the causal factor.

17.3 Elements/Types Of Analysis

As stated earlier, by analysis we mean the computation of certain indices or measures along withsearching for patterns of relationship that exist among the data groups. Analysis, particularly in caseof survey or experimental data, involves estimating the values of unknown parameters of the populationand testing of hypotheses for drawing inferences. Analysis may, therefore, be categorized as descriptiveanalysis and inferential analysis (Inferential analysis is often known as statistical analysis).

"*Descriptiveanalysis* is largely the study of distributions of one variable. This study provides us with profiles ofcompanies, work groups, persons and other subjects on any of a multiple of characteristics such assize. Composition, efficiency, preferences, etc."

So this sort of analysis may be in respect of onevariable (described as unidimensional analysis), or in respect of two variables (described as bivariate analysis) or in respect of more than two variables (described as multivariate analysis). In this contextwe work out various measures that show the size and shape of a distribution(s) along with the studyof measuring relationships between two or more variables.

We may as well talk of correlation analysis and causal analysis. *Correlation analysis* studiesthe joint variation of two or more variables for determining the amount of correlation between two ormore variables. *Causal analysis* is concerned with the study of how one or more variables affectchanges in another variable. It is thus a study of functional relationships existing between two ormore variables. This analysis can be termed as regression analysis. Causal analysis is consideredrelatively more important in experimental researches, whereas in most social and business researchesour interest lies in understanding and controlling relationships between variables then with determiningcauses *per se* and as such we consider correlation analysis as relatively more important.

In modern times, with the availability of computer facilities, there has been a rapid developmentof *multivariate analysis* which may be defined as "all statistical methods which simultaneouslyanalyze more than two variables on a sample of observations"3. Usually the following analyses* areinvolved when we make a reference of multivariate analysis:

(a) *Multiple regression analysis:* This analysis is adopted when the researcher has one dependentvariable which is presumed to be a function of two or more independent

variables. The objective ofthis analysis is to make a prediction about the dependent variable based on its covariance with all theconcerned independent variables.

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

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

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

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

17.4 Statistics in Research

The role of statistics in research is to function as a tool in designing research, analyzing its data anddrawing conclusions therefrom. Most research studies result in a large volume of raw data whichmust be suitably reduced so that the same can be read easily and can be used for further analysis.Clearly the science of statistics cannot be ignored by any research worker, even though he may nothave occasion to use statistical methods in all their details and ramifications. Classification andtabulation, as stated earlier, achieve this objective to some extent, but we have to go a step furtherand develop certain indices or measures to summarize the collected/classified data. Only after thiswe can adopt the process of generalization from small groups (i.e., samples) to population. If fact,there are two major areas of statistics viz., descriptive statistics and inferential statistics. *Descriptivestatistics* concern the development of certain indices from the raw data, whereas inferential statisticsconcern with the process of generalization. *Inferential statistics* are also known as sampling statisticsand are mainly concerned with two major type of problems:

(i) the estimation of population parameters,
and (ii) the testing of statistical hypotheses.
The important statistical measures that are used to summarize the survey/research data are:
(1) measures of central tendency or statistical averages;
(2) measures of dispersion;
(3) measures
of asymmetry (skewness);
(4) measures of relationship; and
(5) other measures.

Amongst the measures of central tendency, the three most important ones are the arithmeticaverage or mean, median and mode. Geometric mean and harmonic mean are also sometimes used.From among the measures of dispersion, variance, and its square root—the standard deviationare the most often used measures. Other measures such as mean deviation, range, etc. are alsoused. For comparison purpose, we use mostly the coefficient of standard deviation or the coefficient of variation.

In respect of the measures of skewness and kurtosis, we mostly use the first measure of skewnessbased on mean and mode or on mean and median. Other measures of skewness, based on quartilesor on the methods of moments, are also used sometimes. Kurtosis is also used to measure thepeakedness of the curve of the frequency distribution.

Amongst the measures of relationship, Karl Pearson's coefficient of correlation is the frequentlyused measure in case of statistics of variables, whereas Yule's coefficient of association is used incase of statistics of attributes. Multiple correlation coefficient, partial correlation coefficient, regressionanalysis, etc., are other important measures often used by a researcher.

Index numbers, analysis of time series, coefficient of contingency, etc., are other measures thatmay as well be used by a researcher, depending upon the nature of the problem under study.We give below a brief outline of some important measures (our of the above listed measures)often used in the context of research studies.

17.5 Measures of Central Tendency

Measures of central tendency (or statistical averages) tell us the point about which items have atendency to cluster. Such a measure is considered as the most representative figure for the entiremass of data. Measure of central tendency is also known as statistical average. Mean, median andmode are the most popular averages. *Mean,* also known as arithmetic average, is the most common
measure of central tendency and may be defined as the value which we get by dividing the total ofthe values of various given items in a series by the total number of items. we can work it out as under:

$$\text{Mean (or } \bar{X})^* = \frac{\Sigma X_i}{n} = \frac{X_1 + X_2 + \ldots + X_n}{n}$$

where $\bar{X}$ = The symbol we use for mean (pronounced as X bar)

Σ = Symbol for summation

X_i = Value of the ith item X, $i = 1, 2, \ldots, n$

n = total number of items

In case of a frequency distribution, we can work out mean in this way:

$$\bar{X} = \frac{\Sigma f_i X_i}{\Sigma f_i} = \frac{f_1 X_1 + f_2 X_2 + \ldots + f_n X_n}{f_1 + f_2 + \ldots + f_n = n}$$

Sometimes, instead of calculating the simple mean, as stated above, we may workout the weighted mean for a realistic average. The weighted mean can be worked out as follows:

$$\bar{X}_w = \frac{\Sigma w_i X_i}{\Sigma w_i}$$

where $\bar{X}_w$ = Weighted item

w_i = weight of ith item X

X_i = value of the ith item X

Mean is the simplest measurement of central tendency and is a widely used measure. Its chiefuse consists in summarizing the essential features of a series and in enabling data to be compared. Itis amenable to algebraic treatment and is used in further statistical calculations. It is a relativelystable measure of central tendency. But it suffers from some limitations viz., it is unduly affected byextreme items; it may not coincide with the actual value of an item in a series, and it may lead towrong impressions, particularly when the item values are not given with the average. However,mean is better than other averages, especially in economic and social studies where direct quantitative measurements are possible.

Median is the value of the middle item of series when it is arranged in ascending or descendingorder of magnitude. It divides the series into two halves; in one half all items are less than median,whereas in the other half all items have values higher than median. If the values of the items arrangedin the ascending order are: 60, 74, 80, 90, 95, 100, then the value of the 4th item viz., 88 is the valueof median. We can also write thus:

* If we use assumed average A, then mean would be worked out as under:

$\bar{X} = A + \frac{\Sigma(X_i - A)}{n}$ or $\bar{X} = A + \frac{\Sigma f_i(X_i - A)}{\Sigma f_i}$, in case of frequency distribution. This is also known as short cut method of finding $\bar{X}$.

$$\text{Median } (M) = \text{Value of } \left(\frac{n+1}{2}\right)\text{th item}$$

Median is a positional average and is used only in the context of qualitative phenomena, forexample, in estimating intelligence, etc., which are often encountered in sociological fields. Median isnot useful where items need to be assigned relative importance and weights. It is not frequently used in sampling statistics.

Mode is the most commonly or frequently occurring value in a series. The mode in a distributionis that item around which there is maximum concentration. In general, mode is the size of the itemwhich has the maximum frequency, but at items such as item may not be mode on account of theeffect of the frequencies of the neighboring items. Like median, mode is a positional average and isnot affected by the values of extreme items. It is, therefore, useful in all situations where we want toeliminate the effect of extreme variations. Mode is particularly useful in the study of popular sizes.

For example, a manufacturer of shoes is usually interested in finding out the size most in demand sothat he may manufacture a larger quantity of that size. In other words, he wants a modal size to bedetermined for median or mean size would not serve his purpose. but there are certain limitations ofmode as well. For example, it is not amenable to algebraic treatment and sometimes remainsindeterminate when we have two or more model values in a series. It is considered unsuitable incases where we want to give relative importance to items under consideration.

Geometric mean is also useful under certain conditions. It is defined as the *n*th root of theproduct of the values of *n* times in a given series. Symbolically, we can put it thus:

$$\text{Geometric mean (or G.M.)} = \sqrt[n]{\pi X_i}$$

$$= \sqrt[n]{X_1 \cdot X_2 \cdot X_3 \ldots X_n}$$

where

G.M. = geometric mean,

n = number of items.

X_i = ith value of the variable X

π = conventional product notation

For instance, the geometric mean of the numbers, 4, 6, and 9 is worked out as

$$\text{G.M.} = \sqrt[3]{4.6.9}$$

The most frequently used application of this average is in the determination of average per cent of change i.e., it is often used in the preparation of index numbers or when we deal in ratios.

Harmonic mean is defined as the reciprocal of the average of reciprocals of the values of items of a series. Symbolically, we can express it as under:

$$\text{Harmonic mean (H.M.)} = \text{Rec.}\frac{\sum \text{Rec}X_i}{n}$$

$$= \text{Rec.}\frac{\text{Rec.}X_1 + \text{Rec.}X_2 + \ldots + \text{Rec.}X_n}{n}$$

where

H.M. = Harmonic mean
Rec. = Reciprocal
X_i = ith value of the variable X
n = number of items

For instance, the harmonic mean of the numbers 4, 5, and 10 is worked out as

$$\text{H.M.} = \text{Rec}\frac{1/4 + 1/5 + 1/10}{3} = \text{Rec}\ \frac{\frac{15+12+6}{60}}{3}$$

$$= \text{Rec}\left(\frac{33}{60} \times \frac{1}{3}\right) = \frac{60}{11} = 5.45$$

Harmonic mean is of limited application, particularly in cases where time and rate are involved.

The harmonic mean gives largest weight to the smallest item and smallest weight to the largest item.As such it is used in cases like time and motion study where time is variable and distance constant.From what has been stated above, we can say that there are several types of statistical averages.Researcher has to make a choice for some average. There are no hard and fast rules for theselection of a particular average in statistical analysis for the selection of an average mostly dependson the nature, type of objectives of the research study. One particular type of average cannot betaken as appropriate for all types of studies. The chief characteristics and the limitations of thevarious averages must be kept in view; discriminate use of average is very essential for sound statistical analysis.

17.6 Measures of Dispersion

An average can represent a series only as best as a single figure can, but it certainly cannot revealthe entire story of any phenomenon under study. Especially it fails to give any idea about the scatter ofthe values of items of a variable in the series around the true value of average. In order to measurethis scatter, statistical devices called measures of dispersion are calculated. Important measures ofdispersion are (a) range, (b) mean deviation, and (c) standard deviation.

(a) *Range* is the simplest possible measure of dispersion and is defined as the difference between the values of the extreme items of a series. Thus,

$$\text{Range} = \begin{pmatrix}\text{Highest value of an}\\ \text{item in a series}\end{pmatrix} - \begin{pmatrix}\text{Lowest value of an}\\ \text{item in a series}\end{pmatrix}$$

The utility of range is that it gives an idea of the variability very quickly, but the drawback is that range is affected very greatly by fluctuations of sampling. Its value is never stable, being based ononly two values of the variable. As such, range is mostly used as a rough measure of variability andis not considered as an appropriate measure in serious research studies.

(b) *Mean deviation* is the average of difference of the values of items from some average of theseries. Such a difference is technically described as deviation. In calculating mean deviation weignore the minus sign of deviations while taking their total for obtaining the mean deviation. Meandeviation is, thus, obtained as under:'

Mean deviation from mean $(\delta_{\bar{X}}) = \dfrac{\Sigma|X_i - \bar{X}|}{n}$, if deviations, $|X_i - \bar{X}|$, are obtained from arithmetic average.

or

Mean deviation from median $(\delta_m) = \dfrac{\Sigma|X_i - M|}{n}$, if deviations, $|X_i - M|$, are obtained from median

or

Mean deviation from mode $(\delta_z) = \dfrac{\Sigma|X_i - Z|}{n}$, if deviations, $|X_i - Z|$, are obtained from mode.

where δ = Symbol for mean deviation (pronounced as delta);
X_i = ith values of the variable X;
n = number of items;
$\bar{X}$ = Arithmetic average;
M = Median;
Z = Mode.

When mean deviation is divided by the average used in finding out the mean deviation itself, theresulting quantity is described as the *coefficient of mean deviation*. Coefficient of mean deviationis a relative measure of dispersion and is comparable to similar measure of other series. Meandeviation and its coefficient are used in statistical studies for judging the variability, and therebyrender the study of central tendency of a series more precise by throwing light on the typicalness ofan average. It is a better measure of variability than range as it takes into consideration the values ofall items of a series. Even then it is not a frequently used measure as it is not amenable to algebraic process.

(c) *Standard deviation* is most widely used measure of dispersion of a series and is commonly denoted by the symbol s ' (pronounced as sigma). Standard deviation is defined as the square-rootof the average of squares of deviations, when such deviations for the values of individual items in aseries are obtained from the arithmetic average. It is worked out as under:

$$\text{Standard deviation}^{*}(\sigma) = \sqrt{\frac{\Sigma\left(X_i - \bar{X}\right)^2}{n}},$$

*If we use assumed average, A, in place of $\bar{X}$ while finding deviations, then standard deviation would be worked out as under:

$$\sigma = \sqrt{\frac{\Sigma(X_i - A)^2}{n} - \left(\frac{\Sigma(X_i - A)}{n}\right)^2}$$

Or

$$\sigma = \sqrt{\frac{\Sigma f_i(X_i - A)^2}{\Sigma f_i} - \left(\frac{\Sigma f_i(X_i - A)}{\Sigma f_i}\right)^2}, \text{ in case of frequency distribution.}$$

This is also known as the short-cut method of finding σ.

Or

$$\text{Standard deviation}(\sigma) = \sqrt{\frac{\Sigma f_i\left(X_i - \bar{X}\right)^2}{\Sigma f_i}}, \text{ in case of frequency distribution}$$

where *fi* means the frequency of the *i*th item.

When we divide the standard deviation by the arithmetic average of the series, the resulting quantity is known as *coefficient of standard deviation which* happens to be a relative measure and is oftenused for comparing with similar measure of other series. When this coefficient of standard deviationis multiplied by 100, the resulting figure is known as *coefficient of variation*. Sometimes, we workout the square of standard deviation, known as *variance*, which is frequently used in the context of analysis of variation.

The standard deviation (along with several related measures like variance, coefficient of variation, etc.) is used mostly in research studies and is regarded as a very satisfactory measure of dispersionin a series. It is amenable to mathematical manipulation because the algebraic signs are not ignoredin its calculation (as we ignore in case of mean deviation). It is less affected by fluctuations ofsampling. These advantages make standard deviation and its coefficient a very popular measure ofthe scatteredness of a series. It is popularly used in the context of estimation and testing of hypotheses.

17.7 Summary

Data analysis is a process of inspecting, cleansing, transforming, and modelling data with the goal of discovering useful information, informing conclusions, and supporting decision-making. Data analysis has multiple facets and approaches, encompassing diverse techniques under a variety of names, and is used in different business, science, and social science domains. In today's business world, data analysis plays a role in making decisions more scientific and helping businesses operate more effectively. Data mining is a particular data analysis

technique that focuses on statistical modelling and knowledge discovery for predictive rather than purely descriptive purposes, while business intelligence covers data analysis that relies heavily on aggregation, focusing mainly on business information.In statistical applications, data analysis can be divided into descriptive statistics, exploratory data analysis (EDA), and confirmatory data analysis (CDA).EDA focuses on discovering new features in the data while CDA focuses on confirming or falsifying existing hypotheses. Predictive analytics focuses on the application of statistical models for predictive forecasting or classification, while text analytics applies statistical, linguistic, and structural techniques to extract and classify information from textual sources, a species of unstructured data. All of the above are varieties of data analysis

17.8 key words

Tabulation- When a mass of data has been assembled, it becomes necessary for the researcherto arrange the same in some kind of concise and logical order. This procedure is referred to astabulation

Editing-Editing of data is a process of examining the collected raw data (specially in surveys) todetect errors and omissions and to correct these when possible

Coding- Coding refers to the process of assigning numerals or other symbols to answers so thatresponses can be put into a limited number of categories or classes

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

Central editing- *It* should take place when all forms or schedules have been completed and returnedto the office.

Canonical analysis-This analysis can be used in case of both measurable and non-measurablevariables for the purpose of simultaneously predicting a set of dependent variables from their jointcovariance with a set of independent variables.

17.9SelfAssessment Questions

1. Define Processing of data? Discuss the Classification according to the class Interviews
2. Describe the Measures of Central Tendency
3. Explain the Measures of Dispersion

17.10 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri LJacksonCenage Learning Publications, Third Edition, 2009

2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.

3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.

4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit Kumar Sage Publications 2015

5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, andDipayan Das, Springer Publications, 2018.

6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Edu creation Publishing 2019.

7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019

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LESSON-18

REPORT WRITING

Learning Objectives

- ✓ To understand the features of Research report
- ✓ To know the preparation of report
- ✓ To discuss the different steps in writing report

Structure

18.0 Introduction

A report is a more highly structured form of writing than an essay, and is designed so that it can be read quickly and accurately; though reports are not necessarily read from beginning to end. Structure and convention in written reports stress the process by which the information was gathered as much as the information itself. Reports should be organized for the convenience of the intended reader. Reports are written on a wide range of subjects for a wide variety of reasons. Before writing any report, you should identify the objective and the preferred conventions of structure and presentation. This is as true for reports you write at university as it is for reports written in employment. All reports attempt to communicate findings for one reason or another, whether to inform decision makers, change public opinion or maintain a record of development.

Whenever you write a report you must bear in mind why you are writing and who you are writing for. All reports have an intended reader

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.

Research report is considered a major component of the research study for the research task remains incomplete till the report has been presented and/or written. As a matter of fact even the most brilliant hypothesis, highly well designed and conducted research study, and the most striking generalizations and findings are of little value unless they are effectively communicated to others. The purpose of research is not well served unless the findings are made known to others. Research results must invariably enter the general store of knowledge. All this explains the significance of writing research report. There are people who do not consider writing of report as an integral part of the research process. But the general opinion is in favor of treating the presentation of research results or the writing of report as part and parcel of the research project. Writing of report is the last step in a research study and requires a set of skills somewhat different from those called for in respect of the earlier stages of research. This task should be accomplished by the researcher without most care; he may seek the assistance and guidance of experts for the purpose.

18.1 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 person and avoid use of pronouns like, 'I', 'Me', 'My' etc.
5. The report should facilitate the reader with systematic presentation like proper headings, title, 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.

18.2 Different Steps in Writing Report

Research reports are the product of slow, painstaking, accurate inductive work. The usual steps

involved in writing report are:
(a) logical analysis of the subject-matter;
(b) preparation of the final outline;
(c) preparation of the rough draft;
(d) rewriting and polishing;
(c) preparation of the final bibliography; and
(f) writing the final draft.

Though all these steps are self-explanatory, yet a brief mention of each one of these will be appropriate for better understanding.

Logical analysis of the subject matter: It is the first step which is primarily concerned with the development of a subject. There are two ways in which to develop a subject
(a) logically and
(b) chronologically.

The logical development is made on the basis of mental connections and associations between the one thing and another by means of analysis. Logical treatment often consists in developing the material from the simple possible to the most complex structures. Chronological development is based on a connection or sequence in time or occurrence. The directions for doing or making something usually follow the chronological order.

18.2.1 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."

18.2.2 Preparation of the rough draft

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

18.2.3 Rewriting and polishing of the rough draft:

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

to the fact that in his rough draft he has been consistent or not. He should check them mechanics of writing—grammar, spelling and usage.

18.2.4 Preparation of the final bibliography

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

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

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

Example

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

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

1. Name of the author, last name first.
2. Title of article, in quotation marks.
3. Name of periodical, underlined to indicate italics.
4. The volume or volume and number.
5. The date of the issue.
6. The pagination.

Example

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

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

18.2.6 Writing the final draft

This constitutes the last step. The final draft should be written in a concise and objective style and in simple language, avoiding vague expressions such as "it seems", "there may be", and

the like ones. While writing the final draft, the researcher must avoid abstract terminology and technical jargon. Illustrations and examples based on common experiences must be incorporated in the final draft as they happen to be most effective in communicating the research findings to others. A research report should not be dull, but must enthuse people and maintain interest and must show originality. It must be remembered that every report should be an attempt to solve some intellectual problem and must contribute to the solution of a problem and must add to the knowledge of both the researcher and the reader.

18.3 Layout of The Research Report

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

18.3.1 Preliminary Pages

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

18.3.2 Main Text

The main text provides the complete outline of the research report along with all details. Title of the research study is repeated at the top of the first page of the main text and then follows the other details on pages numbered consecutively, beginning with the second page. Each main section of the report should begin on a new page. The main text of the report should have the following sections:

(i) Introduction;
(ii) Statement of findings and recommendations;
(iii) The results;
(iv) The implications drawn from the results; and
(v) The summary.

18.3.2 (i) Introduction

The purpose of introduction is to introduce the research project to the readers. It should contain a clear statement of the objectives of research i.e., enough background should be given to make clear to the reader why the problem was considered worth investigating. A brief summary of other relevant research may also be stated so that the present study can be

seen in that context. The hypotheses of study, if any, and the definitions of the major concepts employed in the study should be explicitly stated in the introduction of the report.

The methodology adopted in conducting the study must be fully explained.

The scientific reader would like to know in detail about such thing: How was the study carried out? What was its basic design?

If the study was an experimental one, then what were the experimental manipulations?

If the data were collected by means of questionnaires or interviews, then exactly what questions were asked (The questionnaire or interview schedule is usually given in an appendix)?

If measurements were based on observation, then what instructions were given to the observers?

Regarding the sample used in the study the reader should be told:

Who were the subjects?

How many were there?

How were they selected?

All these questions are crucial for estimating the probable limits of generalizability of the findings. The statistical analysis adopted must also be clearly stated. In addition to all this, the scope of the study should be stated and the boundary lines be demarcated. The various limitations, under which the research project was completed, must also be narrated.

18.3.2(ii) Statement of findings and recommendations:

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

18.3.2(iii) Results

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

18.3.2 (iv) Implications of the results

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

(a) A statement of the inferences drawn from the present study which may be expected to apply in similar circumstances.
(b) The conditions of the present study which may limit the extent of legitimate generalizations of the inferences drawn from the study.
(c) The relevant questions that still remain unanswered or new questions raised by the study along with suggestions for the kind of research that would provide answers for them. It is considered a good practice to finish the report with a short conclusion which summarizes and recapitulates the main points of the study. The conclusion drawn from the study should be clearly related to the hypotheses that were stated in the introductory section. At the same time, a forecast of the probable future of the subject and an indication of the kind of research which needs to be done in that particular field is useful and desirable.

18.3.3 (v) Summary

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

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

18.4 Common Weaknesses in Report

It is important to know the general mistakes committed in report writing and also the points to consider while finalizing the text.
i) **Endless Description** without interpretation is a pitfall. Tables need conclusions, not detailed presentation of all numbers or percentages in the cells which readers can see for themselves. The chapter discussion, in particular, needs comparison of data, highlighting of unexpected results, your **Report Writing** own or others' opinions on problems discovered, weighing of pro's and con's of possible solutions. Yet, too often the discussion is merely a dry summary of findings.
ii) **Neglect of Qualitative Data** is also quite common. Quotes of informants as illustration of your findings and conclusions make your report lively. They also have scientific value in allowing the reader to draw his/her own conclusions from the data you present. (Assuming you are not biased in your presentation!). Presentation of important photographs also makes report attractive and explains facts better.
iii) Sometimes qualitative data (e.g., open opinion questions) are just coded and counted like quantitative data, **without interpretation,** whereas they may provide interesting illustrations of reasons for the behavior of informants or of their attitudes. This is serious maltreatment of data that needs correction.

Style of writing Keep it simple. Avoid sentences that are too long and eliminate unnecessary jargon. Your tutor will be able to advise whether the report should be written in the

'active' or 'passive' voice. The active voice reads as follows: 'I recommend ...' The passive voice reads: 'It is recommended that ...' The active voice allows you to write short, punchy sentences. The passive appears more formal and considered and is more suitable for academic writing. Avoid mixing the two voices. In which voice will you be expected to write? Layout Most reports have a progressive numbering system. The main sections are given single numbers - 1, 2, 3 and so on. Subsections are given a decimal number- 1.1, 1.2, 1.3 etc. Subsections can be further divided- 1.1.1, 1.1.2, 1.1.3, 1.2.1, 1.2.2 etc. Redrafting and checking Once you have written the first draft of your report you will need to check it through. It is probably sensible to leave it on your desk for a day or so if you have the time. This will make a clear break from the intensive writing period, allowing you to view your work more objectively. Assess your work by re-reading particularly focusing on:

• structure,
• content,
• Style.

18.5 Summary

The last part of any research is writing the research report. The report writing is an art as well as science. You have to identify who will be reading your report and the report should be prepared accordingly. A summary of report in the beginning is important. The report layout plan should be comprehensive and all aspects of report including realistic recommendations and future directions of research should be described.

18.6 Key words

Research Report- A research report is a publication that reports on the findings of a research project or alternatively scientific observations on or about a subject.

Preliminary pages - In its preliminary pages the report should carry a *title and date,* followed by acknowledgements in the form of 'Preface' or 'Foreword'

18.7 Self -Assessment Questions

1. Discuss the features of Research report?
2. Describe the Different steps in writing report?
3. Examine the Layout of Research Report?

18.8 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.Jackson Cengage Learning Publications, Third Edition, 2009

2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.

3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.

4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit Kumar Sage Publications 2015

5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, and Dipayan Das, Springer Publications, 2018.

6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.

7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019

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LESSON-19

LAY OUT OF THE RESEARCH REPORT

Learning Objectives

- ✓ To understand the Data Collection and Analysis
  To study Main text and chapter wise Discussion
- ✓ To Learn the style and layout of the report

Structure

19.0 Introduction

Once the data collection and analysis work is over, the researcher will start writing the research report. Social and development research reports need to have a logical, clear structure

be to the point use simple language, and have a pleasant layout Just as an architect has to draw a layout plan for a house that is being designed, you first have to make an outline for your report. This outline will contain a head, a body, and a tail. The head consists of a description of your problem within its context (the country and research area), the objectives of the study and the methodology followed. This part should not comprise more than one quarter of the report, otherwise it becomes top-heavy. The body will form the bigger part of your report: it will contain the research findings. The tail, finally, consists of the discussion of your data, conclusions, and recommendations.

Before you start writing, it is essential to group and review the data you have analyzed by objective. Check whether all data has indeed been processed and analyzed as you planned in the research protocol/proposal which is duly approved. Draw major conclusions and relate these to the research literature. Again, you may be inspired to go back to your raw data and refine your analysis, or to search for additional literature to answer questions that the analysis of your data may evoke. Compile the major conclusions and tables or quotes from qualitative data related to each specific objective. You are now ready to draft the report.

The research report will have, broadly, three parts.

Part I : The Preliminary Pages

Part II : The Main Text of the Research Report

Part III : The End Matter

The Preliminary Pages Of Research Report

The preliminary pages of the research report should have the following main constituents.
19.1 Data Collection and Analysis

• Title and cover page

• A foreword

• Preface

• Acknowledgements

• Table of contents

• List of tables

• List of figures

• List of appendices

• List of abbreviations

• Executive Summary

19.1.1 Title and Cover page

The cover page should contain the title, the names of the authors with their designations, the institution that is publishing the report with its logo, (e.g., Health Systems Research Unit, Ministry of Health), the month, and the year of publication. The title could consist of a challenging statement or question, followed by an informative subtitle covering the content of the study and indicating the area where the study was implemented. However, this is suggestive in nature and should not be considered standard. It would be appropriate if the cover page is designed by an expert in computer graphics who may be suggested to include some important photograph related to identity of organization or problem under study or from the field within the background. Design software may be used. An example of a title of a research report is given in the box below.

Title of the research report

Labour Migration and its Implication on Rural Economy of Indo-Gangetic Plains of India

19.1.2 Foreword

A foreword is usually a short piece of writing found at the beginning of a book or other piece of literature, before the introduction. This may or may not be written by the primary author of the work. Often, a foreword will tell of some interaction between the writer of the foreword and the story, or, the writer of the story. A foreword to later editions of a work often explains how the new edition differs from previous ones. Unlike a preface, a foreword is always signed. An example of a foreword is given in the box below.

Foreword

Migration of all kinds, particularly income seeking migration across state boundaries, has attracted much attention in recent scholarly and policy literature. This study provides sufficient evidences of the effect of labour migration, more specifically, male outmigration on the rural economy of the Indo-Gangetic region. The number of districts of high and moderately high male outmigration has increased. The findings reveal the holistic scenario of migration led changes in agricultural and household domains. I am sure that this volume would be of great interest to researchers, policy makers, and development agencies while framing strategies for agricultural and rural development.

19.1.3 Preface Report Writing

A preface, by contrast, is written by the author of the book. A preface generally covers the story of how the book came into being, or how the idea for the book was developed; this is often followed by thanks and acknowledgments to people who were helpful to the author during the time of writing. A preface is an introduction to a book or other literary work written by the work's author. An example of preface is given in the box below.

19.1.4 Acknowledgements

It is good practice to thank those who supported you technically or financially in the design and implementation of your study. You should not forget to thank your research guide and your employer, too, who has allowed you to invest time in the study; and, the respondents may be acknowledged. You should not forget to acknowledge the contribution of computer professionals, library staff, local officials, and the community at large that provided the

Information. Acknowledgements are usually placed right after the title page or at the end of the report, before the references. An example of acknowledgement is given in the box below.

Acknowledgements

I take this opportunity to thank the Indian Council of Agricultural Research for providing funds and facilities for the project. I offer my sincere thanks to the Director, Indian Agricultural Research Institute for his encouragement and support for pursuing this study. I am also grateful to the head, Division of Agricultural Economics, IARI for providing all needed support, encouragement, and technical guidance. All the Research Associates, Senior Research Fellows and technical assistants working under the project deserve special appreciation for their hard work and sincere efforts in completing this project.

19.1.5 Table of Contents

A table of contents is essential. It provides the reader a quick overview of the chapters with major sections and sub sections of your report, and page references, so that the reader can go through the report in a different order, or skip certain sections. The sections and sub sections within each chapter may be given numbers that are specific to the chapter. For example, a section in chapter III may be given no as 3.1; and, a sub section as 3.1.1. An example of a table of contents is given below.

Contents

19.1.6 List of Tables

If you have many tables or figures, it is essential to list these also in a table of contents with formatted with page numbers. The initial letters of the key words in the title are capitalized and no terminal punctuation is used. An example is given below.

List of Tables

19.1.7 List of Figures

The list of figures appears in the same format as the list of tables, titled List of Figures.

19.1.8 List of Appendices

The appendices will contain any additional information that the researcher have collected while carrying out the study. It may be a questionnaire, a letter of appreciation, a government notification, etc. The list of appendices appears in the same format as the list of tables.

19.1.9 List of Abbreviations (optional) Report Writing

If abbreviations or acronyms are used in the report, these should be stated in full in the text the first time that they are mentioned. If there are many, they should be listed in alphabetical order as well. The list can be placed before the first chapter of the report.
The table of contents and lists of tables, figures, abbreviations should be prepared last, as only then can you include the page numbers of all chapters and sections, sub-sections in the table of contents. Then, you can also finalize the numbering of figures and tables and include all abbreviations. An Example of a List of Abbreviations follows.

x) List of Abbreviations

List of Abbreviations

AI	:	Agreement Index
CMIE	:	Centre for Monitoring of Indian Economy
CV	:	Coefficient of Variation
DEA	:	Data Envelopment Analysis

19.1.10 Executive Summary

The summary should be written only *after* the first or even the second draft of the report has been completed. It should contain

• a very brief description of the problem (**Why** this study was needed)— the main
• objectives (**What** has been studied)
• the place of study (**Where**)
• the type of study and methods used (**How**)
• the major findings and conclusions
• the major (or all) recommendations.

The summary will be the first (and for busy programme manager/decision makers most likely the only) part of your study that will be read. Therefore, it demands thorough reflection

and is time consuming. Several drafts may have to be made, each discussed by the research team as a whole.

As you may have collaborated with various groups during the drafting and implementation of your research proposal, you may consider writing **different summaries** for each of these groups. For example, you may prepare different summaries for policymakers and programme managers, for implementing staff of lower levels, for community members, or for the public at large (newspaper, TV). In a later stage, you may write articles in scientific journals. In this section, we discussed about the types of report and the contents to be included in the preliminary pages of research report. Now answer the following questions.

Main Components Or Chaptering Of Research Report

19.2 The Main Text includes the following chapters

a) Introduction
b) Review of Literature
c) Methodology
d) Research Findings
e) Discussion
f) Conclusion and Recommendations
g) Summary

19.2.1 Chapter 1: Introduction

The introduction is a relatively easy part of the report that can best be written after a first draft of the findings has been made. It should certainly contain some relevant (environmental/ administrative/ economic/ social) background data and information about the topic on which you are carrying out research for example if you are doing research on primary education, then a brief about the status of primary education, such as their number, state-wise break up, expenditure on primary education, etc., need to be described. You may make additions to the corresponding section in your research proposal, including additional literature, and use it for your report Then, the statement of the problem should follow, again, revised from your Report Writing research proposal with additional comments and relevant literature collected during the implementation of the study. It should contain a paragraph on what you hope/ hoped to achieve from the results of the study. Enough background should be given to make clear to the reader why the problem was considered worth investigating.

The general and specific objectives should also be included in this chapter. If necessary, you can adjust them slightly for style and sequence. However, you should not change their basic nature. If you have not been able to meet some of the objectives of the project, this should be stated in the methodology section ,and in the discussion of the findings. The objectives form the heart of your study.

They determined the methodology you chose and will determine how you structure the reporting of your findings.

19.2.2 Chapter 2: Review of Literature

Global literature can be reviewed in the introduction to the statement of the problem if you have selected a problem of global interest. Otherwise, relevant literature from individual countries may follow as a separate literature review after the statement of the problem. A

literature review is a body of text that aims to review the critical points of current knowledge and or methodological approaches on a particular topic. Literature reviews are secondary sources, and, as such, do not report any new or original experimental work. Its ultimate goal is to bring the reader up to date with current literature on a topic, and forms the basis for another goal, such as future research that may be needed in the area.

A well-structured literature review is characterized by a logical flow of ideas; current and relevant references with consistent, appropriate referencing style; proper use of terminology; and an unbiased and comprehensive view of the previous research on the topic. One research study should be presented in one paragraph and it should mention the name of the researcher, year of study, topic and area of study, sample size, main objectives, and findings of the study. An example of a review is given in the box below.

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Review of Literature

Singh (2008) conducted a study on labour out-migration from the Indo-Gangetic plains of India. The study provides sufficient evidence of the effect of male out-migration on the rural economy of the Indo-Gangetic plains of India. Male out-migration has resulted in gender role reversal in terms of decision making on important household and farm issues. Besides, the women of the migrant households had to take up many male specific activities, like land preparation, seed selection, broadcasting, irrigation, and herbicide application. The study also proved that the crop returns of non-migrant households were significantly higher than that of migrant households in case of both rice and wheat cultivation. The technical, allocative and economic efficiencies of non-migrant households was much higher that the migrant households in both rice and wheat cultivation.

19.2.3 Chapter 3: Methodology

The methodology adopted in conducting the study must be fully explained. The scientific reader would like to know about the basic design of the study, the methods of data collection, information regarding the sample used in the study, the statistical analysis adopted and the factors limiting the study The methodology section should include a description of

a. the study type
b. major study themes or variables (a detailed list of variables on which data was collected may be annexed)
c. the study/ target population(s), sampling method(s) and the size of the sample(s)
d. data collection techniques used for the different study populations
e. duration of data collection
f. how the data was collected and by whom
g. procedures used for data analysis, including statistical tests (if applicable)
h. any constraints and its management
i. limitations of the study.

If you have deviated from the original study design presented in your researchproposal, you should explain to what extent you did so, and why. Theconsequences of this deviation for meeting certain objectives of your study shouldbe indicated. If the quality of some of the data is weak, resulting in possible biases, this should be described as well under the heading 'limitations of the study'. An example of methodology is given in the box below.

Methodology

Data Collection/Sample

A micro level study based on primary cross section data was designed to attain the objectives of this project. The survey was conducted in three states; Bihar, Uttar Pradesh and Punjab. A systematic interview schedule was used to collect information on various aspects of labour migration and its impact on rural economy of Indo-Gangetic Plains of India. The data was collected for 200 families with migration and 200 families without migrating members.

Analytical tools

Various statistical tools were used in the analysis of data. Those are mean, standard deviation, correlation, t-test, and regression.

19.2.4 Chapter 4: Research Findings

A detailed presentation of the findings of the study with supporting data in the form of tables and charts, together with a validation of the results is the next step in writing the main text of the report. The result section of the study should contain the statistical summaries and reductions of data, rather than raw data. All the results should be presented in a logical sequence and split into readily identifiable sections.

The systematic presentation of your findings in relation to the research objectives is the crucial part of your report.

The list of data by objectives will help you to decide how to organize the presentation of data. The decision concerning where to put what can best be made after all data have been fully processed and analyzed, and before the writing **Report Writing** starts.

When all data have been analyzed, a detailed **outline** has to be made for the presentation of the findings. This will help the decision-making on how to organize the data, and is *an absolute precondition for optimal division of tasks among group members in the writing process*. At this stage you might as well prepare an outline for the whole report, taking the main components of a research report as a point of departure.

An **outline** should contain

a. the headings of the main sections of the report
b. the headings of subsections
c. the points to be made in each section
d. the list of tables, figures and/or quotes to illustrate each section.

The outline for the chapter on findings will predictably be the most elaborate. The first section under findings is usually a description of the study/ target population. When different study populations have been studied, you should provide a short description of each group before you present the data pertaining to these informants.

Then, depending on the study design, you may provide more information on the problem you studied (size, distribution, characteristics). Thereafter, in an analytics tudy, the degree to which different independent variables influence the problem will be discussed.

For better understanding, an example of how the research findings are tabulated and presented in the form of findings is given in the following table. An analysis of table 5.1 is given in the box below.

Table 5.1: Social Characteristics of Migrants **(Percentage)**

Particulars	Bihar	UP	Overall
Number	**245**	**308**	**553**
i) Age Profile			
Up to 30 Years	69.80	56.49	62.39
31 to 45 Years	26.53	35.39	31.46
Above 46 Years	3.68	8.11	6.15
ii) Literacy Status			
Illiterate	33.88	19.16	25.50
Primary	50.20	29.87	38.00
Matriculation and above	15.92	50.97	36.48
iii) Social Status			
Upper Caste	22.86	9.42	15.37
SC/ST/BC	77.15	90.58	84.63

Analysis of Table 5.1

The socio-economic characteristics of the migrants are depicted in Table 3. The table clearly shows that in UP there had been 308 migrants from 200 households while Bihar had only 245 migrants from 200 households. On an average, 62 percent of the migrants were below 30 years of age with a higher percentage of younger migrants from Bihar than from UP. Most of the migrants from both UP and Bihar were literate, and only 25 per cent of the total migrants from both UP and Bihar were illiterate. Most of the migrants belonged to a schedule caste or backward class, the percentage being higher in UP (91%) compared with Bihar (77%).

Tables and **Figures** in the text should be numbered and have clear titles. It is advisable to first use the number of the section to which the table belongs. In the final draft you may decide to number tables and figures in sequence. It is appreciated in case some pictures from the field are also appropriately presented to give visual presentation of the field information. Include only

those tables and figures that present main findings and need more elaborate discussion in the text. Others may be put in annexes, or, if they don't reveal interesting points, be omitted.
It is advisable to involve statistician/data analyst from the very beginning and in each process of the research so that he may provide meaningful tables and himself judge irrelevant findings.

Note: It is unnecessary to describe in detail a table that you include in the report. Only present the main conclusions.

The first draft of your findings is never final. Therefore, you might concentrate primarily on content rather than on style. Nevertheless, it is advisable to structure the text from the beginning in paragraphs and to attempt to phrase each sentence clearly and precisely.

19.2.5 Chapter 5: Discussion

The findings can now be discussed by objective or by cluster of related variables or themes, which should lead to conclusions and possible recommendations. The discussion may also include findings from other related studies that support or contradict your own. For easy understanding, the discussion of the table given in findings is given in the box below.

The socio-economic characteristics of the migrants are depicted in Table 3. The number of migrants gives an idea about frequency of migrants in a household. In UP, the percentage of households having more than one migrant was relatively higher when compared with that of Bihar. Most of the migrants in both the states were up to 30 years of age. This clearly indicates that young men in their productive age were more involved in migration. Similar results were reported by Sidhu et.al. (1997) and Kumar et.al. (1998) in their studies, that most of the migrants of both the states were literate and belong to the backward sections of the society. The underlying fact is that the backward classes belonging to the lower social hierarchy were more capable of doing menial jobs and tasks, which required lot of energy.

19.2.6 Chapter 6: Conclusions and Recommendations Report Writing

The conclusions and recommendations should follow logically from the discussion of the findings. Conclusions can be short, as they have already been elaborately discussed in Chapter 5. As the discussion will follow the sequence in which the findings have been presented (which in turn depends on your objectives)the conclusions should logically follow the same order. Sometimes, it is advisable to present conclusion and recommendations in specific sections related to issues of importance/under investigation/objectives of the study for better clarity to different stake holders. The conclusions should be given in bullets so that it can easily catch the attention of the reader. Remember that action-oriented groups are most interested in this section.
The conclusions should be followed by suggestions or recommendations. While making recommendations, use not only the findings of your study, but also supportive information from

other sources. The recommendations should be generated from the findings and conclusions. It should not be generalized; rather it should be specific to particular stake holders in pure, actionable term which is feasible in relation to social context, policy and constitution of country, political acceptability, budget, time, etc. One should **not give general recommendations** such as, "Government should provide free treatment to everyone for all health problems".

If your recommendations are short (roughly one page), you might include the mall in your summary and omit them as a separate section in Chapter 6 in order to avoid repetition.

19.2.7 Chapter 7:References

This is the list of books/articles in some way pertinent to the research which was followed while conducting research. It should contain all those works which the researcher has consulted. The references in your text can be numbered in the sequence in which they appear in the report and then listed in this order in the list of references (Vancouver system). Another possibility is the Harvard system of listing in brackets the author's name(s) in the text, followed by the date of the publication and page number, for example: (Sharma et. Al., 2000: 84). In the listof references, the publications are then arranged in alphabetical order by the principal author's last name. You can choose either system as long as you use it consistently throughout the report unless some guidelines specifically ask for it(in case of research publications).
The references should be given in the following order.

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

Example
Kothari, C.R., *Quantitative Techniques*, New Delhi, Vikas Publishing HousePvt. Ltd., 1978.
For magazines and newspapers the order may be as follows.
1) Name of the author, last name first.
2) Title of the article, in quotation marks.
3) Name of the periodical, underlined to indicate italics.
4) The volume and number.
5) The date of the issue.
6) The pagination.

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

Annexure

The annexes should contain any additional information needed to enable professionals to follow your research procedures and data analysis. Information that would be useful to special categories of readers but is not of interest to the average reader can be included in annexes as well. Examples of information that can be presented in annexes are

• tables, figures (graphs) and pictures referred to in the text but not included in order to keep the report short
• lists of hospitals, districts, villages, etc., that participated in the study
• questionnaires or check lists used for data collection
.

Note: Never start writing without an outline. Make sure that all sections carry the headings and numbers consistent with the outline before they are word-processed. Have the outline visible on the wall so that everyone will be aware immediately of any additions or changes, and of progress made.

19.3 Style and Layout of The Report

19.3.1 Style of Writing

Remember that your reader
• is short of time
• has many other urgent matters demanding his or her interest and attention
• is probably not knowledgeable concerning 'research jargon'.
Therefore, the rules are
• simplify- Keep to the essentials
• justify- Make no statement that is not based on facts and data do not quote the name of anyone who has provided the information

19.3.2 Report Writing

a) in case of sensitive findings, one should think not to clearly mention name of village/ location, etc.
b) quantify when you have the data to do so; avoid 'large', 'small'- instead, say '50%', 'one in three'
c) the percentage 45.8 in table may be presented in the text as about 46% and45.3% may be presented as approximately 45%
d) be precise and specific in your phrasing of findings
e) inform, not impress - avoid exaggeration
f) use short sentences
g) use adverbs and adjectives infrequently
h) be consistent in the use of past and present tenses
i) avoid the passive voice, if possible, as it creates vagueness (e.g., 'patients were interviewed' leaves uncertainty as to who interviewed them) and
j) repeated use makes dull reading
k) aim to be logical and systematic in your presentation

19.3.3 Layout of the Report

A good *physical layout* is important, as it will help your report
a. make a good initial impression

b. encourage the readers
c. give them an idea of how the material has been organized so the reader can make a quick determination of what he will read first.
d. Particular *attention* should be paid to make sure there is
e. an attractive layout for the title page and a clear table of contents
f. consistency in margins and spacing
g. consistency in headings and subheadings, e.g.: **Font size 16 or 18 bold**, for headings of chapters; **size 14 bold** for headings of major sections; **size 12bold**, for headings of sub-sections, etc.
a) good quality printing and photocopying
b) correct drafts carefully with spell check as well as critical reading for clarity by other team-members, your facilitator and, if possible, outsiders
c) numbering of figures and tables, provision of clear titles for tables, and clear
d) headings for columns and rows, etc.
e) accuracy and consistency in quotations and references.

19.3.4 Revising and Finalizing the Text

Prepare a double-spaced first draft of your report with wide margins so that you can easily make comments and corrections in the text. Have several copies made of the first draft, so you will have one or more copies to work on, and one copy on which to insert the final changes for revision. When a first draft of the findings, discussion, and conclusions has been completed, all working group members and facilitators should read it critically and make comments
The following questions should be kept in mind when reading the draft.

a. Have all important findings been included?
b. Do the conclusions follow logically from the findings? If some of the findings contradict each other, has this been discussed and explained, if possible?

Have weaknesses in the methodology, if any, been revealed?

a. Are there any overlaps in the draft that have to be removed?
b. Is it possible to condense the content? In general, a text improves by shortening. Some parts less relevant for action may be included in annexes.

Check if descriptive paragraphs may be shortened and *introduced or finished by a concluding sentence*.

a. Do data in the text agree with data in the tables? Are all tables consistent(with the same number of informants per variable), are they numbered in sequence, and do they have clear titles and headings?
b. Is the sequence of paragraphs and subsections logical and coherent? Is there a smooth connection between successive paragraphs and sections? Is the phrasing of findings and conclusions precise and clear? The original authors of each section may prepare a second draft, taking into consideration all comments that have been made. However, you might consider the appointment of two editors amongst yourselves, to draft the complete version.

The help from proof readers may also be taken to remove minor mistakes from the draft. It is advisable to have one of the other groups and facilitators read the second draft and judge it on the points mentioned in the previous section. Then a final version of the report should be prepared.

This time you should give extra care to the presentation and layout: structure, style and consistency of spelling
Use verb tenses consistently.

Descriptions of the field situation may be stated in the past tense (e.g., 'Five households owned less than one acre of land.').Conclusions drawn from the data are usually in the present tense (e.g., 'Food taboos hardly have any impact on the nutritional status of young children.)

19.4 Summary

A research report is considered a major component of any research study as the research remains incomplete till the report has been presented or written. No matter how good a research study, and how meticulously the research study has been conducted, the findings of the research are of little value unless they are effectively documented and communicated to others. The research results must invariably enter the general store of knowledge. Writing a report is the last step in a research study and requires a set of skills somewhat different from those called for in actually conducting research. It is any informational work made with an intention to relay information or recounting certain events in a presentable manner. Reports are often conveyed in writing, speech, television, or film. Report is an administrative necessity. Most official form of information or work are completed via report. Report is always written in a sequential manner in order of occurrence.

19.5 Key words

Preface - A preface generally covers the story of how the book came into being, or how the idea for the book was developed

Foreword-A foreword is usually a short piece of writing found at the beginning of a book or other piece of literature, before the introduction. This may or may not be written by the primary author of the work

Annexure - The annexes should contain any additional information needed to enable professionals to follow your research procedures and data analysis

Methodology-The methodology adopted in conducting the study must be fully explained. The scientific reader would like to know about the basic design of the study, the methods of data collection, information regarding the sample used in the study, the statistical analysis adopted and the factors limiting the study

19.6 Self-Assessment questions

1. Discuss the data Collection and Analysis in report writing
2. Describe the Chapter wise framing of the report writing
3. How did you analyze the style and Layout of the report writing

19.7 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri L.JacksonCenage Learning Publications, Third Edition, 2009

2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.

3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.

4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit kumar Sage Publications 2015

5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja selvamuthu, andDipayan Das, Springer Publications, 2018.

6. Handbook of Research Methodology A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Educreation Publishing 2019.

7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019

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LESSON-20

TYPES OF REPORTS

Learning Objectives

- ✓ To Understand the Technical and Popular Report
- ✓ To Discuss the size and Physical design of the report
- ✓ To Learn the precautions of writing Research report

Structure

20.0 Introduction

Research reports vary greatly in length and type. In each individual case, both the length and theform are largely dictated by the problems at hand. For instance, business firms prefer reports in theletter form, just one or two pages in length. Banks, insurance organizations and financial institutionsare generally fond of the short balance-sheet type of tabulation for their annual reports to theircustomers and shareholders. Mathematicians prefer to write the results of their investigations in theform of algebraic notations. Chemists report their results in symbols and formulae. Students ofliterature usually write long reports presenting the critical analysis of some writer or period or the likewith a liberal use of quotations from the works of the author under discussion. In the field of education and psychology, the favorite form is the report on the results of experimentation accompanied bythe detailed statistical tabulations. Clinical psychologists and social pathologists frequently find itnecessary to make use of the case-history form.

News items in the daily papers are also forms of report writing. They represent firsthand on-these accounts of the events described or compilations of interviews with persons who were on thescene. In such reports the first paragraph usually contains the important information in detail and thesucceeding paragraphs contain material which is progressively less and less important.Book-reviews which analyze the content of the book and report on the author's intentions, hissuccess or failure in achieving his aims, his language, his style, scholarship, bias or his point of view.

Such reviews also happen to be a kind of short report. The reports prepared by governmental bureaus,special commissions, and similar other organizations are generally very comprehensive reports on the issues involved. Such reports are usually considered as important research products. Similarly,Ph.D. theses and dissertations are also a form of report-writing, usually completed by students inacademic institutions.

The above narration throws light on the fact that the results of a research investigation can bepresented in a number of ways viz., a technical report, a popular report, an article, a monograph or attimes even in the form of oral presentation. Which method(s) of presentation to be used in a particularstudy depends on the circumstances under which the study arose and the nature of the results. Atechnical report is used whenever a full written report of the study is required whether for recordkeepingor for public dissemination. A popular report is used if the research results have policyimplications. We give below a few details about the said two types of reports:

20.1 Technical Report

In the technical report the main emphasis is on

(i) the methods employed,
(ii) assumptions made in the course of the study,
(iii) the detailed presentation of the findings including their limitations and supporting data.

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

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

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

3. Methods employed: Specific methods used in the study and their limitations. For instance, insampling studies we should give details of sample design viz., sample size, sample selection, etc.

4. Data: Discussion of data collected, their sources, characteristics and limitations. If secondarydata are used, their suitability to the problem at hand be fully assessed. In case of a survey, themanner in which data were collected should be fully described.

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

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

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

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

9. Index: Index must be prepared and be given invariably in the report at the end.The order presented above only gives a general idea of the nature of a technical report; the orderof presentation may not necessarily be the same in all the technical reports. This, in other words,means that the presentation may vary in different reports; even the different sections outlined abovewill not always be the same, nor will all these sections appear in any particular report.It should, however, be remembered that even in a technical report, simple presentation and readyavailability of the findings remain an important consideration and as such the liberal use of charts anddiagrams is considered desirable.

20.2 Popular Report

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

We give below a general outline of a popular report.

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

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

3. Objective of the study: A general review of how the problem arise is presented along with thespecific objectives of the project under study.

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

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

6. Technical appendices: More detailed information on methods used, forms, etc. is presented inthe form of appendices. But the appendices are often not detailed if the report is entirelyimportant thing about such a report is that it gives emphasis on simplicity and policy implications fromthe operational point of view, avoiding the technical details of all sorts to the extent possible.

20.3 Oral Presentation

At times oral presentation of the results of the study is considered effective, particularly in caseswhere policy recommendations are indicated by project results. The merit of this approach lies in thefact that it provides an opportunity for give-and-take decisions which generally lead to a betterunderstanding of the findings and their implications. But the main demerit of this sort of presentation is the lack of any permanent record concerning the research details and it may be just possible that the findings may fade away from people's memory even before an action is taken. In order toovercome this difficulty, a written report may be circulated before the oral presentation and referredto frequently during the discussion. Oral presentation is effective when supplemented by variousvisual devices. Use of slides, wall charts and blackboards is quite helpful in contributing to clarity andin reducing the boredom, if any. Distributing a board outline, with a few important tables and chartsconcerning the research results, makes the listeners attentive who have a ready outline on which tofocus their thinking. This very often happens in academic institutions where the researcher discusseshis research findings and policy implications with others either in a seminar or in a group discussion.Thus, research results can be reported in more than one way, but the usual practice adopted, inacademic institutions particularly, is that of writing the Technical Report and then preparing severalresearch papers to be discussed at various forums in one form or the other. But in practical field andwith problems having policy implications, the technique followed is that of writing a popular report.Researches done on governmental account or on behalf of some major public or private organizationsare usually presented in the form of technical reports.

20.4 Mechanics of Writing A Research Report

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

20.4.1. Size and physical design

The manuscript should be written on unruled paper $8\frac{1}{2} \times 11$ insize. If it is to be written by hand, then black or blue-black ink should be used. A margin of at leastone and one-half inches should be allowed at the left hand and of at least half an inch at the right handof the paper. There should also be one-inch margins, top and bottom. The paper should be neat and eligibleIf the manuscript is to be typed, then all typing should be double-spaced on one side of thepage only except for the insertion of the long quotations.

20.4.2. Procedure

Various steps in writing the report should be strictly adhered (All such steps havealready been explained earlier in this chapter).Types of reports have been described in this chapter earlier which should be taken as a guide forreport-writing in case of a particular problem).

20.4.3. Treatment of quotations:

Quotations should be placed in quotation marks and double spacedforming an immediate part of the text. But if a quotation is of a considerable length (more than fouror five type written lines) then it should be single-spaced and indented at least half an inch to the right 0f the normal text margin.

20.4.4 . The footnotes

Regarding footnotes one should keep in view the followings:

(a) The footnotes serve two purposes viz., the identification of materials used in quotations inthe report and the notice of materials not immediately necessary to the body of the researchtext 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 apoint of view. It should always be kept in view that footnote is not an end nor a means ofthe display of scholarship. The modern tendency is to make the minimum use of footnotesfor scholarship does not need to be displayed.

(b) Footnotes are placed at the bottom of the page on which the reference or quotation whichthey identify or supplement ends. Footnotes are customarily separated from the textualmaterial by a space of half an inch and a line about one and a half inches long.

(c) Footnotes should be numbered consecutively, usually beginning with 1 in each chapterseparately. The number should be put slightly above the line, say at the end of a quotation.At the foot of the page, again, the footnote number should be indented and typed a littleabove the line. Thus, consecutive numbers must be used to correlate the reference in thetext with its corresponding note at the bottom of the page, except in case of statisticaltables and other numerical material, where symbols such as the asterisk (*) or the like onemay be used to prevent confusion.

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

20.4.5. Documentation style

Regarding documentation, the first footnote reference to any given workshould be complete in its documentation, giving all the essential facts about the edition used. Suchdocumentary footnotes follow a general sequence. The common order may be described as under:

(i) Regarding the single-volume reference

1. Author's name in normal order (and not beginning with the last name as in a bibliography)followed by a comma;

2. Title of work, underlined to indicate italics;
3. Place and date of publication;
4. Pagination references (The page number).

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

(ii) Regarding multivolumed reference

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

(iii) *Regarding works arranged alphabetically*

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

Example 1

"Salamanca," *Encyclopedia Britannica,* 14th Edition.

Example 2

"Mary Wollstonecraft Godwin," *Dictionary of national biography*.

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

(iv) *Regarding periodicals reference*

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

(v) *Regarding anthologies and collections reference*

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

(vi) *Regarding second-hand quotations reference*

In such cases the documentation should be handled as follows:

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

Example

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

(vii) *Case of multiple authorship*

If there are more than two authors or editors, then in the documentation the name of only the first is given and the multiple authorship is indicated by "et al." or "and others".Subsequent

references to the same work need not be so detailed as stated above. If the work iscited again without any other work intervening, it may be indicated as *ibid,* followed by a comma andthe page number. A single page should be referred to as p., but more than one page be referred. 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 190and the following page '190f'. Roman numerical is generally used to indicate the number of thevolume of a book. Op. cit. (opera citato, in the work cited) or Loc. cit. (loco citato, in the place cited)are two of the very convenient abbreviations used in the footnotes. Op. cit. or Loc. cit. after thewriter's name would suggest that the reference is to work by the writer which has been cited indetail in an earlier footnote but intervened by some other references.

7. Punctuation and abbreviations in footnotes:

\ The first item after the number in the footnote is the author's name, given in the normal signature order. This is followed by a comma. After the comma, the title of the book is given: the article (such as "A", "An", "The" etc.) is omitted and only the first word and proper nouns and adjectives are capitalized. The title is followed by a comma.Information concerning the edition is given next. This entry is followed by a comma. The place ofpublication is then stated; it may be mentioned in an abbreviated form, if the place happens to be afamous one such as for London, N.Y. for New York, N.D. for New Delhi and so on. Thisentry is followed by a comma. Then the name of the publisher is mentioned and this entry is closedby a comma. It is followed by the date of publication if the date is given on the title page. If the dateappears in the copyright notice on the reverse side of the title page or elsewhere in the volume, thecomma should be omitted and the date enclosed in square brackets [c 1978], [1978]. The entry isfollowed by a comma. Then follow the volume and page references and are separated by a comma if both are given. A period closes the complete documentary reference. But one should rememberthat the documentation regarding acknowledgements from magazine articles and periodical literaturefollow a different form as stated earlier while explaining the entries in the bibliography.Certain English and Latin abbreviations are quite often used in bibliographies and footnotes to
eliminate tedious repetition. The following is a partial list of the most common abbreviations frequently used in report-writing (the researcher should learn to recognize them as well as he should learn touse them)

et seq.,	et sequens: and the following
ex.,	example
f., ff.,	and the following
fig(s).,	figure(s)
fn.,	footnote
ibid., ibidem:	in the same place (when two or more successive footnotes refer to the same work, it is not necessary to repeat complete reference for the second footnote. Ibid. may be used. If different pages are referred to, pagination must be shown).
id., idem:	the same
ill., illus., or illust(s).	illustrated, illustration(s)
Intro., intro.,	introduction
l, or *ll*,	line(s)
loc. cit., loco citato:	in the place cited; used as op.cit., (when new reference is made to the same pagination as cited in the previous note)
MS., MSS.,	Manuscript or Manuscripts
N.B., nota bene:	note well
n.d.,	no date
n.p.,	no place
no pub.,	no publisher
no(s).,	number(s)
o.p.,	out of print
op. cit: opera citato	in the work cited (If reference has been made to a work and new reference is to be made, ibid., may be used, if intervening reference has been made to different works, op.cit. must be used. The name of the author must precede.
p. or pp.,	page(s)

et seq.,	et sequens: and the following
ex.,	example
f., ff.,	and the following
fig(s).,	figure(s)
fn.,	footnote
ibid., ibidem:	in the same place (when two or more successive footnotes refer to the same work, it is not necessary to repeat complete reference for the second footnote. Ibid. may be used. If different pages are referred to, pagination must be shown).
id., idem:	the same
ill., illus., or	
illust(s).	illustrated, illustration(s)
Intro., intro.,	introduction
l, or *ll*,	line(s)
loc. cit.,	in the place cited; used as op.cit., (when new reference
loco citato:	is made to the same pagination as cited in the previous note)
MS., MSS.,	Manuscript or Manuscripts
N.B., nota bene:	note well
n.d.,	no date
n.p.,	no place
no pub.,	no publisher
no(s).,	number(s)
o.p.,	out of print
op. cit:	in the work cited (If reference has been made to a work
opera citato	and new reference is to be made, ibid., may be used, if intervening reference has been made to different works, op.cit. must be used. The name of the author must precede.
p. or pp.,	page(s)

20.4.6 Use of statistics, charts and graphs:

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

20.4.7. The final draft

Revising and rewriting the rough draft of the report should be done with greatcare before writing the final draft. For the purpose, the researcher should put to himself questionslike:
Are the sentences written in the report clear? Are they grammatically, correct?
Do they saywhat 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 thatseem crystal-clear to the writer may prove quite confusing to other people; a connection that hadseemed self-evident may strike others as a *non-sequitur*. A friendly critic, by pointing out passagesthat seem unclear or illogical, and perhaps suggesting ways of remedying the difficulties, can be aninvaluable aid in achieving the goal of adequate communication."
10. *Bibliography:* Bibliography should be prepared and appended to the research report as discussed earlier.

20.4.8 Preparation of the index

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

20.5 Precautions for Writing Research Reports

Research report is a channel of communicating the research findings to the readers of the report. Agood research report is one which does this task efficiently and effectively. As such it must be
prepared keeping the following precautions in view:
1. While determining the length of the report (since research reports vary greatly in length),one should keep in view the fact that it should be long enough to cover the subject but shortenough to maintain interest. In fact, report-writing should not be a means to learning moreand more about less and less.
2. A research report should not, if this can be avoided, be dull; it should be such as to sustain reader's interest.

3. Abstract terminology and technical jargon should be avoided in a research report. The report should be able to convey the matter as simply as possible. This, in other words,means that report should be written in an objective style in simple language, avoidingexpressions such as "it seems," "there may be" and the like.
4. Readers are often interested in acquiring a quick knowledge of the main findings and assuch the report must provide a ready availability of the findings. For this purpose, charts, graphs and the statistical tables may be used for the various results in the main report in addition to the summary of important findings.
5. The layout of the report should be well thought out and must be appropriate and in accordancewith the objective of the research problem.
6. The reports should be free from grammatical mistakes and must be prepared strictly in accordance with the techniques of composition of report-writing such as the use of quotations, footnotes, documentation, proper punctuation and use of abbreviations in footnotes and thelike.
7. The report must present the logical analysis of the subject matter. It must reflect a structurewherein the different pieces of analysis relating to the research problem fit well.
8. A research report should show originality and should necessarily be an attempt to solvesome intellectual problem. It must contribute to the solution of a problem and must add tothe store of knowledge.
9. Towards the end, the report must also state the policy implications relating to the problemunder consideration. It is usually considered desirable if the report makes a forecast of theprobable future of the subject concerned and indicates the kinds of research still needs tobe done in that particular field.
10. Appendices should be enlisted in respect of all the technical data in the report.
11. Bibliography of sources consulted is a must for a good report and must necessarily begiven.
12. Index is also considered an essential part of a good report and as such must be prepared and appended at the end.
13. Report must be attractive in appearance, neat and clean, whether typed or printed.
14. Calculated confidence limits must be mentioned and the various constraints experienced in conducting the research study may also be stated in the report.
15. Objective of the study, the nature of the problem, the methods employed and the analysistechniques adopted must all be clearly stated in the beginning of the report in the form ofintroduction

20.6 Summary

A research report is considered a major component of any research study as the research remains incomplete till the report has been presented or written. No matter how good a research study, and how meticulously the research study has been conducted, the findings of the research are of little value unless they are effectively documented and communicated to others. The research results must invariably enter the general store of knowledge. Writing a report is the last step in a research study and requires a set of skills somewhat different from those called for in actually conducting aresearch.

20.7 key words

Bibliography- Bibliography of various sources consulted be prepared and attached.

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

Index- Index must be prepared and be given invariably in the report at the end.The order presented above only gives a general idea of the nature of a technical report; the orderof presentation may not necessarily be the same in all the technical reports.

Foot notes- The footnotes serve two purposes viz., the identification of materials used in quotations inthe report and the notice of materials not immediately necessary to the body of the researchtext but still of supplemental value

Documentation style- Regarding documentation, the first footnote reference to any given workshould be complete in its documentation, giving all the essential facts about the edition used. Suchdocumentary footnotes follow a general sequence

20.8 Self-Assessment Questions

1. Discuss the Types of Reports
2. Examine the Mechanics of Writing Research Reports

20.9 Suggested Readings

1. Research Methods & statistics A Critical thinking approach by Sherri LJacksonCenage Learning Publications, Third Edition, 2009

2. Business Statistics for Contemporary Decision Making, Ken black, Sixth Edition, Springer Publication, 2010.

3.Research Methodology by Dr.Nishikant Jha Himalaya Publishing House, 2013.

4. Research Methodology, A step-by-step guide for beginners Kumar, Dr Ranjit Kumar Sage Publications 2015

5. Introduction to statistics Management Design of Experiment and Statistical quality Control by Dharmaraja Selvamuthu, andDipayan Das, Springer Publications, 2018.

6. Handbook of Research Methodology (A Compendium for Scholars and Researchers) by Dr. Shanti Bhushan Mishra, Dr. Shashi Alok, Edu creation Publishing 2019.

7. Research Design, Qualitative and Quantitative Mixed Method, Approaches, 4th Edition, Sage Publications, 2019

Dr.V.NAGA NIRMALA

204HM21

MHRM DEGREE EXAMINATION

First Year-Semester - II

Paper-IV

RESEARCH METHODOLOGY

Time: Three hours **Maximum : 70 marks**

SECTION A — (5 x 4 = 20 marks)
Answer any FIVE of the following

1 (a). Research
(b). Literature Review
(c). Research Design
(d).Experimental Design
(e). Data Collecting
(f).Sampling
(g). Hypothesis
(h). Qualitative Research
(i). Report Writing
(j). Research Process

SECTION B — (2 × 10 = 20 marks)
Answer any TWO of the following

2). Explain the Meaning and objectives of Research?
3). Outline the Research process and Criteria for Good Research?
4). Define Research Design? Explain the Features of Good Research Design
5). Elucidate the Methods of Data Collection ?

SECTION C — (2 × 15 = 30 marks)
Answer any TWO of the following

6). Discuss the Sampling Methods and Scaling Techniques?
7). Define Hypothesis**?** Briefly explain the Characteristics and types of Hypothesis?
8). Explain the Significance of Report writing and steps in Report writing**?**
9). Discuss the Techniques of Interpretation for Report Writing?

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GENERAL COMMENTS

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