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OPEN UNIVERSITY**

# BBA

**BACHELOR OF BUSINESS ADMINISTRATION**



**BBAR-401**

**Basics of Research Methods**

# **Basics of Research Methods**



ISBN 978-93-91071-45-5

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**Edition : 2021**

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## **ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING**

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self-instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this. Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self-instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure student's performance (continuous assessment).



## **PREFACE**

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included many tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect.

All the best for your studies from our team!



# Basics of Research Methods

## Contents

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### **BLOCK 1 : INTRODUCTION TO RESEARCH**

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#### **Unit 1 : Foundations of Research**

Introduction, Nature, Structure and Assumptions of Science, Assumption, Various Tools of Science, Objectivist and Subjectivist Conceptions of Social Reality, Different Approaches

#### **Unit 2 : Meaning and Objectives of Good Research**

Introduction, Meaning of Good Research, Basic and Applied Research, Objectives of Good Research, Significance of Good Research, Criteria of Good Research

#### **Unit 3 : Types of Research**

Introduction, Types of Research and Research Processes, Research Process, Contemporary Debate on the Status of Scientific Method, The Characteristics of Research, Objectivity and Ethical Concerns in Research

#### **Unit 4 : Structuring a Research Proposal**

Introduction, Problem Statement, Formulating Hypothesis, Demarcation of Region of Study, Defining Terminology, Significance of the Research, Literature Survey, Time Schedule, Budget, Resource List

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### **BLOCK 2 : RESEARCH DESIGN AND RESEARCH METHODS**

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#### **Unit 1 : Research Design**

Introduction, Types of Research Design, Historical Design, Descriptive Design, Formation of Hypothesis, Synopsis Writing, Computers in Research

## **Unit 2 : General Research**

Introduction, Meaning, Need, Process, Spiral Scientific Method, Types of Research, Kinds of Research, Research Ethics

## **Unit 3 : Methods of Research**

Introduction, Experimental Research, Different Types and Basic Principles, Different Types of Experimental Research, Survey Research, Different Types and Tools of Survey

## **Unit 4 : Basic Thumb Rules for Research Process**

Introduction, Identifying and Defining the Problem, Exploratory Research, Developing the Hypothesis, Creating the Research Design, Determining Sampling Design, Collecting Data, Analyzing Data, Testing of Hypothesis, Generalisations and Interpretations, Reporting the Results, Report Writing

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## **BLOCK 3 : SAMPLING AND QUANTITATIVE METHODS IN RESEARCH**

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### **Unit 1 : Sampling Theory and Fundamentals**

Introduction, Need and Purpose of Sampling, Sampling Theory, Important Sampling Distribution, Various Techniques/Methods of Sampling, Sampling and Non-Sampling Errors

### **Unit 2 : Testing of Hypothesis**

Introduction, Hypotheses Testing, Basic Concepts Concerning Testing of Hypotheses, Type I and Type II Errors, Two Tailed and One Tailed Tests, Sampling of Attributes and Sampling of Variables

### **Unit 3 : Quantitative Techniques**

Introduction, Regression and Correlation Analysis, Types of Correlation, Coefficient of Correlation, Rank Correlation, Regression, Parametric Tests, Non-Parametric, Multivariate Analysis

---

## **BLOCK 4 : DATA ANALYSIS AND RESEARCH REPORTING**

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### **Unit 1 : Statistical Data Techniques used in Data Analysis**

Introduction, Types of Data, Levels of Data, Sources of Data



**Unit 2 : Data Interpretation and Analysis**

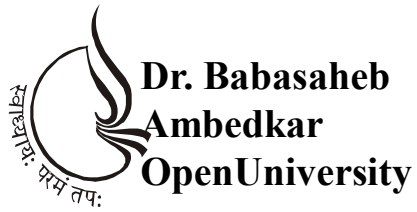
Introduction, Geographical and Graphical Representation of Data, Geographical Representation, Graphical Representation, Statistical Analysis, Measures of Central Tendency, Measures of Dispersion, Regression and Correlation, Chi-Square Test

**Unit 3 : Application of Statistical Tools**

Introduction, Statistical Package, Tools of Argument

**Unit 4 : Research Reporting**

Introduction, Structure, Style and Contents, Different Steps in Writing Report, Contents of a Report, Style Manuals (Chicago, APA, MLA), Citation Styles, Footnotes, References, Evaluation of Research, Types of Evaluation, Current Trends in LIS Research



**BBAR-401**

# **Basics of Research Methods**

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## **BLOCK-1 INTRODUCTION TO RESEARCH**

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### **UNIT 1**

FOUNDATIONS OF RESEARCH

### **UNIT 2**

MEANING AND OBJECTIVES OF GOOD RESEARCH

### **UNIT 3**

TYPES OF RESEARCH

### **UNIT 4**

STRUCTURING A RESEARCH PROPOSAL

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## **BLOCK 1 : INTRODUCTION TO RESEARCH**

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### **Block Introduction**

The main objective of research is to find out answers to questions through the application of various scientific measures. The key objective of research is to bring out the truth which is unknown and which has not been exposed yet. Research is equally important for social scientists in studying social relationships and finding out answers to various social problems. Research methodology is a method to methodically resolve the research problem. It is the science of studying how research is done scientifically. We study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them. It is necessary for the researcher to know not only the research methods and techniques but also the methodology. Researchers not only need to know-how to develop certain tests, how to calculate the mean, the mode, the median or the standard deviation or chi-square, how to apply particular research techniques, but they also need to know which of these methods or techniques, are relevant and which are not, and what would they mean and indicate.

The block will explain all the concepts related to science such as its nature, structure and assumptions. The relation between the subjectivity and objectivity of science, which is effectively related to the nature of science, which is a part of worldwide science education, is discussed in the block in detail. The block explains why a research study has been undertaken and how the research problem has been defined. The present significance of scientific research methods also is described in detail.

Unit 1 provides detailed information about the Nature, Structure and assumptions of science. A detailed study of various tools of science was included in this block. The objectivist and subjectivist conceptions of social reality and different approaches of research are also discussed in detail.

Units 2, 3 and 4 provide a detailed study about the types of research. It also will help to add knowledge about search processes. An up to date discussion on the present situation of the Scientific Method has also been included in this unit. The unit comprises about the characteristics of research. A detailed study about objectivity and ethical concerns in research has also been added in this unit.

## **Block Objectives**

**After learning this block, you will be able to understand :**

- To add knowledge about the foundations of research.
- Understand about the various tools of science.
- Know about Conceptions of Social Reality
- Understand about the present status of Scientific method
- To attain a detail knowledge about research

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**Block Structure**

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Unit 1 : Foundations of Research

Unit 2 : Meaning and Objectives of Good Research

Unit 3 : Types of Research

Unit 4 : Structuring a Research Proposal



**: UNIT STRUCTURE :**

- 1.0 Learning Objectives**
- 1.1 Introduction**
- 1.2 Nature, Structure and Assumptions of Science**
  - 1.2.1 Assumption**
- 1.3 Various Tools of Science**
- 1.4 Objectivist and Subjectivist Conceptions of Social Reality**
- 1.5 Different Approaches**
- 1.6 Let Us Sum Up**
- 1.7 Answers for Check Your Progress**
- 1.8 Glossary**
- 1.9 Assignment**
- 1.10 Activities**
- 1.11 Case Study**
- 1.12 Further Readings**

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**1.0 Learning Objectives :**

**After learning this unit, you will be able to :**

- Understand what is the Nature structure and assumptions of science
- Understand about objectivist and subjectivist concepts
- Understand about different approaches of research

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**1.1 Introduction :**

Research is an essential significant and powerful tool in leading man towards advancement. Without systematic research there would have been very little advancement. Scientific research leads to advancement in some field of life. New products, new facts, new concepts and new ways of doing things are being found due to ever-increasing significant research in the physical, the biological, the social and the psychological fields. Research today is no longer confined to the science laboratory.

According to John W. Best "The secret of our cultural development has been research, pushing back the areas of ignorance by discovering new truths, which, in turn, lead to better ways of doing things and better products."

## Basics of Research Methods

### Meaning of Research :

Word "Research" comprises of two words = Re + Search. It means to search again. So research means a systematic investigation or activity to gain new knowledge of the already existing facts.

Research is an intellectual activity. It is responsible for bringing in new knowledge to light. It is also responsible for correcting the present mistakes, removing existing misconceptions and adding new learning to the existing knowledge pool. Research is also considered as the application of scientific method in solving the problems. It is a systematic, formal and intensive process of carrying on the scientific method of analysis

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### 1.2 Nature, Structure and Assumptions of Science :

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The nature of science consign to the key principles and facts which offer a description of science as a technique of knowing, as well as features of scientific knowledge. Scientists perceive certain fundamental viewpoints and outlooks about their activities. It can be described as follows :

- **The World is Rational** : Science assumes that the possessions and proceedings in the world happen in reliable model that are understandable through vigilant, methodical study. Science also presupposes that the universe is a distinct system with a common rule prevailing everywhere. So the data collected from the study of one part of the universe is valid to the entire parts.
- **Scientific Ideas are Variable** : Science facilitates knowledge with the help of watchful interpretation of facts and inventing theories out of these observations. So modifications in knowledge are unavoidable as new findings may defy existing theories. As a result the analysis and improvement and occasional discarding of theories go on time to time.
- **Scientific Knowledge is Long-Lasting** : Although scientists discard the idea of achieving absolute truth and admit some ambiguity as part of nature, widely held scientific knowledge is long-lasting.
- **Science Doesn't give Absolute Answer to All Queries** : All matters cannot be scientifically examined.
- **Science Demands Evidence** : The authority of scientific claims is settled by referring to observations and so most of the scientists focus on attainment of precise data. This type of proof is obtained by explanations and dimensions adopted from circumstances that range from natural situations to entirely artificial ones such as laboratory. The scientists may use their senses or instruments such as microscopes to make observations.
- **Science is a Blend of Logic and Imagination** : Though the start-up will be in the form of imaginations and thoughts based on hypotheses and theories, it should be backed up with a logic and

the validity of the arguments should be tested with the help of principles of logical reasoning that join evidence and assumptions with conclusions. Even though the usage of logic and the frequent assessment of evidence are essential for the development of science they are not usually satisfactory. Formulating hypotheses or theories in order to imagine how an idea works and then finding out how to put to them to the test of reality. Discoveries in science may be unexpectedly or accidentally which are recognised by highly intellectual scientists.

- **Science Explains :** The authorities of scientific theories are evaluated by taking into account of their ability to show interaction among facts that formerly seemed unconnected. The soul of science is justification by observation.
- **Scientists Avoid Bias :** Bias in the samples, the data collection methods, or the equipments cannot be may not be prevented every time, but scientists investigate about the source of bias and how does this bias effect the result.
- **Science is a Complex Social Activity :** As a social activity, science inevitably reflects social values and viewpoints. Science goes on in many diverse situations. Scientists are engaged in hospitals academic institutions, business and industry, government sector, organisations which conduct independent research and scientific centers. Some of them work single-handedly, in small groups, or as a part of large research teams. Their work place will start from small classrooms to and natural fields such as space to the sea bottoms.
- **Ethical Principles in the Conduct of Science :** Most scientists conduct themselves according to the ethical norms of science. Scientific ethics relates to possible harm that could result from scientific experiments. Modern scientific ethics require that due regard must be given to the health, comfort, and well-being of animal subjects. Moreover, research involving human subjects may be conducted only with full disclosure of the risks and intended benefits of the research and the right to refuse to participate. The ethics of science also relates to the possible harmful effects of applying the results of research. The long-term effects of science may be unpredictable, but some idea of what applications are expected from scientific work can be ascertained by knowing who is interested in funding it.

### **1.2.1 Assumption :**

An assumption is something that you assume to be the case, without a clear proof. For example, if you wear a sun glass and a walking stick used by blinds, people might assume that you're blind, even though that's not true. Scientists make assumptions about their experimental results, theories, and laws. And so assumptions, or working hypotheses, are most



## Basics of Research Methods

important part of science. Though every researcher takes a number of assumptions at the beginning of each investigation the assumptions are reduced at the end of the research with help of knowledge gained through the investigation. An assumption is a realistic expectation which is something that we believe to be true. However, no adequate evidence exists to support this belief. In other words, an assumption is an act of faith which does not have empirical evidence to support. Assumption provide a basis to develop theories & research instrument & therefore, influence the development & implement of research process.

### • **Uses of Assumption in Research :**

Research is built upon assumptions since a foundation is needed to move forward. One must assume something to discover something. Assumptions listed in research paper may be good sources of the research topics. Assumption provide basis to conduct of the research study. Tested assumptions through research studies expand the professional body of knowledge

### **Check Your Progress – 1 :**

1. The data collected from the study of one part of the universe is not valid to the entire parts.  
a. True b. False
2. Science assumes the happenings in the world in a reliable model that can be understood by a methodical study  
a. True b. False
3. Scientists formulate hypotheses in order to imagine how an idea works and then finding out how to put to them to the test of reality.  
a. True b. False
4. An assumption is a realistic expectation which is something that we believe to be true.  
a. True b. False

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### **1.3 Various Tools of Science :**

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To become successful scientists, we must be able to identify and use scientific instruments or tools. These tools are for collecting data, taking measurements, and recording observations. Scientists use a variety of tools to do investigations.

#### **1. Observation :**

Observation is something we often do instinctively. Observation is more than simply noticing something. Scientific observation is the central element of scientific method or process. The core skill of scientist is to make observation. Observation is the act of thoroughly viewing another's interactions with his or her surroundings. It is a little bit more complicated than just looking at someone doing something, even if you use one of those fancy two-way mirrors. Observations can be

- (a) **Field Observation** : Field observation happens when a researcher carefully observes and notes a participant in their natural setting without interference.
- (b) **Laboratory Observation** : A laboratory observation is when a researcher creates a precipitating condition and then observes the ensuing behaviors in a natural environment

**2. Measurements :**

Measurement is the process observing and recording the observations that are collected as part of a research effort. First, you have to understand the fundamental ideas involved in measuring. It is easy to assign numbers in respect of properties of some objects, but it is relatively difficult in respect of others. For instance, measuring such things as social conformity, intelligence, or marital adjustment is much less obvious and requires much closer attention than measuring physical weight, biological age or a person's financial assets. In other words, properties like weight, height, etc., can be measured directly with some standard unit of measurement, but it is not that easy to measure properties like motivation to succeed, ability to stand stress and the like. We can expect high accuracy in measuring the length of pipe with a yard stick, but if the concept is abstract and the measurement tools are not standardized, we are less confident about the accuracy of the results of measurement.

- (a) **Qualitative** : Qualitative descriptions or distinctions are based on some quality or characteristic rather than on some quantity or measured value. Qualitative may also refer to: Qualitative property, a property that can be observed but not measured numerically.
- (b) **Quantitative** : A quantitative description of a relevant characteristic involves a numerical measurement.

**Measuring Instruments :**

- (a) **Meterstick** :



A measurement tool that is used to measure the distance and length of objects. It tells how long an object is. In science, we use the metric system for measuring.

## Basics of Research Methods

### (b) Thermometer :



A tool used to measure temperature. It measures the temperature of air and most liquids.

### (c) Balance :



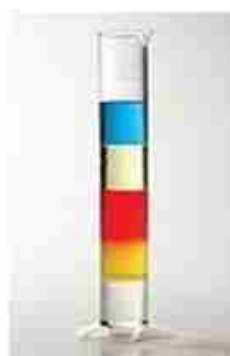
A tool used to measure the mass of an object. It measures the amount of matter an object contains

### (d) Beaker :



An open cylindrical container with a pouring lip. It measures volume or the amount of liquid that is being held in the container

### (e) Density :



The same amount of two different liquids will have different densities because they have different masses. The liquids that have more mass (have a higher density) and will sink below the liquids that have less mass (have a lower density).

Scientists consume massive amounts of information from many sources: journal articles, books, theses, databases, conferences, and

collaborators, to name a few. Journal articles are one of the most prominent sources of information for scientists. With such a large portion of their time spent finding and reading journal articles and other information resources, scientists are turning to the World Wide Web as a means to more efficiently locate the information they are seeking. A web browser can be used to access facsimiles of journal articles and theses, to search databases on many subjects, and to obtain data from other scientists. E-Journals are a convenient way for scientists to access scholarly journal articles without leaving their offices. Unfortunately, these web-based resources are more expensive than their print counterparts, so libraries are limited in the number of electronic subscriptions that will fit in their budgets

**Check Your Progress – 2 :**

1. Observation is the act of thoroughly viewing another's interactions with his or her surroundings.
  - a. True
  - b. False
2. \_\_\_\_\_ happens when a researcher carefully observes and notes a participant in their natural setting without interference.
  - a. Field observation
  - b. Laboratory observation
  - c. none of these
3. A \_\_\_\_\_ is when a researcher creates a precipitating condition and then observes
  - a. Field observation
  - b. Laboratory observation
  - c. none of these
4. Measurement is the process observing and recording the observations that are collected as part of a research effort.
  - a. True
  - b. False

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**1.4 Objectivist and Subjectivist Conceptions of Social Reality:**

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A statement that is entirely unbiased can be called as objective statement. The speaker's past experience or his choices will not influence the statement. It can be verified by mathematical calculations or by scrutinizing facts. On the other hand subjective statement is influenced by the speaker. The perspective of the speaker or author is reflected in the subjective statement.

Scientific facts are objective as are mathematical proofs and it can be anything that can be backed up with solid data. Opinions, interpretations, and any type of marketing presentation are all subjective. The subjectivity and objectivity of science is powerfully related to the nature of science, and is a part of science education worldwide. Objectivity is one of the most important ideas of the research community. Objectivity means in some contexts being reasonably open to all sides of any disputes. Objectivity refers to method or procedure through which we acquire, collect information,

## Basics of Research Methods

### Objective Reality and Subjective Reality :

The objective reality is the collection of things that we are sure exists independently of us. Every person is able, in principle, to verify every aspect of the objective reality. Anything that cannot be verified in this way is not part of the objective reality.

Subjective reality refers to the reality inside your mind. It is the meaning you assign to things and events. All objects, dreams ideas and "truths" are different for each person. Objectivist consideration in social reality :

- Self-control and patience of researcher for useful thinking.–
- Open mind of researcher–
- Use of statistical and mathematical techniques
- Use of random sampling
- Understanding complexity of social reality
- Use of standardized concepts

### Check Your Progress – 3 :

1. A statement that is entirely unbiased is being called as \_\_\_\_\_.  
a. Objective    b. Subjective    c. both
2. The perspective of the speaker or author is reflected in the \_\_\_\_\_.  
a. Objective statement                    b. Subjective statement  
c. Both
3. Scientific facts and mathematical proofs are \_\_\_\_\_ statements.  
a. Objective    b. Subjective    c. Both

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### 1.5 Different Approaches :

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There are two main approaches to research, namely quantitative approach and qualitative approach.

#### Quantitative Approach :

The quantitative approach involves the collection of quantitative data, which are put to rigorous quantitative analysis in a formal and rigid manner. This approach can be further sub-classified into inferential, experimental and simulation approaches to research.

- (a) **Inferential Approach** : The purpose of inferential approach to research is to form a data base from which to infer characteristics or relationships of population. This usually means survey research where a sample of population is studied (questioned or observed) to determine its characteristics, and it is then inferred that the population has the same characteristics.
- (b) **Experimental Approach** : Experimental approach is characterised by much greater control over the research environment and in this

case some variables are manipulated to observe their effect on other variables.

### **Simulation Approach :**

Simulation approach involves the construction of an artificial environment within which relevant information and data can be generated. This permits an observation of the dynamic behavior of a system (or its sub-system) under controlled conditions. Simulation approach can also be useful in building models for understanding future conditions

### **Qualitative Approach :**

The qualitative approach uses the method of subjective assessment of opinions, behaviour and attitudes. Research in such a situation is a function of the researcher's impressions and insights. The results generated by this type of research are either in non-quantitative form or in the form which cannot be put to rigorous quantitative analysis. Usually, this approach uses techniques like in depth interviews, focus group interviews, and projective techniques.

## **1.6 Let Us Sum Up :**

To conclude, research is an original addition to the available knowledge, which contributes to its further advancement. It is an attempt to pursue truth through the methods of study, observation, comparison and experiment. The objective of research is to find answers to the questions by applying scientific procedures. Science also presupposes that the universe is a distinct system with a common rule prevailing everywhere. Discoveries in science may be unexpectedly or accidentally which are recognised by highly intellectual scientists. The long-term effects of science may be unpredictable, but some idea of what applications are expected from scientific work can be ascertained by knowing who is interested in funding it.

## **1.7 Answers for Check Your Progress :**

### **Check Your Progress – 1 :**

1. b            2. a            3. a            4. a

### **Check Your Progress – 2 :**

1. a            2. a            3. b            4. a

### **Check Your Progress – 3 :**

1. b            2. a            3. b

## **1.8 Glossary :**

1. **Misconception** – Misunderstanding
2. **Intensive** – Demanding
3. **Consign** – Send

**Basics of  
Research Methods**

4. **Rational** – Logical
5. **Scrutinize** – Examine
6. **Rigid** – Severe

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**1.9 Assignment :**

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1. Describe the nature of science.
- 

**1.10 Activities :**

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1. Give example for Objectivist and Subjectivist statements.
- 

**1.11 Case Study :**

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1. Give an example for quantitative approach and qualitative approach.
- 

**1.12 Further Readings :**

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1. Research Methodology by C. R. Kothari
2. Research In Education by John. W. West



**Unit  
2**

**MEANING AND OBJECTIVES OF  
GOOD RESEARCH**

**: UNIT STRUCTURE :**

- 2.0 Learning Objectives**
- 2.1 Introduction**
- 2.2 Meaning of Good Research**
- 2.3 Basic and Applied Research**
- 2.4 Objectives of Good Research**
- 2.5 Significance of Good Research**
- 2.6 Criteria of Good Research**
- 2.7 Let Us Sum Up**
- 2.8 Answers for Check Your Progress**
- 2.9 Glossary**
- 2.10 Assignment**
- 2.11 Activities**
- 2.12 Case Study**
- 2.13 Further Readings**

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**2.0 Learning Objectives :**

**After learning this unit, you will be able to :**

- Understand about the concepts of good research
- Understand the nature and structure of scientific research
- Understand about different approaches of research

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**2.1 Introduction :**

Research today is no longer confined to the science laboratory. Without systematic research there would have been very little progress. Scientific research leads to progress in some field of life. Research is an essential and powerful tool in leading man towards progress. New products, new facts, new concepts and new ways of doing things are being found due to ever-increasing significant research in the physical, the biological, the social and the psychological fields.

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**2.2 Meaning of Good Research :**

Research in simple way means to hunt for facts or truth about a subject. The word research describes the systematic process of collecting and analyzing the information in order to increase understanding of any branch of knowledge. According to Redman and Mory, "Research is a systematic effort to gain knowledge". Research is an endeavour to discover



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### **2.3 Basic and Applied Research :**

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The basic aim of research is to answer to the unanswered questions through scientific approach. Research objectives can be classified broadly in to following main categories :

1. Exploratory
  2. Descriptive
  3. Diagnostic
  4. Hypothetical
1. **Exploratory Objective :** The main objective of the exploratory research work is to gain a greater understanding of something that is not much known.
  2. **Descriptive Objective :** The main objective of the descriptive research work is to study the characteristics of a particular individual, situation or a group.
  3. **Diagnostic Objective :** The main objective of the diagnostic research work is to obtain the frequency with which a phenomenon occurs.
  4. **Hypothetical Objective :** The main objective of the hypothetical research work is to test the assumption about various relationships.

Research can be further classified into following categories :

1. Basic Research
2. Applied Research

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### **2.4 Objectives of Good Research :**

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1. **Basic Research :** Basic research or fundamental research is undertaken to increase knowledge. It is conducted to satisfy any curiosity. It stimulates new ways of thinking. There is absolutely no commercial value to the discoveries resulting from such result. Basic Research is purely theoretical to increase the understanding of particular phenomenon or behaviour, but does not seek to solve any existing problem.
2. **Applied Research :** On the other side, the applied research is the use of basic research or past theories methods for solving an existing problem. It focuses on uncovering what needs are not being met and use that information in designing products or services that would create their own demand. In analytical research, the available information is used to analyze and make its critical evaluation. There are various other types of research, but they are one or more variations of the above research approaches based on either the purpose of research or the time of environment in which research is done on the basis of some other similar factor.

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## **2.5 Significance of Good Research :**

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Research trains scientific and inductive thinking and it promotes the development of logical habits of thinking and organisation. The increasing complexity of business has focused attention on the use of research in solving the operational problems. Operation Research and market research are very vital in taking business decisions. Market Research is imperative for a company to know what type of products or services would be profitable to introduce in the market. Also with respect to its existing products in the market, good market research enables a company to know if it has been able to satisfy customer needs and whether there is a need to make necessary changes. This enables a company to formulate a viable marketing plan or measure the success of existing plan. Operation Research refers to the applications of mathematical, logical and analytical techniques to the solution of business problems. Moreover, motivational research based on behavioural science attempts to explain why consumers behave as they do. It seeks to discover and comprehend which factors influence in consumers particular behaviour so that business man better understands the target audience and how to influence that audience.

Business Research can also be useful in forecasting sales, which then can be used for various business decisions like production, investment programmes and financial planning. Thus, if traditional intuitive business decisions are substituted by research, decisions will be more logical and scientific and hence, profitable.

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## **2.6 Criteria of Good Research :**

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Researcher should expect that his research should satisfy the following criteria :

- The purpose of the research should be clearly defined.
- The research methodology should be detailed so that in future other researcher can use it as base research or case study.
- Proper care should be taken to plan the procedural design so that the results are as unbiased as possible.
- The validity and reliability of the data should be checked carefully.
- The analysis of the data should be sufficient to disclose its significance and appropriate methods of analysis should be used.
- Conclusions should be restricted to those confirmed by the data and limited to those for which the data provide sufficient basis.
- The research results should be such that it can be verified replicating the study.

### **Check Your Progress :**

1. In Quantitative approach \_\_\_\_\_ data is collected.  
a. quantitative   b. qualitative   c. both

## Basics of Research Methods

2. In qualitative approach \_\_\_\_\_ data is collected.  
a. quantitative b. qualitative c. both
3. \_\_\_\_\_ has an experimental, inferential, and simulation approach to research.  
a. quantitative b. qualitative c. both
4. Scientific facts and mathematical proofs are statements.  
a. Objective b. Subjective c. Both
5. The perspective of the speaker or author is reflected in the \_\_\_\_\_.  
a. Objective statement b. Subjective statement  
c. Both

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### 2.7 Let Us Sum Up :

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Research methods include all those methods and techniques that are adopted for conducting research. Thus, research techniques or methods are the methods that the researchers adopt for conducting the research studies. There are two main approaches to research, namely quantitative approach and qualitative approach. Research encourages scientific and inductive thinking, besides promoting the development of logical habits of thinking and organisation. Research is built upon assumptions since a foundation is needed to move forward. One must assume something to discover something. Above all the main aim of research is to find out the truth which is hidden and has not yet been discovered.

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### 2.8 Answers for Check Your Progress :

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- |      |      |      |      |      |
|------|------|------|------|------|
| 1. a | 2. b | 3. a | 4. b | 5. a |
|------|------|------|------|------|
- 

### 2.9 Glossary :

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1. **Interpretation** – Explanation
  2. **Precise** – Exact
  3. **Bias** – Unfairness
  4. **Empirical** – Experimental
- 

### 2.10 Assignment :

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1. Give an example of basic research
- 

### 2.11 Activities :

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1. Give an example of applied research
- 

### 2.12 Case Study :

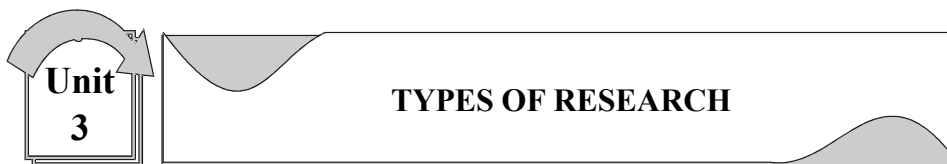
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1. Take a case study of your choice where qualitative and quantitative approaches are used
- 

### 2.13 Further Readings :

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1. Research Methodology C. R. Kothari



**: UNIT STRUCTURE :**

- 3.0 Learning Objectives**
- 3.1 Introduction**
- 3.2 Types of Research and Research Processes**
  - 3.2.1 Research Process**
- 3.3 Contemporary Debate on the Status of Scientific Method**
- 3.4 The Characteristics of Research**
- 3.5 Objectivity and Ethical Concerns in Research**
- 3.6 Let Us Sum Up**
- 3.7 Answers for Check Your Progress**
- 3.8 Glossary**
- 3.9 Assignment**
- 3.10 Activities**
- 3.11 Case Study**
- 3.12 Further Readings**

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**3.0 Learning Objectives :**

**After learning this unit, you will be able to :**

- Understand about types of research
- Understand about research process
- Understand about characteristics of research
- Objectivity and Ethical concerns of research

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**3.1 Introduction :**

Research comprises "creative" work undertaken on a systematic basis in order to increase the stock of knowledge, comprising including knowledge of humans, culture and society, and the use of this stock of knowledge to devise new applications. It is used to establish or confirm facts, reaffirm the results of previous work, solve new or existing problems, support theorems, or develop new theories. A research project may also be an expansion on past work in the field. To test the validity of instruments, procedures, or experiments, research may replicate elements of prior projects, or the project as a whole. The primary purposes of basic research (as opposed to applied research) are documentation, discovery, interpretation, or the research and development (R&D) of methods and systems for the advancement of human knowledge. Approaches to research depend on epistemologies, which vary considerably

both within and between humanities and sciences. There are several forms of research: scientific, humanities, artistic, economic, social, business, marketing, practitioner research, life, technological, etc.

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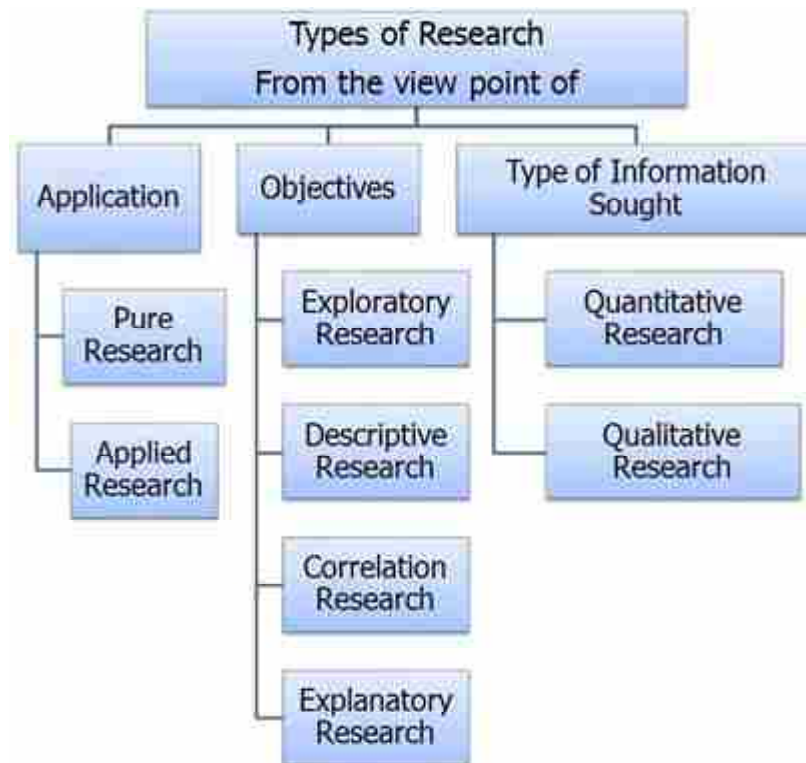
### **3.2 Types of Research and Research Processes :**

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There are varieties of ways through which we may classify it into different categories.

- **On the Basis of Type of Information.**
- **Qualitative Research.**

Qualitative research is concerned with qualitative phenomenon, i.e. phenomena relating to or involving quality or kind. The information will be in the form of qualitative data. Qualitative research is particularly important in the behavioral sciences where the intent is to find out the underlying motives of human behavior. Through such research we can analyse the various factors which motivate people to behave in a particular manner or which make people like or dislike a particular thing.



**Fig. 3.1 : Types of Research**

- **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.

The information is in the form of quantitative data.

- **On the Basis of Application :**

- Basic / Fundamental / Conceptual / Pure or Theoretical 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. Its utility is universal. This research is mainly concerned with generalisations and with the formulation of a theory. Research concerning some natural phenomenon or relating to pure mathematics are examples of fundamental research.

- b. Experimental / Applied / Empirical Research :** Empirical research relies on experience or observation alone, often without due regard for system and theory. It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment. We can also call it as experimental type of research. This type of research is also called applied (or action) research. This research aims at finding a solution for an immediate problem facing a society or an industrial/business organization. Empirical research is appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered the most powerful support possible for a given hypothesis
- c. On the Basis of Objectives :**
  - i. Exploratory Research :** Exploratory research is defined as the initial research into a hypothetical or theoretical idea. This is where a researcher has an idea or has observed something and seeks to understand more about it. An exploratory research project is an attempt to lay the groundwork that will lead to future studies, or to determine if what is being observed might be explained by a currently existing theory. Most often, exploratory research lays the initial groundwork for future research. Exploratory research is research conducted for a problem that has not been clearly defined. Exploratory research helps determine the best research design, data collection method and selection of subjects. Exploratory research often relies on secondary research such as reviewing available literature and/or data, or qualitative approaches such as informal discussions with consumers, employees, management or competitors, and more formal approaches through in-depth interviews, focus groups, projective methods, case studies or pilot studies.
  - ii. Descriptive Research :** Once the groundwork is established, the newly explored field needs more information. The next step is descriptive research, defined as attempts to explore and explain while providing additional information about a topic. This is where research is trying to describe what is happening in more detail, filling in the missing parts and expanding our understanding. This is also where as much information is collected as possible instead of making guesses or elaborate models to predict the future – the 'what' and 'how,' rather than the 'why.'
  - iii. Correlation Research :** A correlation is simply defined as a relationship between two variables. The whole purpose of using

## Basics of Research Methods

correlations in research is to figure out which variables are connected. Correlation research is looking for variables that seem to interact with each other, so that when you can see one changing, you have an idea of how the other will change. This often entails the researcher using variables that they can't control.

- iv. **Explanatory Research** : Explanatory research also called Causal research is the investigation of cause-and-effect relationships .This type of research is very complex and the researcher can never be completely certain that there are not other factors influencing the causal relationship, especially when dealing with people's attitudes and motivations.

### 3.2.1 Research Process :

Research process consists of series of actions or steps necessary to effectively carry out research. These actions or steps are;

- a. Formulating the Research Problem
  - b. Extensive Literature Survey
  - c. Developing the Research Hypothesis
  - d. Preparing the Research Design
  - e. Determining the Research Design
  - f. Collecting the Research Data
  - g. Execution of the Project
  - h. Analysis of Data
  - i. Hypothesis Testing
  - j. Generalization and Interpretation
  - k. Preparing of the Report or Presentation of the Result
- a. **Formulation of Research Problem** : At the very outset, the researcher must decide the general area of interest or aspect of a subject matter that he would like to inquire into and then research problem should be formulated.
  - b. **Extensive Literature Survey** : Once the problem is formulated the researcher should undertake extensive literature survey connected with the problem. For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place to go.
  - c. **Development of Working Hypothesis** : After extensive literature survey, researcher should state in clear terms the working hypothesis or hypotheses. Working hypothesis is tentative assumption made in order to draw out and test its logical or empirical consequences. It's very important or it provides the focal point for research.
  - d. **Preparing the Research Design** : After framing hypothesis we have to prepare a research design i.e. we have to state the conceptual structure within which research would be conducted. The preparation

of such a design facilitates research to be as efficient as possible yielding maximal information. In other words, the function of research design is to provide for the collection of relevant evidence with optimum effort, time and expenditure. But how all these can be achieved depends mainly on the research purpose.

- e. **Determining Sample Design :** A sample design is a definite plan determined before any data is actually collected for obtaining a sample from a given population. In census inquiry we involve a great deal of time, money and energy so it not possible in practice under many circumstances. Sample designs can be either probability or non-probability. With probability samples each element has a known probability of being included in the sample but the non-probability samples do not allow the researchers to determine this probability.
- f. **Collecting the Data :** There are several ways of collecting the appropriate data, which differ considerably in context of cost, time and other resources at the disposal of the researcher. Primary data can be collected either through experiment or through survey. In case of survey, data can be collected by any one or more of the following ways:
  - observation,
  - Through personal interview,
  - Through telephonic interviews,
  - By mailing of questionnaires or
  - Through schedules.
- g. **Execution of the Project :** Execution of project is a very important step in the research process. If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable .A careful watch should be kept for unanticipated factors in order to keep the survey realistic as much as possible.
- h. **Analysis of Data :** The analysis of data requires a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inference. Analysis work after tabulation is generally based on the computation of various percentages; coefficients etc., by applying various well defined statistical formulae. In the process of analysis, relationships of differences supporting or conflicting with original or new hypothesis should be subjected to tests of significance to determine with what validity data can be said to indicate any conclusions.
- i. **Hypothesis Testing :** After analyzing the data, the researcher is in a position to test the hypothesis, if any, he had formulated earlier. Do the facts support the hypothesis or they happen to be contrary? This is the usual question which is to be answered by applying



## Basics of Research Methods

various tests like t-test, F-test etc. F-test has been developed by statisticians for the purpose. Hypothesis testing will result in either accepting the hypothesis or in rejecting it. If the researcher had no hypothesis to start with, generalizations established on the basis of data may be stated.

- j. Generalizations and Interpretation :** If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalization i.e. to build a theory. As a matter of fact, the real value of research lies in its ability to arrive at certain generalizations. If the researcher had no hypothesis to start with, he might seek to explain his findings on the basis of some theory. It is known as interpretation.
- k. Preparation of the Report or the Thesis :** Finally, the researcher has to prepare the report of what has been done by him. The layout of the report should be as follows; the preliminary pages, the main text and end matter. The preliminary pages carry title, acknowledgements and forward and then index. The main text of the report should have introduction, review of literature and methodology.

### Check Your Progress – 1 :

1. Research concerning some natural phenomenon or relating to pure mathematics are examples of \_\_\_\_\_ .
  - a. Fundamental research
  - b. Empirical research
  - c. Qualitative research
  - d. Quantitative research
2. Quantitative research is based on the measurement of quantity or amount.
  - a. Fundamental research
  - b. Empirical research
  - c. Qualitative research
  - d. Quantitative research
3. Qualitative research is concerned with qualitative phenomenon, i.e. phenomena relating to or involving quality or kind.
  - a. Fundamental research
  - b. Empirical research
  - c. Qualitative research
  - d. Quantitative research
4. Empirical research relies on experience or observation alone, often without due regard for system and theory.
  - a. Fundamental research
  - b. Empirical research
  - c. Qualitative research
  - d. Quantitative research
5. Exploratory research is defined as the initial research into a hypothetical or theoretical idea.
  - a. Exploratory research
  - b. Empirical research
  - c. Qualitative research
  - d. Quantitative research

6. Explanatory research also called Causal research is the investigation of cause-and-effect relationships.
  - a. Explanatory research
  - b. Empirical research
  - c. Qualitative research
  - d. Quantitative research
7. \_\_\_\_\_ consists of series of actions or steps necessary to effectively carry out research.
  - a. Learning process
  - b. Scientific process
  - c. Research process

---

### 3.3 Contemporary Debate on the Status of Scientific Method :

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When conducting research, scientists use the scientific method to collect measurable, empirical evidence in an experiment related to a hypothesis, the results aiming to support or contradict a theory. The scientific method, developed in the 17th century, is a way of problem-solving by making a hypothesis and then testing it, a way of thinking that values observation and data instead of fanciful ideas about the order of things. The scientific method is something that probably seems pretty understandable, because currently, everyone uses it. Doing experiments to test hypotheses is the foundation of the scientific method.

For a clear view of the term research, the researcher must be aware of the meaning of scientific method. It has been observed that the two terms, research and scientific method are closely interrelated. Research, as stated earlier can be called as the inquiry into the nature of, the reasons for, and the consequences of any particular set of circumstances, whether these circumstances are experimentally controlled or recorded just as they occur. Moreover the research entails whether the researcher is interested in more than an exact result or is he interested in a recurring result. All the above the viewpoint common to all research methods and techniques, although they may vary considerably from one science to another, is usually given the name of scientific method. Karl Pearson states that "The scientific method is one and same in the branches (of science) and that method is the method of all logically trained minds ... the unity of all sciences consists alone in its methods, not its material; the man who classifies facts of any kind whatever, who sees their mutual relation and describes their sequences, is applying the Scientific Method and is a man of science." Scientific method is the detection of truth as determined by logical thoughts. The ideal of science is to attain a methodical interrelation of facts. In scientific method, logic aids in formulating propositions explicitly and accurately so that their possible alternatives become clear. Further, reason develops the consequences of such substitutes, and when these are compared with visible phenomena, it becomes possible for the researcher or the scientist to state which alternative is most in accord with the experiential facts.

The scientific method demands a scientific attitude which is based on the following essentials

## Basics of Research Methods

1. Reliable thought
2. Intentional, unemotional, and impartial dedication to collection and management of data.
3. Avoiding self–preconceptions and value decision as they will have a deforming result on the data.
4. Enthusiastic interest, fruitful thoughts, and a passion for investigation.
5. Willful willpower to explore self–method of thinking and nothing approved without proof, examination and evidence.

### Check Your Progress – 2 :

1. Doing experiments to test hypotheses is the foundation of the
  - a. Scientific Method
  - b. Explanatory method
  - c. Correlation method
2. \_\_\_\_\_ is an essential for Scientific method.
  - a. Reliable thought
  - b. Unreliable thought
  - c. Both
3. The two terms, research and scientific method, are closely interrelated.
  - a. True
  - b. False

---

### 3.4 The Characteristics of Research :

---

The above points reveal the following characteristics of Research

1. Research is a systematic and critical investigation into a phenomenon.
2. Research involves gathering new data from primary or first–hand sources or using existing data for a new purpose
3. Research requires expertise.
4. It is not mere compilation of facts.
5. It adopts scientific method.
6. Research strives to be objective and logical, applying every possible test to validate the procedures employed the data collected, and the conclusions reached.
7. Research is based upon observable experience or empirical evidences.
8. Research is directed towards finding answers to questions and solutions to problems.
9. Research emphasizes the development of generalizations, principles, or theories that will be helpful in predicting future occurrences.
10. Research emphasis the generalization theories and principle

---

### 3.5 Objectivity and Ethical Concerns in Research :

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Value is belief, fondness or position. Values are subjective to factors such as society, culture, history of a person. An empirical researcher is a part of the society. So there is a chance of intruding values in the

research. He will evaluate the facts and evidence in empirical research according to his own predetermined views which may be biased by personal values.

Objectivity is the readiness and capability to examine evidence neutrally. Objective research is value-free research. It is a major condition of good research. Ethics refers to the norms and rules of conduct in the research process that guide moral preferences. Ethics and morality stand together and used interchangeably. Ethics are social and cultural constructs, and grounded in the values of time and place. The objective of ethics in research is to make sure that no one is harmed from the undesirable consequences from research activities. It is desirable to interpret and present authentic and real facts of the observations of any research. Objectivity need to be upheld in the research process. This means that once the research begins, researchers should not let their personal values influence the collection and analysis of data, and they should not hide or alter research findings for their own beliefs or expectations. Empirical research might be influenced by social interest, economic and organizational forces. Therefore, the research becomes social, economical or organizational value dependent. It is evident that objectivity and ethics are very crucial in empirical research for improving knowledge and contributing to decision making related to society and nature.

**Check Your Progress – 3 :**

1. "Objectivity" is the readiness and capability to examine evidence with bias.
  - a. True
  - b. False
2. "Ethics" refers to the norms and "rules of conduct" in the research process, that guide moral preferences
  - a. True
  - b. False
3. "Objective research" is value-free research
  - a. True
  - b. False

**3.6 Let Us Sum Up :**

Research ethics is the way to carry out a research with truthfulness and ethically. Ethical research is the logical inquiry that is conducted with honesty and truthfulness. Honesty associated with the non-usage of others work without acknowledgement. The researchers have to be objective, to manage own liking and prejudice, to observe clearly from the facts rather than to umpire normatively.

**3.7 Answers for Check Your Progress :**

**Check Your Progress – 1 :**

- |      |      |      |      |
|------|------|------|------|
| 1. b | 2. d | 3. c | 4. b |
| 5. a | 6. a | 7. c |      |

**Basics of  
Research Methods**

**Check Your Progress – 2 :**

1. a                      2. a                      3. a

**Check Your Progress – 3 :**

1. b                      2. a                      3. a

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**3.8 Glossary :**

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1. **Reaffirm** – Confirm
  2. **Phenomena** – Observable Fact
  3. **Elaborate** – Detailed
  4. **Entail** – Necessitate
  5. **Fondness** – Liking
- 

**3.9 Assignment :**

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1. What are the different types of research methods ?
- 

**3.10 Activities :**

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1. Prepare a flow chart of a Research process.
- 

**3.11 Case Study :**

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1. Write about plagiarism as an ethical concern of research.
- 

**3.12 Further Readings :**

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1. Research methodology by C. R. Kothari



## STRUCTURING A RESEARCH PROPOSAL

### UNIT STRUCTURE :

- 4.0 Learning Objectives**
- 4.1 Introduction**
- 4.2 Problem Statement**
- 4.3 Formulating Hypothesis**
- 4.4 Demarcation of Region of Study**
- 4.5 Defining Terminology**
- 4.6 Significance of the Research**
- 4.7 Literature Survey**
- 4.8 Time Schedule**
- 4.9 Budget**
- 4.10 Resource List**
- 4.11 Let Us Sum Up**
- 4.12 Answers for Check Your Progress**
- 4.13 Glossary**
- 4.14 Assignment**
- 4.15 Activities**
- 4.16 Case Study**
- 4.17 Further Readings**

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#### **4.0 Learning Objectives :**

**After learning this unit, you will be able to understand about the elements of research proposal which are as follows;**

- Title
- Problem Statement
- Formulating Hypothesis
- Demarcation Region of Study
- Defining Terminology
- Significance of the Research
- Literature Survey
- Time Schedule
- Budget
- Resource List

---

#### **4.1 Introduction :**

---

Before actually starting with a research project, a research proposal should be structured. This does not only require subject knowledge, but also insight into the problem. It gives logical and structured approach to research visualized. It includes step guidelines to plan and to give structure to the research with the aim of increasing the validity of the research.

The title is usually formulated after the research problem and sub problem have been stated.

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#### **4.2 Problem Statement :**

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The problem statement is an axis around which the whole research revolves. The research problem should be stated in such a way that it would lead to analytical thinking.

---

#### **4.3 Formulating Hypothesis :**

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Hypotheses are the tentative statements that should either be acknowledged or rejected by means of research.

---

#### **4.4 Demarcation of Region of Study :**

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A precise indication is given of the scope of the research with the indication of the assumptions made, limitations and delimitations of the research before the research is started.

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#### **4.5 Defining Terminology :**

---

An indication must be given as to how researcher is going to use terminology in the research report. It is necessary to define the terminology as terms are often used in different meanings by different authors.

---

#### **4.6 Significance of the Research :**

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The researcher should indicate why it is necessary to undertake the research. The benefits that will result from the research and to whom it will be beneficial should also be given.

---

#### **4.7 Literature Survey :**

---

To conduct a research regarding a topic, by inference means that the researcher has obtained sound knowledge regarding the research topic. It is therefore essential that the researcher indicates what theoretical knowledge he possesses about the prospective research at the time of the submission of the research proposal clearly. A literature search therefore simplifies the formulation of hypothesis for the researcher.

---

#### **4.8 Time Schedule :**

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A detailed proposed time schedule should be supplied for the research.





**Basics of  
Research Methods**

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**4.14 Assignment :**

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1. Carry out a survey for a research on economy pre and post demonetization period
- 

**4.15 Activities :**

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1. Write a detailed literature survey for a research on economy pre and post GST implementation
- 

**4.16 Case Study :**

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1. Prepare a questionnaire and give the conclusion on the food habits of people in pre and post covid period
- 

**4.17 Further Readings :**

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1. C. R. Kothari Research Methodology

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## **BLOCK SUMMARY**

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The block explained about the meaning of research which added value to the whole topic. It also gave a detailed description about the nature of science. The block also gave information about the concept of assumption and the uses of assumption in research. Another important topic covered in this block was about the variety of tools used by scientists in research. A detailed study about the tools such as observation and measurement was a highlight of this block. A detailed discussion on the objective statement and subjective statement was also included in this block. The two main approaches to research were also discussed in detail. The block explained the types of research on the basis of type of information, on the basis of application, and on the basis of objectives. Another topic discussed in detail was the research process. A study on the characteristics of research was also included in this block.

Research is habitually connected with cautious investigation of many diverse resource tools and visits to a library. Conducting research is not an easy task; it cannot be completed at once. A researcher should begin as soon as the plan is assigned. Creating a practical timeline will give you sense of way to the entire process of research. This involves detailing all the tasks to be done and the time to be consumed in doing each exact task. Research, like any other scholarly activity, is governed and governed by a number of policies and systems, particularly on the ethical issues. These plans defend the intellectual rights of the researchers. Thus a failure to obey with the regulations put forward in research would certainly end to violation. Qualitative methodology approves that the subjectivity of the researcher is very well influenced in scientific research. Subjectivity of the researcher starts from the selection of the topic that one studies, to formulating hypotheses, to choosing methodologies, and data interpretation. In qualitative methodology, the researcher is optimistic to reproduce on the morals and objectives he wishes to bring into his research and how these influence the research project.

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**BLOCK ASSIGNMENT**

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**Short Questions :**

1. Assumption
2. Observation
3. Measurements
4. Subjective reality
5. Research on the basis of type of information
6. Research on the basis of application
7. Research on the basis of objectives

**Long Questions :**

1. Write a note on nature of science ? Describe Objectivist and Subjectivist conceptions of research ?
2. Write a note on Research Process ?
3. Write about the ethical principles in the conduct of science ? What the various tools of science ?

**Basics of  
Research Methods**

❖ **Enrolment No. :**

1. How many hours did you need for studying the units ?

Unit No.	1	2	3	4
No. of Hrs.				

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

3. Any other Comments

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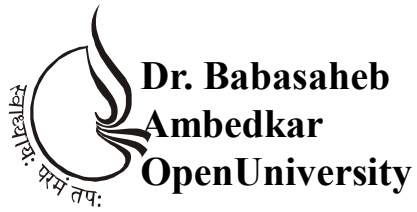
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**BBAR-401**

## **Basics of Research Methods**

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### **BLOCK-2 RESEARCH DESIGN AND RESEARCH METHODS**

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#### **UNIT 1**

RESEARCH DESIGN

#### **UNIT 2**

GENERAL RESEARCH

#### **UNIT 3**

METHODS OF RESEARCH

#### **UNIT 4**

BASIC THUMB RULES FOR RESEARCH PROCESS

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## **BLOCK 2 : RESEARCH DESIGN AND RESEARCH METHODS**

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### **Block Introduction**

Research is a creative work carried out on a methodical way in order to add to the reserve knowledge the social order, all living beings specially human beings and to make use of this knowledge to develop new applications. Research is a scientific inquiry aimed at learning new facts, testing ideas, etc. It is the systematic collection, analysis and interpretation of data to generate new knowledge and answer a certain question or solve a problem. The basic research is necessary to generate new knowledge and technologies to deal with major unresolved problems. On the other hand, applied research is necessary to identify priority problems and to design and evaluate policies and programs that will deliver the greatest benefit, making optimal use of available resources.

The block will explain all the aspects related to research such as its meaning, need and process. Different types of research design with an additional description on Historical design and descriptive design is also added in this block. The block also provides detailed information about the research process; types, kinds and different methods of research are discussed in detail.

Unit 1 comprises of a detailed study on different types of Research Designs. A short note on historical design and descriptive design is also included in this unit. The unit will help to add knowledge on the formation of hypothesis. The study of synopsis writing and the topic role of computers in research will help the students to gain more knowledge in this field.

Unit 2 provides a detailed study on the meaning, need and process of research. A detailed study on Spiral Scientific Method is the highlight of this unit. The unit also comprises with a detailed study on the types of research and kinds of Research. The detailed discussion on the research ethics will help the students to understand about the precautions to be taken while conducting a research.

Unit 3 and 4 provide a detailed knowledge on experimental research by discussing about the different types of experimental research and its basic principles. The unit also provides information about the Survey Research and different types of survey research along with the different tools of Survey

## **Block Objectives**

**After learning this block, you will be able to understand :**

- To add knowledge about different types of research.
- Understand about the formation of Hypothesis.
- Know about Concept of Research Ethics
- Understand about the Experimental research
- To attain a detail knowledge about the Survey research



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**Block Structure**

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Unit 1 : Research Design

Unit 2 : General Research

Unit 3 : Methods of Research

Unit 4 : Basic Thumb Rules for Research Process



**: UNIT STRUCTURE :**

- 1.0 Learning Objectives**
- 1.1 Introduction**
- 1.2 Types of Research Design**
- 1.3 Historical Design**
- 1.4 Descriptive Design**
- 1.5 Formation of Hypothesis**
- 1.6 Synopsis Writing**
- 1.7 Computers in Research**
- 1.8 Let Us Sum Up**
- 1.9 Answers for Check Your Progress**
- 1.10 Glossary**
- 1.11 Assignment**
- 1.12 Activities**
- 1.13 Case Study**
- 1.14 Further Readings**

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**1.0 Learning Objectives :**

**After learning this unit, you will be able to :**

- Understand what is a research design
- Understand what is Hypothesis
- Know about Synopsis writing
- Understand about the role of computers in Research

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**1.1 Introduction :**

The most important step after defining the research problem is preparing the design of the research project, which is popularly known as the research design. A research design helps to decide upon issues like what, when, where, how much, by what means etc. A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. Research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. Thus, research design provides an outline of what the researcher is going to do in terms of framing the hypothesis, its operational implications and the final data analysis.

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## **1.2 Types of Research Design :**

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### **Research Design :**

"A Research Design is the logical and systematic planning in directing the research. The research design helps in translating a general scientific model into varied research problem. However, in actual practice in most of the cases it is just a plan of study. The research design can be either formal or informal.

### **Definition :**

- (1) According to Philips Bernard S "It constitutes the blue print for the collection, measurement, and analysis of data"
- (2) John N Best states that research "provides a systematic plan of procedure for the researcher to follow"
- (3) According to P.V. Young "The design research from controlling general scientific model into varied research procedure"

There are different types of research designs. They may be broadly categorized as :

- (1) Exploratory Research Design;
- (2) Descriptive and Diagnostic Research Design; and
- (3) Hypothesis–Testing Research Design.

### **(1) Exploratory Research Design :**

The Exploratory Research Design is known as formulative research design. The main objective of using such a research design is to formulate a research problem for an in–depth or more precise investigation, or for developing a working hypothesis from an operational aspect. The major purpose of such studies is the discovery of ideas and insights. Therefore, such a research design suitable for such a study should be flexible enough to provide opportunity for considering different dimensions of the problem under study. The in–built flexibility in research design is required as the initial research problem would be transformed into a more precise one in the exploratory study, which in turn may necessitate changes in the research procedure for collecting relevant data. Usually, the following three methods are considered in the context of a research design for such studies. They are (a) a survey of related literature; (b) experience survey; and (c) analysis of insight–stimulating? instances.

### **(2) Descriptive and Diagnostic Research Design :**

A Descriptive Research Design is concerned with describing the characteristics of a particular individual or a group. Meanwhile, a diagnostic research design determines the frequency with which a variable occurs or its relationship with another variable. In other words, the study analyzing whether a certain variable is associated with another comprises a diagnostic research study. On the other hand, a study that is concerned with specific predictions or with the narration of facts and characteristics related to

an individual, group or situation, are instances of descriptive research studies. Generally, most of the social research design falls under this category. As a research design, both the descriptive and diagnostic studies share common requirements, hence they are grouped together. However, the procedure to be used and the research design need to plan carefully. The research design must also make appropriate provision for protection against bias and thus maximize reliability, with due regard to the completion of the research study in an economical manner. The research design in such studies should be rigid and not flexible. Besides, it must also focus attention on the following:

- (a) Formulation of the objectives of the study,
- (b) Proper designing of the methods of data collection,
- (c) Sample selection,
- (d) Data collection,
- (e) Processing and analysis of the collected data, and
- (f) Reporting the findings

### **(3) Hypothesis–Testing Research Design :**

Hypothesis–Testing Research Designs are those in which the researcher tests the hypothesis of causal relationship between two or more variables. These studies require procedures that would not only decrease bias and enhance reliability, but also facilitate deriving inferences about the causality. Generally, experiments satisfy such requirements. Hence, when research design is discussed in such studies, it often refers to the design of experiments.

#### **Check Your Progress – 1 :**

1. Hypothesis–Testing Research Designs are those in which the researcher tests the hypothesis of causal relationship between two or more variables.
  - a. True
  - b. False
2. A \_\_\_\_\_ is concerned with describing the characteristics of a particular individual or a group.
  - a. Exploratory Research Design
  - b. Descriptive Research Design
  - c. Explanatory Research Design
3. The \_\_\_\_\_ is also known as formulative research design.
  - a. Exploratory Research Design
  - b. Descriptive Research Design
  - c. Explanatory Research Design

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### **1.3 Historical Design :**

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The purpose of a historical research design is to collect, verify, and synthesize evidence from the past to establish facts that defend or disprove your hypothesis. It is a known fact that the preceding generations must have worked hard to find or invent a lot of things. Through a historical research we are getting an opportunity to study about their lives and effort they have taken. But, we should be aware of the fact that all the data from the past cannot be used. The advantage is that if we keep historical memory, we can think about each new phenomenon, and find out if it occurred before and the way it was solved. But if we do not have this memory, then we are really doomed to repeat history.

The first stage in historical research is heuristics which more specifically means discovering, gathering and research of both historical sources and literature. It does not study the subject of its research immediately but through historical sources and literature, which is distinctive of the science of history. When selecting the topic and formulating the problem, historians rest upon their experience, present outcomes of their work, study of professional literature and source foundation as to the respective issue. Historical research, sometimes referred to as historiography, means according to Berg (2012) investigation of elements from history. It is a specific type of scientific research work. According to Hendl (2005) is one of the basic approaches of qualitative research. Kerlinger (1972: 673) defines historical research as critical investigation of events, development and experiences of the past, careful consideration of past testimonies from the perspective of information sources validity and subsequent interpretation of the concerned testimonies. It differs from other scientific activities only by the subject matter which is hard to capture – the past – and especially by a difficult task of interpretation influenced by the nature of the unique subject matter. The objective of historical research is to ascertain and describe history of any area of human activity, subject or event by means of scientific processes. For us to be able to ascertain history there must be a certain course on a time axis which the research subject has passed, so that we have something to study. Historical research serves us for capturing historical facts on a scientific basis. The result of historical research is not an accidental.

General Stages of Historical Research :

- Defining the research issue,
- formulating research questions or hypotheses
- Ascertaining the state of the issue under study in secondary sources
- Identifying and localizing relevant materials of primary character.
- Applying a research technique relevant to the topic of historical research
- Evaluating the historical research, interpreting and publishing the findings.

**Check Your Progress – 2 :**

1. The purpose of a historical research design is to collect, verify, and synthesize evidence at present.
  - a. True
  - b. False
2. The first stage in historical research is heuristic.
  - a. True
  - b. False
3. Historical research, sometimes referred to as
  - a. Cinematography
  - b. Historiography.
  - c. Geography

**1.4 Descriptive Design :**

Descriptive research design is a scientific method which involves observing and describing the behaviour of a subject without influencing it in any way. Many scientific disciplines, especially social science and psychology, use this method to obtain a general overview of the subject. The results from a descriptive research can in no way be used as a definitive answer or to disprove a hypothesis but, if the limitations are understood, they can still be a useful tool in many areas of scientific research. There are three main types of descriptive methods: observational methods, case–study methods and survey methods

- (a) **Observational Method :** With the observational method animal and human behaviour can be closely observed. There are two types of observational methods .They are naturalistic observation and laboratory observation. The biggest benefit of the naturalistic method of research is that researchers observe the accomplice in their natural environments. Laboratory observations are generally less time–consuming and of low cost than naturalistic observations.
- (b) **Case Study Method :** Case study research gives a thorough study of an individual or group of individuals. Case studies often lead to testable hypotheses and which enable a researcher to study odd phenomena. Case studies should not be used to establish foundation and conclusion, and they have limited use for making accurate predictions.
- (c) **Survey Method :** In survey method research, participants respond to queries administered through interview as well as questionnaires. After participants respond to the queries, researchers explain the reactions.

**Check Your Progress – 3 :**

1. \_\_\_\_\_ is a scientific method which involves observing and describing the behavior of a subject without influencing it in anyway.
  - a. Historical research Design
  - b. Descriptive research design
  - c. Exploratory research design

## Basics of Research Methods

2. The results from a descriptive research can be used as a definitive answer.
  - a. True
  - b. False
3. Laboratory observations consume more time and are costly than naturalistic observations.
  - a. True
  - b. False
4. Case studies enable a researcher to study odd phenomena
  - a. True
  - b. False

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### 1.5 Formation of Hypothesis :

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The word hypothesis consists of two words Hypo +Thesis. "Hypo":means uncertain or subject to the verification."Thesis" means statement about solution of the problem. Thus the truthful meaning of the term hypothesis is a cautious statement about the answer to a problem. Hypothesis offers a solution of the problem that is to be verified empirically and based on some rationale.

Again, "hypo" means the composition of two or more variables which are to be verified and "thesis" means position of these variables in the specific frame of reference.

*"A hypothesis is a tentative generalization the validity of which remains to be tested. In its most elementary stage the hypothesis may be any hunch, guess, imaginative idea which becomes basis for further investigation."*

**Lundberg :**

#### 1.5.1 Hypothesis Formulation :

As soon as the research question is identified, the hypothesis is to be formulated. While formulating the hypothesis for the study, the following criteria should be kept in mind.

- (1) Make out the independent and dependent variables that comes understudy.
- (2) Identify the character of the relationship that exists among thesevariables.
- (3) It is recommended to have several simple hypotheses than one complicated hypothesis.

**Nature of Hypothesis :**

- (i) **Conceptual :** Some kind of conceptual elements in the framework are involved in a hypothesis.
- (ii) **Verbal Statement in a Declarative Form :** It is a verbal expression of ideas and concepts. It is not merely mental idea but in the verbal form, the idea is ready enough for empirical verification.
- (iii) It represents the tentative relationship between two or more variables.





## Basics of Research Methods

11. Study methods
12. Data collection
13. Ethical clearance
14. Data analysis
15. Official requirements
16. References

1. **Title :** The title of the research project should be brief but informative; sensational titles should be avoided. It should not be too short nor too long. Any name of the institution, the number of cases to be studied should not be included. The hypothesis to be studied can be included.
2. **Statement of the problem or hypothesis :** The problem that is to be studied must be mentioned in specific and clear terms. Understanding the problem aids the researcher in constructing the research proposal. It also allows the person to formulate the hypothesis. The problem under study should be relevant to the present. A brief account of its utility at the local or national level has to be discussed. The present status of the problem and the necessity for taking up the study needs to be mentioned. Hypothesis is mentioned as a tentative prediction or explanation of the relationship between two or more variables. Hypothesis should not be a haphazard guess but should reflect the knowledge, imagination, and experience of the investigator. Hypothesis can be formulated by understanding the problem, reviewing the literature on it, and considering other factors. A researcher can state the problem and the hypothesis in about 200 words covering all the aspects described above.
3. **Aims and objectives :** All research projects should have objectives and aims and every effort should be made to achieve them. The objectives and aims should be only a few (2–3). They must pertain to the study problem. Usages of terms like "first study", "the only study", etc. should be avoided.
4. **Review of literature :** Review of literature is a very important part of a research project. It achieves the following:
  - a. Familiarizes the reader to the problem under study.
  - b. It describes the work done by others either at local or international level on it or similar subject.
  - c. It helps the researcher to understand the difficulties faced by others and the corrective steps taken or modifications made by them. The researcher can anticipate similar or additional problems during the study and review of literature helps him in anticipating them.
  - d. Research methodology of the researcher can be structured and modified after reviewing the literature.

- e. The review assists in identifying various variables in the research project and conceptualizes their relationship.
- f. Review of literature in a synopsis helps the reviewer in assessing the knowledge of the researcher. The reviewer can assess the work put in by the researcher and assists in assessing the feasibility of the study.

The review of literature in a synopsis need not be comprehensive. The significant information should be covered in about 300 words quoting 8–10 authentic, easily retrievable references. Literature can be reviewed by using various scientific–information–gathering methods. These are journals, national or international; bulletins of organizations like WHO, CDC, and ICMR; books; computer–assisted searches like Medline and Medlar; and personal communications with other researchers. Internet provides a vast avenue for information gathering. Care must be taken to retrieve only relevant information. In this era of information technology review of literature is literally "just a click away".

**5. Research methodology :** In a synopsis the research methodology adopted should be mentioned in about 150–200 words. The research methodology forms the core of the research project. The methodology should cover the following aspects:

- Study design
- Study settings
- Sampling
- Variables
- Controls
- Study methods – examinations or investigations
- Data collection
- Data analysis
- Ethical clearance

**6. Study design :** The methodology starts with selection of study design. A single study design or a combination can be selected e.g.:

- (a) **Descriptive designs :** Cross–sectional study or survey, Epidemiological description of disease occurrence community diagnosis, Study of natural history of a disease
- (b) **Observational analytical designs :** Prospective study, Retrospective study, Follow–up study.
- (c) **Experimental designs :** Animal studies, Therapeutic clinical trials – drugs, Prophylactic clinical trials– vaccines, Field trials.
- (d) Operational designs

## Basics of Research Methods

7. **Study settings** : A mention about the research setting should be made. This includes information about the institution, facilities available, time of study, and population of study.
8. **Sampling** : Sampling is selecting a sample of appropriate size for the study. The sample size depends on the study design. The study population can be population of cases, population of people, or population of recipients of certain treatment. There are many methods for sampling like simple random, systemic and stratified sampling, cluster sampling, etc. Care should be taken to ensure that the sample size is adequate to produce meaningful results. The sample size should be adequate to apply all relevant tests of statistical significance. The samples should be representative of the population and should be reliable. This minimizes sampling errors.
9. **Variables** : Variables are the factors that can change. These changes can affect the outcome of a research project. Thus, it is important to identify the variables at the planning stage. They should be quantified with a measurable unit. Knowledge of the various variables in a research project will assist in refining the objectives. Usually, objectives of a research will be to see the effect of independent variables on dependent variables. There are four types of variables.
  - a. **Independent variables** : These are the variables that can be manipulated by the researcher and the effects of that are observed on the other variables. For example, predisposing factors, risk factors and cause.
  - b. **Dependent variables** : The changes occur as a result of independent variables. For example: disease and outcome.
  - c. **Intervening variables** : These may influence the effect of independent variables on the dependent variables. For example, while studying the response of HIV–AIDS to HAART the outcome may be influenced by the presence of anti–tubercular drugs.
  - d. **Background variables** : These are changes that are relevant in the groups or population under study. These need to be included in the study. For example: age, sex, and ethnic origin.
10. **Controls** : Control groups increase the validity of the research project. They usually consist of units of same population but differ in some respects. Controls are not necessary for all research projects. As far as possible they should be used in all analytical studies, drug trials, and intervention programs.
11. **Study methods** : Here the researcher will have to describe the method of data collection, which may be in the form of :
  - Questionnaire
  - Interviews
  - Medical examination

- Laboratory investigations
- Screening procedures

A sample of the Performa should be prepared and attached. The possible cost involved and any financial assistance received must be mentioned.

**12. Data collection :** A brief note on how data are collected should be included. The information should be about:

- a. The organizational setup
- b. Training to data collecting team
- c. Logistic support
- d. Plans for collaboration with other organization should be included

**13. Data analysis :** Data analysis is an important part of a research project. A good analysis leads to good results. The plans for data analysis should be mentioned under the following heads Statistical methods, Computer program used, and Data sorting method. A general statement "appropriate statistical methods will be used." must be avoided..

**14. Ethical clearance :** Wherever necessary, ethical committee clearance from the institute should be obtained. The certificate must be attached. Ethical clearance is required in all human and animal studies.

**15. References :** All references quoted in review of literature and anywhere else in the synopsis should be listed here. There are two styles for writing references, Vancouver style and Harvard style. Vancouver style is easy to follow as it depends on the numbers as quoted in text.

**16. Official requirements :**

- (a) A synopsis is incomplete if it does not contain the following information:

Name of the researcher and designation

- (b) Name and designation of the guide
- (c) Name and designation of head of department\institution
- (d) Name of the institution
- (e) Signatures of all with official seal

Synopsis writing is an important step in a research project. A good synopsis will give maximum information in minimum words. A well-conceived synopsis will go a long way in convincing the reviewer about the ability of the researcher to conduct the project. In cases of need for financial assistance, the request will be considered favorably. Thus, all research workers should make efforts to prepare a well-structured synopsis.

**Check Your Progress – 4 :**

1. \_\_\_\_\_ is the idea of your planned project submitted for approval from competent authorities.  
a. Introduction    b. Synopsis    c. Structure
2. The \_\_\_\_\_ of the research project should be brief but informative; avoiding sensational words.  
a. Footnote    b. Title    c. Paragraphs
3. A synopsis is incomplete if it does not contain the official requirements.  
a. True    b. False
4. In a synopsis the research methodology adopted should be mentioned in about \_\_\_\_\_ words.  
a. 250–500    b. 150–200    c. More than 1000
5. \_\_\_\_\_ is selecting a sample of appropriate size for the study  
a. Sampling    b. Research    c. Marketing

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**1.7 Computers in Research :**

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Computers revolutionized research by providing new ways to connect and share information. In scientific and social scientific research, computers opened up new opportunities regarding how data can be processed to yield valuable information and knowledge. Problem solving is an age old activity. The development of electronic devices especially the computer has given added impetus to this activity. Problems which could not be solved earlier due to sheer amount of computations involved are solved with the aid of computer accurately and rapidly. Today people use computer in all walks of life. To the researcher the use of computer to analyse complex data had made complicated research design practical. Electronic computers became an indispensable part of research students in physical and behavioural sciences as well as in humanities.

There are four main application of computer in research :

**Data Storage & Analysis Experimentation :**

Data Storage & Analysis Experimentation is the base of any type of research. Every experiment in any of the natural sciences generates a lot of data, which needs to be stored and analyzed to derive important conclusions, to validate or disprove hypotheses. Researchers in economics and other social sciences have found, by now, electronic computers. The storage facility which the computers provide is of immense help to a researcher for he can make use of stored up data whenever he requires to do so.

To constitute an indispensable part of their research equipment. Computers attached with experimental apparatuses, directly record data generated and subject it to analysis through specially designed software. Analyzing tons of statistical data is made possible using specially designed algorithms that are implemented by computers. This makes the extremely

time-consuming job of data analysis to be a matter of a few minutes. Data from different sources can be stored and accessed via computer networks set up in research labs, which makes collaboration simpler. Computers store vast amounts of information. Researcher can quickly and efficiently organize and search information, making for easier retrieval than paper storage. One can store your raw data in multiple formats. Some researchers conduct their research online, often through the use of surveys.

### **Computational Tools :**

Computers began as powerful calculators, and that service is important to research today. Regardless of the amount of data you have, you can do more with it with a computer's help. Statistical programs, modeling programs and spatial mapping tools are all possible because of computers. Researchers can use information in new ways, such as layering different types of maps on one another to discover new patterns in how people use their environment. Communication Building knowledge through research requires communication between experts to identify new areas requiring research and debating results. Before computers, this was accomplished through papers and workshops. Now, the world's experts can communicate via email or web chats. Information can be spread by virtual conferences. In the form of Internet, computers have provided an entirely new way to share knowledge. Today, anyone can access the latest research papers that are made available on websites. Sharing of knowledge and collaboration through the Internet has made international cooperation on scientific projects possible. Mobility Researchers can take computers anywhere, making it easier to conduct field research and collect data. New areas of research in remote areas or at a community level are opened up by the mobility of computers. Social media sites have become a new medium for interaction and information. Computers are useful tools that make the research process easier and faster with accuracy and great reliability. Through various kinds of analytical software programs, computers are contributing research in every discipline, ranging from biology to astrophysics, discovering new patterns and providing novel insights. There are the obvious ways computers help: we use them to write, search, store data, create tables and diagrams, edit pictures and audio and video, and so on. Software for qualitative data analysis allows the analyst to systematically index and organize qualitative data, and then to reliably and flexibly retrieve that data in many different ways. Researchers who interested in budding skills in computer data analysis, while approaching the computer centers and reading the relevant literature, must be aware of the following steps :

- (i) Data organisation and coding;
- (ii) Saving the data in the computer;
- (iii) Selection of appropriate statistical measures/techniques;
- (iv) Selection of appropriate software package;
- (v) Execution of the computer program.



## Check Your Progress – 5 :

## Research Design

1. c                      2. a

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### 1.10 Glossary :

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1. **Precise** – Exact
2. **Bias** – Partiality
3. **Inference** – Assumption
4. **Distinctive** – Unique
5. **Rationale** – Basis
6. **Tentative** – Uncertain
7. **Empirical** – Observed
8. **Pivot** – Revolve
9. **Competent** – Capable
10. **Imperative** – Vital
11. **Haphazard** – Random
12. **Ethnic** – Cultural

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### 1.11 Assignment :

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1. Describe different types of Research Design ?

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### 1.12 Activities :

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1. Prepare a model of a synopsis ?

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### 1.13 Case Study :

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1. How does internet help in researching ? Describe with examples ?

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### 1.11 Further Readings :

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1. Research Methodology C.R. KOTHARI.
2. Research in Education JOHN BEST
3. Research Design PHILIP BERNARD
4. Scientific Research Procedure P. V. YOUNG





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: UNIT STRUCTURE :  
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- 2.0 Learning Objectives
- 2.1 Introduction
- 2.2 Meaning, Need, Process
- 2.3 Spiral Scientific Method
- 2.4 Types of Research
- 2.5 Kinds of Research
- 2.6 Research Ethics
- 2.7 Let Us Sum Up
- 2.8 Answers for Check Your Progress
- 2.9 Glossary
- 2.10 Assignment
- 2.11 Activities
- 2.12 Case Study
- 2.13 Further Readings

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**2.0 Learning Objectives :**

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**After learning this unit, you will be able to :**

- Understand about meaning need and process of research
- Understand what is Spiral Scientific Method
- Know about different types of research
- What is research ethics

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**2.1 Introduction :**

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Many things that we do in our daily lives are based on common sense, acquired by us with the help experience of life. These may be what we have learnt from others or what we have learnt through personal experience or observation. Sometimes common sense may not the best approach and sometimes there are conflicting theories about what is best or what works in a particular situation. Above all, what works in one situation or for one condition might be ineffective or even dangerous in another, or when combined with other measures.

Carefully organized and controlled research enables researchers to test and compare different theories and approaches, explore different methods and learn from other people's experience. It also enables them to ruleout or atleast consider external factors which might influence their

results. Another advantage to carrying out research is that for a lot of studies, the findings can be recorded numerically and then statistically analysed in order to determine whether the findings are significant. The advantage to many qualitative studies is that they permit an in-depth investigation into a particular aspect of human experience. They give people the opportunity to explain in their own words how they feel, what they think and how they make sense of the world they live in.

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## **2.2 Meaning, Need, Process :**

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### **Meaning of Research :**

Research in simple terms refers to search for knowledge. It is a scientific and systematic search for information on a particular topic or issue. It is also known as the art of scientific investigation. Several social scientists have defined research in different ways. Thus, research is an original addition to the available knowledge, which contributes to its further advancement. It is an attempt to pursue truth through the methods of study, observation, comparison and experiment. In sum, research is the search for knowledge, using objective and systematic methods to find solution to a problem.

### **Need for Research :**

The need for research can be pointed as follows :

1. Extension of knowledge.
2. Bring to light information that might never be discovered during the ordinary course of life.
3. Establish generalizations and general laws which contributes to theory building.
4. Verify and test the existing facts and theories.
5. Initiate, formulate, deflect, and analyze interrelationships between variables and to derive causal explanations.
6. Find solutions to problems; develop new tools, concepts and theories.
7. Aid in planning and contributes to national development.
8. Disseminate research findings to create awareness of current situations and problems.
9. Formulate strategies and policies.
10. Brings prestige to the person and the institution.
11. Promote progress of the society.

### **Research Process :**

The research process is a multiple-step process where the steps are interlinked with the other steps in the process. The research process is the step-by-step procedure of developing one's research and research paper. However, one can seldom progress in a step-by-step fashion as such. Writing a research paper frequently requires continuous, and

**Basics of  
Research Methods**

sometimes extensive, re-evaluation and revision of both one's topic and the way it is presented. It is often necessary to revise an initial research plan. You may need to add new material, delete extraneous material, or even change the topic completely, depending on what is discovered during your research. You may find that your topic is too broad and needs to be narrowed, or that sufficient information resources may not be available (e.g. the topic is too narrow, and needs to be expanded or changed). Sometimes what you learn may not support the thesis with which you began. The research process involves identifying, locating, assessing, analyzing, and then developing and expressing your ideas. These are the same skills that will be needed in the post-university "real world" when you produce reports, proposals, or other research for your employer. All of these activities will be based on primary and secondary sources from which recommendations or plans are formulated.

**Research Process**



**Fig. 2.1 : Research Process**

**Check Your Progress – 1 :**

1. Research is an original addition to the available knowledge, which contributes to its further advancement.
  - a. True
  - b. False
2. The need for research is \_\_\_\_\_.
  - a. Extension of knowledge
  - b. Bring to light information
  - c. Establish generalizations
  - d. all the above
3. The research process is the step-by-step procedure of developing one's research and research paper.
  - a. True
  - b. False

### 2.3 Spiral Scientific Method :

Scientific method is characterised by a non– ending spiral movement. The cycle inferred in the spiral will have a clock–wise direction. For the ease of reference, the four cardinal points of the cycle are symbolized as **Nadir, Ascendent, Zenith, and Descendent**. The nadir marks the accumulation of facts, obtained by observation, experimentation, and other similar forms of experience.

The four cardinal points give rise to four quadrants in the cycle implied in the spiral. For the ease of reference, the quadrants will be numbered 1 to 4 respectively, as follows:

- Quadrant 1 is the one between descendent and nadir;
- Quadrant 2 is the one between nadir and ascendent;
- Quadrant 3 is the one between ascendent and zenith
- Quadrant 4 is the one between zenith and descendent.



Fig 2.2 : Spiral Scientific Method

**Quadrant 1** corresponds to the stage in the development of a domain of the universe of knowledge, conforming to scientific method, in which

- Primary sense are used either in their native state or with the aid of instruments of various degrees of powerfulness;
- observations are made of knowees, either with or without experimental interference and conditioning;
- there is progression towards particularisation and regression from generalisation,

## Basics of Research Methods

- (d) There is progression towards concreteness and regression from abstractness
- (e) Facts are found and recorded.

**Quadrant 2** corresponds to the stage in which

- (a) intellect is used either by itself or aided by machinery constructed to speed up the work of the intellect and to give relief to it in some measure
- (b) reasoning is made with the aid of inductive logic including normal equations and other statistical and other calculuses to boil down the numerous facts, accumulated at the nadir to a small number of inducted or empirical laws–  
e.g. Kepler's Law of equal area in the motion of planets, boiled down from the facts recorded by Tycho Brahe – more easy to hold in memory than the multitude of the–facts themselves;
- (c) there is regression from particularisation and progression towards generalisation;
- (d) there is regression from concreteness and progression towards abstractness; and
- (e) The inducted and empirical laws are formulated and recorded.

**Quadrant 3** corresponds to the stage in which

- (a) Intuition of some intensity or other is used unmediated by the primary senses or the intellect;
- (b) The inducted or empirical laws stand boiled down to a very small number of fundamental laws e. g. Newton's Laws of motion to which many empirical laws such as the Keplart's Law stand reduced at one stroke – more easy to hold in memory than the more numerous empirical inducted laws;
- (c) There is regression from particularization and progression towards ultimate generalization
- (d) there is regression from concreteness and progression towards ultimate abstractness
- (e) the fundamental laws are seized and recorded.

**Quadrant 4** corresponds to the stage in which

- (a) intellect is used either by itself or aided by machinery constructed to speed up the work of the intellect and to give relief to it in some measure
- (b) Reasoning is made with the aid of deductive logic including general semantics, and mathematical and other calculuses to work out all the compelling implications of the fundamental laws;
- (c) There is progression towards particularisation and regression generalisation;

- (d) There is progression towards concreteness and regression from abstractness;
- (e) The deduced laws are derived and recorded
- (f) The derived deduced laws include one and all of the inducted empirical laws and
- (g) The number of deduced laws exceeds that of the empirical laws, if the fundamental laws had been seized with intuition of adequate intensity.

### Check Your Progress – 2 :

1. Spiral Scientific Method is characterised by a non- ending spiral movement
  - a. true
  - b. False
2. In observations are made of knowees, either with or without experimental interference and conditioning
  - a. Quadrant1
  - b. Quadrant2
  - c. Quadrant3
  - d. Quadrant4
3. There is regression from concreteness and progression towards ultimate abstractness in
  - a. Quadrant1
  - b. Quadrant2
  - c. Quadrant3
  - d. Quadrant4
4. There is progression towards concreteness and regression from abstractness
  - a. Quadrant1
  - b. Quadrant2
  - c. Quadrant3
  - d. Quadrant4

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## 2.4 Types of Research :

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The basic types of research are as follows :

- (i) **Descriptive vs. Analytical** : Descriptive research is the survey and fact– finding enquiries of different kinds. The key objective of the descriptive research is description of the state of affairs as it exists currently. It is used in social science and business researches. The term Ex post facto research is used for descriptive research studies. The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or what is happening.

The methods of research that are used in descriptive research are survey methods of all kinds along with comparative and correlational methods. In analytical research, the researcher should use facts or information which are readily available, and examine these to make a significant assessment of the material.

- (ii) **Applied vs. Fundamental** : Research can either be applied /action research or fundamental /basic or pure) research. Applied research aims to find a solution for an instant problem faced by a society or an industry or a business organization. While the fundamental research mainly deals with the generalizations and the formulation of a theory. Research of a natural phenomenon or related to the



**Quantitative Research :**

This research generates data in quantitative form which can be subjected to accurate quantitative analysis in a proper and rigid fashion. This approach is further subdivided to inferential, experimental and simulation approaches to research. The purpose of inferential approach to research is to create data base from which characteristics or relationships of population is worked out. This can be also called survey research where a study helps to find out the characteristics of the population and it is then concluded that the population has the same characteristics.

Experimental approach has much larger control over the research environment and in this case some variables are influenced to observe their effect on other variables.

Simulation approach manages the construction of a non-natural environment within which significant information and data can be produced. This allows an observation of the active behavior of a system under regulated conditions.

**Qualitative Research :**

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

**Types of Research with Difference in Approaches :**

Other types of research are based on the intention of research, or the time mandatory to carry out research or the environment in which research is carried out, or on the basis of some other similar aspect.

**Form the point of view of time**, we can think of research as either **one-time research or longitudinal research**. In the onetime research the research is confined to a single time-period, whereas in the longitudinal research the research is carried on over a number of time-periods. Research can be field-setting research or laboratory research or simulation research, **on the basis of environment** in which it is to be carried out. Research can as well be understood as **clinical or diagnostic research**. Such research is based on case-study methods or in detail approaches to accomplish the vital fundamental relations. The researcher may usually go deep into the reason events that he is interested by using small samples and sophisticated data gathering devices. The research can also be **exploratory** or it may be **formalized**. The purpose of exploratory research is to develop hypotheses rather than their testing, but formalized research studies are those with significant structure and with definite hypotheses to be tested. Historical research is that which uses historical resources such as documents, remains, etc. to study proceedings or thoughts of the past, such as the philosophy of individuals and groups at any



## Basics of Research Methods

inaccessible point of time. Research can also be classified as **conclusion-oriented and decision-oriented**. While conducting a **conclusion oriented** research, a researcher has the freedom to pick up a problem, restructure the enquiry according to his wish.

**Decision-oriented** research is an important tool for the decision maker and the researcher in this case do not have the freedom to do the research according to his wish. Operations research is the best example for the decision oriented research.

### Check Your Progress – 4 :

1. This research is concerned with subjective assessment of attitudes, opinions and behavior
  - a. Qualitative Research
  - b. Quantitative research
  - c. none
2. The purpose of inferential approach to research is to create data base from which characteristics or relationships of population is worked out.
  - a. true
  - b. false
3. Simulation approach manages the construction of a non-natural environment within which significant information and data can be produced.
  - a. true
  - b. false
4. While conducting a conclusion oriented research, a researcher has the freedom to pick up a problem, restructure the enquiry according to his wish.
  - a. true
  - b. false

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### 2.6 Research Ethics :

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Knowledge of ethical research concepts is very important for all people who conduct research projects or utilize and implement the results from research findings. Every researcher should be well-known with the fundamental ethical principles and have the latest knowledge about the rules and regulations designed to make sure the safety of research subjects and to stop careless or negligent research. The ignorance of policies intended to defend research subjects is not considered as a possible justification for ethically questionable projects. Therefore, it is the duty of the researcher to find out and understand the rules and regulations made to guarantee honest research practices. Research is an open expectation that should be trustworthy ethically conducted, if the results are to be valuable. Every point of a research project starting from the project design to submission of the results must be in order to be considered ethical. Even if a part of a research project is conducted unethically and is questioned, the truthfulness of the whole project is questioned.

**Plagiarism :**

Plagiarism is the act of copying another one's ideas, view, pictures, suppositions, expressions and presenting it as own. Suppose a researcher plagiarizes the effort of another person, he is bringing into question the truthfulness, beliefs, and responsibility of the whole of his or her research. Moreover, the plagiarism is both an illegitimate act and punishable, which is considered as similar as theft.

**Some of the Ethical Standards :****Researchers should**

- Not involve in researches that do harm to people environment and property.
- Not use trick on people who participate for the research
- Obtain consent from the concerned authorities for all the conducted studies.
- Maintain privacy and confidentiality
- Not propose rewards or enforce obligatory contracts for the study. This is particularly important when people are somehow deprived on the incentive.
- Not plagiarise others work.
- Not tilt their conclusion on the basis of funds.

**Check Your Progress – 5 :**

1. The ignorance of policies intended to defend research subjects is considered as a possible justification for ethically questionable projects
  - a. true
  - b. false
2. Plagiarism is the act of copying another one's ideas, view, pictures, suppositions, expressions and presenting it as own.
  - a. true
  - b. false

**2.7 Let Us Sum Up :**

To conclude we can say that organized and controlled research will help the researcher to analyse and compare diverse theories and approaches, investigate diverse means and study from other people's experience. The basic types of research are descriptive, analytical, applied, fundamental, quantitative, qualitative, conceptual, and empirical. While considering the kinds of research it's of two types quantitative research and the qualitative research. Every researcher should be well-known with the fundamental ethical principles and have the latest knowledge about the rules and regulations designed to make sure the safety of research subjects and to stop careless or negligent research.

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**2.8 Answers for Check Your Progress :**

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**Check Your Progress – 1 :**

1. a            2. d            3. a

**Check Your Progress – 2 :**

1. a            2. a            3. b            4. d

**Check Your Progress – 3 :**

1. a            2. b            3. a            4. a

**Check Your Progress – 4 :**

1. b            2. a            3. a            4. a

**Check Your Progress – 5 :**

1. b            2. a
- 

**2.9 Glossary :**

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1. **Ineffective** – Unsuccessful
  2. **Explore** – Investigate
  3. **Observation** – Examination
  4. **Deflect** – Prevent
  5. **Disseminate** – Distribute
  6. **Extraneous** – Unrelated
  7. **Narrowed** – Pointed
  8. **Cardinal** – Basic
  9. **Concreteness** – Thickness
  10. **Induct** – Initiate
  11. **Concreteness** – Thickness
  12. **Rigid** – Unbending
- 

**2.10 Assignment :**

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1. What are different the kinds of research ?
- 

**2.11 Activities :**

---

1. Explain Spiral Scientific Method with diagram ?
- 

**2.12 Case Study :**

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1. Express your view about plagiarism and research, with a suitable example ?
- 

**2.13 Further Readings :**

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1. Research Methodology C. R. KOTHARI.
-



**: UNIT STRUCTURE :**

- 3.0 Learning Objectives**
- 3.1 Introduction**
- 3.2 Experimental Research**
  - 3.2.1 Different Types and Basic Principles**
  - 3.2.2 Different Types of Experimental Research**
- 3.3 Survey Research**
  - 3.3.1 Different Types and Tools of Survey**
- 3.4 Let Us Sum Up**
- 3.5 Answers for Check Your Progress**
- 3.6 Glossary**
- 3.7 Assignment**
- 3.8 Activities**
- 3.9 Case Study**
- 3.10 Further Readings**

---

**3.0 Learning Objectives :**

**After learning this unit, you will be able to :**

- Understand about different types of experimental research
- Understand the basic principles of experimental research
- Understand different types of survey research
- Understand about the tools of survey

---

**3.1 Introduction :**

The purpose of research is to discover answers to questions through the application of scientific procedure. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Research in simple terms refers to search for knowledge. It is a scientific and systematic search for information on a particular topic or issue. It is also known as the art of scientific investigation. Thus, research is an original addition to the available knowledge, which contributes to its further advancement. It is an attempt to pursue truth through the methods of study, observation, comparison and experiment.

---

**3.2 Experimental Research :**

The experimental method is a systematic and scientific approach to research in which the researcher manipulates one or more variables,

## Basics of Research Methods

and controls and measures any change in other variables. When experimental research happens, there are certain steps that scientists take, the first one being an effort to control certain variables, which can be controlled, and then systematically manipulating other variables. The purpose of using control and manipulation on the variables of the experiment is to see if the variables that are being manipulated have an effect on the results, or data. This way, scientists can test hypothesis and analyse outcomes to make new inferences from the research. This makes experimental research extremely important. Another important aspect of experimental research is the usage of randomization. This technique ensures that subjects of an experiment are always randomly assigned, or that the methodology is always random so as to ensure that there will be no bias or error in the experiment that would otherwise compromise the results of the research. An example of randomization would be when subjects are designated to receive an experimental drug and the other subjects are to have a placebo. Randomization would dictate that these subject groups are made out of a completely random selection, and this would make sure that there is no bias or error because the subjects are blinded to their group designation.

The basic principles of experimental designs are randomization, replication and local control. These principles make a valid test of significance possible. Each of them is described briefly in the following subsections.

### 3.2.1 Basic Principles of Experimental Research :

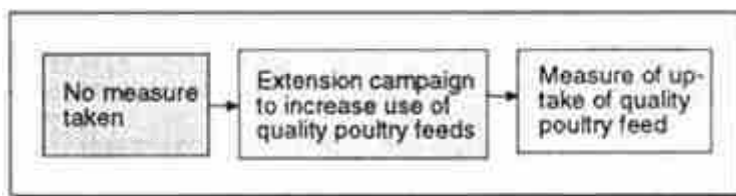
- (a) **Randomization** : It is the foremost principle of an experimental design. It is a random process of assigning treatments to the experimental units. The random process means that every probable allotment of treatments has the same probability. An experimental unit is the least division of the experimental material and a treatment means an experimental condition whose effect is to be measured and compared. The intention of randomization is to eliminate bias and other sources of irrelevant variation, which cannot be controlled. Another advantage of randomization is that it forms the base of any suitable statistical test. So the treatments must be allocated at random to the experimental units. Randomization is generally done by drawing numbered cards from a well-shuffled pack of cards, or by drawing numbered balls from a well-shaken box or by using tables of random numbers.
- (b) **Replication** : The second principle of an experimental design is replication; which is a duplication of the basic experiment. It is an entire run for all the treatments to be tested in the test. In all trials, some deviation is introduced because of the reality that the trial units such as individuals or plots of land in agricultural experiments cannot be physically alike. This type of difference can be separated by using a number of trial units. The experiment is

conducted more than once, that is the basic experiment is repeated. This individual repetition is called a replicate. The number, the nature and the extent of replicates depend upon the nature of the experimental material. A replication is used

- (i) To get more precise approximation of the experimental error, a phrase which represents the disparity that would be observed if the identical treatments were used many times to the similar experimental units;
  - (ii) To reduce the trial error and thus to enhance precision, which is a measure of the unpredictability of the experimental error; and
  - (iii) To get more accurate approximation of the mean effect of a treatment, because  $\sigma^2\bar{y} = \frac{\sigma^2}{n}$ , where n denotes the number of replications.
- (c) **Local Control** : It has been observed that all irrelevant sources of variation are not removed by randomization and replication. This demands a modification in the investigational technique. In other words, we require preferring a design in such a way that all extraneous sources of variation are made under control. For this reason, we employ local control, a term referring to the extent of balancing, blocking, and grouping of the experimental units. By balancing we mean how the treatments should be assigned to the experimental units, so that the result is a balanced arrangement of the treatments. By blocking we mean that the experimental units must be collected jointly to form a comparatively homogeneous group. A block is also a replicate. The main intention of the principle of local control is to enhance the competence of an experimental design by diminishing the experimental error.

**3.2.2 Different Types of Experimental Research :**

- (a) **After-only-designs** : As the name suggests, with after-only experimental designs measures of the independent variable are only taken after the experimental subjects have been exposed to the independent variable.

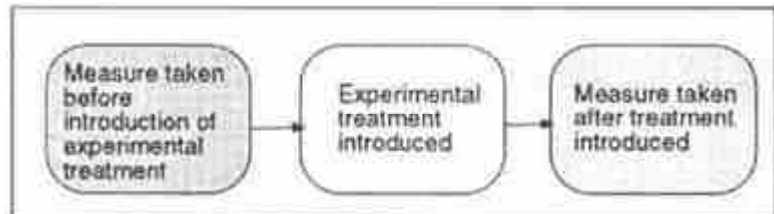


**Fig. 3.1 : after-only- designs**

The main difficulty with after-only designs is that they do not give any control over extraneous factors that could have influenced the post-exposure measurements. After-only designs are not factual experiments as little or no control is exercised over any of the variables by the researcher. However its addition here serves to emphasize the need for more complex designs.

## Basics of Research Methods

- (b) **Before–after–designs** : A before–after design helps the researcher in measuring the dependent variable both before and after the participants has been exposed to the independent variables. The before–after design is an enhancement upon the after–only design, in that the effect of the independent variable, if any, is recognized by examining differences among the value of the dependent variable before and after the experiment. However, before–after designs still have a number of drawbacks.



**Fig. 3.2 : before–after– designs**

- (c) **Before–after with Control Group Design** : This design helps to establish two samples or groups of respondents. An experimental group that will be exposed to the marketing variable and a control group which would not be subjected to the marketing variable under study. The two groups would be matched. That is, the both the samples would be alike in all important respects. The idea is that any confusing factors would affect uniformly on both groups and therefore any disparity in the data drawn from the two groups can be endorsed as the experimental variable. If a "before and after with control group" experiment is correctly planned and executed then the effects of maturation, pretesting and measurement variability should be the identical for the experimental group and the control group.
- (d) **After–only with Control Group Experimental Design** : Again, this design helps in establishing two corresponding samples or groups of respondents. No measurement is taken from either group before the experimental variable is introduced and the control group is not afterwards subjected to the experimental variable. Subsequently measures are taken from both groups and the effect of the experimental variable is recognized by subtracting the control group measure from the experimental group measure
- e) **Ex post Facto Design** : The ex post facto design is a deviation of the –after–only with control group– experimental design. The main dissimilarity is that both the experimental and control groups are selected after the experimental variable is introduced and not before. This approach reduces the prospects that participants will be influenced by awareness that they are being tested.

**Check Your Progress – 1 :**

1. The experimental method is a systematic and scientific approach to research in which the researcher manipulates one or more variables, and controls and measures any change in other variables.
  - a. true
  - b. false
2. Randomization would dictate that these subject groups are made out of a completely random selection.
  - a. true
  - b. false
3. The basic principles of experimental designs are
  - a. randomization
  - b. replication
  - c. local control
  - d. above all
4. \_\_\_\_\_ are not factual experiments as little or no control is exercised over any of the variables by the researcher.
  - a. After-only designs
  - b. before-after design
  - c. ex post facto design
5. The \_\_\_\_\_ is an enhancement upon the after-only design, in that the effect of the independent variable
  - a. After-only designs
  - b. before-after design
  - c. ex post facto design
6. The \_\_\_\_\_ is a deviation of the -after-only with control group-experimental design
  - a. After-only designs
  - b. before-after design
  - c. ex post facto design

**3.3 Survey Research :****3.3.1 Different Types and Tools of Survey :**

Survey research is one of the most important areas of measurement in applied social research. The broad area of survey research encompasses any measurement procedures that involve asking questions of respondents. A "survey" can be anything from a short paper-and-pencil feedback form to an intensive one-on-one in-depth interview. A survey is defined as a brief interview or discussion with individuals about a specific topic. A study is designed to collect information about a topic.

**Types of Surveys :**

Surveys can be divided into two broad categories: the questionnaire and the interview.

**Questionnaires :**

Questionnaires are usually paper-and-pencil instruments that the respondent completes. Interviews are completed by the interviewer based on the respondent says. Sometimes, it's hard to tell the difference between a questionnaire and an interview. For instance, many have the perception



## **Basics of Research Methods**

that questionnaires always have short and closed-ended questions while in interviews interviewers ask broad and open-ended ones. But we will come across questionnaires with open-ended questions and frequently there will be a series of closed-ended questions asked in an interview. There has been a dramatic change in the Survey research in the last ten years. Automated telephone surveys using random dialing methods have been widely used. Computerized kiosks are placed in public places which allow people to ask for input. A whole new variation of group interview has evolved as focus group methodology. The service sector increasingly use survey research to get feedback of the service rendered. For example every class hotels have a customer survey on the desk.

### **Mail Survey :**

But most people think of questionnaires, when they think of the mail survey. It's sure that all of us must have received a questionnaire in the mail. Mail surveys have many advantages. They are relatively cost effective and inexpensive to administer. You can send the same mail to a wide number of people. The respondents have their own choice and convenience. The main disadvantages are the response rates as they are often very low. So they cannot be considered as a best option for detailed written responses.

### **Group Administered Questionnaire :**

In group administered questionnaire the sample of respondents is brought together and asked to respond to a structured sequence of questions. Traditionally, questionnaires were administered in group settings for convenience. The researcher can distribute the questionnaire to those who are present and be fairly sure that there would be a high response rate. If any respondent has a doubt about the meaning of a question they can ask for clarification and clear it instantly.

In the group administered questionnaire, each respondent is handed an instrument and asked to complete it while in the room. Each respondent completes an instrument. In the group interview or focus group, the interviewer facilitates the session. People work as a group, listening to each other's comments and answering the questions. Someone takes notes for the entire group people don't complete an interview individually. A less familiar type of questionnaire is the household drop-off survey. In this approach, a researcher goes to the respondent's home or business and hands the respondent the instrument. In some cases, the respondent is asked to mail it back or the interviewer returns to pick it up. This approach attempts to blend the advantages of the mail survey and the group administered questionnaire. Like the mail survey, the respondent can work on the instrument in private, when it's convenient. Like the group administered questionnaire, the interviewer makes personal contact with the respondent; they don't just send an impersonal survey instrument. And, the respondent can ask questions about the study and get clarification on what is to be done. Generally, this would be expected to increase the percent of people who are willing to respond.

**Interviews :**

Interviews are a far more personal form of research than questionnaires. In the personal interview, the interviewer works directly with the respondent. Unlike with mail surveys, the interviewer has the opportunity to probe or ask follow-up questions. And, interviews are generally easier for the respondent, especially if what are sought are opinions or impressions. Interviews can be very time consuming and they are resource intensive. The interviewer is considered a part of the measurement instrument and interviewers have to be well trained in how to respond to any contingency.

**Statistical Tools –Survey :**

- The **Mean** (or average) is the most commonly used method of describing central tendency. The Mean is calculated from the sum of all the values divided by the total number of values.
- The **Mode** is the most frequently occurring value in the dataset.
- The **Median** is the value found in the exact middle of the set of values when the values are put in order from least to greatest, or in numeric order. If there is an even number of values

**Minimum, Maximum, Range and Quartiles :**

The Minimum, Maximum, Range, and Quartiles are used to determine the spread of the data values. Range shows the spread of the distribution and is calculated by subtracting the smallest value (minimum) from the largest value (maximum). The Quartiles are one-quarter (**1st Quartile** – 25% ) and three-quarters (**3rd Quartile** – 75%) of the way through a range of values. Range and Inter-quartile range (the difference between the upper- and lower-quartiles) are basic measures of the spread of the survey data.

**Variance, Standard Deviation and Standard Error :**

The Variance, Standard Deviation, and Standard Error of the Mean measure the entire spread of data in a more advanced way. All methods are used in Significance Testing and are calculated by considering value. Variance and Standard Deviation measure how much each individual response differs from the Mean of all responses. **Standard Deviation** is a measure of the spread of values in a distribution and is calculated by taking the square route of Variance. It gives an indication of how much the values deviate from the Mean. **Standard Error** of the Mean is the Standard Deviation divided by the square root of the survey sample size.

- **Normal Distribution** is also referred to as the bell-shaped curve. The bell- shape of the Normal Distribution makes it a convenient choice for representing a large variety of random variables.
- **Kurtosis and Skewness** : Kurtosis and Skewness measure the degree to which a set of data values differs from the Normal Distribution..

**Check Your Progress – 2 :**

1. Survey research is one of the most important areas of measurement in applied social research.  
a. True b. False
2. A survey is defined as a brief interview or discussion with individuals without any specific topic.  
a. True b. False
3. Questionnaires are usually paper-and-pencil instruments that the respondent completes.  
a. True b. False
4. Mail surveys are relatively costly and expensive to administer.  
a. True b. False
5. Interviews are a far more personal form of research than questionnaires.  
a. True b. False

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**3.4 Let Us Sum Up :**

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To conclude, experimentation offers the possibility of establishing a cause and effective relationship between variables and this makes it an attractive methodology to marketing researchers. An experiment is a contrived situation that allows a researcher to manipulate one or more variables whilst controlling all of the others and measuring the resultant effects on some independent variable. Experiments are of two types: those conducted in a laboratory setting and those which are executed in natural settings; these are referred to as field experiments. Laboratory experiments give the researcher direct control over most, if not all, of the variables that could affect the outcome of the experiment. The evidence for drawing inferences about causal relationships takes three forms: associative variation, consistent ordering of events and the absence of alternative causes. There are a number of potential impediments to obtaining valid results from experiments. These may be categorised according to whether a given confounding factor has internal validity, external validity, or both. Internal validity is called into question when there is doubt that the experimental treatment is actually responsible for changes in the value of the dependent variable. External validity becomes an issue when there is uncertainty as to whether experimental findings can be generalised to a defined population. The impediments to internal validity are history, pre-testing, maturation, instrumentation, sampling bias and mortality. Impediments to external validity are: the interactive effects of testing, the interactive effects of sampling bias and errors arising from making use of contrived situations.

The main forms of experimental design differ according to whether or not a measure is taken both before and after the introduction of the experimental variable or treatment, and whether or not a control group is used alongside the experimental group. The designs are: after-only,

before–after, before–after with control group, after–only with control group and ex– post facto designs.

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### **3.5 Answers for Check Your Progress :**

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#### **Check Your Progress – 1 :**

- |      |      |      |
|------|------|------|
| 1. a | 2. a | 3. d |
| 4. a | 5. b | 6. c |

#### **Check Your Progress – 2 :**

- |      |      |      |      |      |
|------|------|------|------|------|
| 1. a | 2. b | 3. a | 4. b | 5. a |
|------|------|------|------|------|
- 

### **3.6 Glossary :**

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1. **Comparison** – Association
  2. **Pursue** – Follow
  3. **Manipulate** – Influence
  4. **Inference** – Conclusion
  5. **Bias** – Partiality
  6. **Placebo** – Gesture
  7. **Replication** – Duplication
  8. **Perception** – Observation
  9. **Rendered** – Deliver
- 

### **3.7 Assignment :**

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1. What is an experimental research ?
  2. Explain the different types of experimental research ?
- 

### **3.8 Activities :**

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1. Prepare a questionnaire for a mail survey ? Topic of the survey can be according to your choice.
- 

### **3.9 Case Study :**

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1. Point out the importance of mail survey in the marketing field with suitable example.
- 

### **3.10 Further Readings :**

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1. Research Methodology C. R. KOTHARI.



**: UNIT STRUCTURE :**

- 4.0 Learning Objectives**
- 4.1 Introduction**
- 4.2 Identifying and Defining the Problem**
- 4.3 Exploratory Research**
- 4.4 Developing the Hypothesis**
- 4.5 Creating the Research Design**
- 4.6 Determining Sampling Design**
- 4.7 Collecting Data**
- 4.8 Analyzing Data**
- 4.9 Testing of Hypothesis**
- 4.10 Generalisations and Interpretations**
- 4.11 Reporting the Results**
- 4.12 Report Writing**
- 4.13 Let Us Sum Up**
- 4.14 Answers for Check Your Progress**
- 4.15 Glossary**
- 4.16 Assignment**
- 4.17 Activities**
- 4.18 Case Study**
- 4.19 Further Readings**

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**4.0 Learning Objectives :**

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- Understand how to identify and define the problem
- Understand the concept of exploratory research
- Understand how to develop the hypothesis
- Understand how to create the research design
- Understand how to determine sampling design
- Understand the methods of collecting data
- Understand how to analyze data
- Understand the testing of hypothesis
- Understand generalisations and interpretations and reporting the results

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#### **4.1 Introduction :**

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Research Process consists of services of steps necessary to carry out research in an effective way. There must be a proper sequence of the research process. Some steps begin out of the sequence; some are carried out simultaneously, while some are omitted. However, the following order of various steps provides useful guidance and can be considered as basic thumb rules for any research process.

- Identifying and Defining the Problem
- Exploratory Research
- Developing the Hypothesis
- Creating the Research Design
- Determining Sampling Design
- Collecting Data
- Analyzing Data
- Testing of Hypothesis
- Generalisations and Interpretations
- Reporting the results

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#### **4.2 Identifying and Defining the Problem :**

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The researcher should first identify the problems in business like customer complaints, success of the company's competitor, observation of inappropriate behaviour in the company. The researcher should understand the problem thoroughly and then define the problem into meaningful terms from an analytical point of view.

The researcher can get better in insight of the problem by discussing the problem with colleagues or with those having expertise in the matter.

The task defining the research problem is of great importance in the entire process.

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#### **4.3 Exploratory Research :**

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Once the problem is defined in proper frame, the researcher should start with extensive exploratory research. For that the literature survey relevant with the problem should be undertaken. Similar case studies should be read and studied carefully. Researcher can use academic journals, conference proceedings, reports, books, surf net, etc. for this purpose.

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#### **4.4 Developing the Hypothesis :**

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Exploratory Research should be followed by stating clear hypothesis. Hypothesis is an assumption made to draw and test its logical consequences. Hypothesis should be very clear and specific as it has to be tested. It helps the researcher to focus on the more important aspects of the problem. It will also guide the researcher in selecting the type of data

and techniques to be used in data analysis. Thus, hypothesis can be developed effectively by systematic a-prior thinking about the problem and available resources.

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#### **4.5 Creating the Research Design :**

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The researcher will now have to state the conceptual structure within which the research would be conducted. The proper research design will provide for the collection of relevant information with minimal effort, time and cost.

There are several research designs such as experimental and non-experimental hypothesis testing. Experimental Designs are either formal or informal in nature. Formal Designs include Completely Randomized Design, Latin Square Design and Randomized Block Design, etc.

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#### **4.6 Determining Sampling Design :**

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An inquiry of all units under consideration is called complete enumeration or population survey, while an inquiry of few units selected from the total units is called sample inquiry. The few units selected from total units is called a sample, which should be a representative part of a population. The selection of sample from the populations is called sampling design. Sampling design is a definite plan for obtaining a sample from given population. The sampling design can be either probabilistic sampling or non-probabilistic sampling. The probabilistic sampling includes simple random sampling, systematic sampling, stratified sampling, cluster sampling, etc. The non-probabilistic sampling includes convenient sampling, judgemental sampling, quota sampling, etc.

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#### **4.7 Collecting Data :**

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Exploratory research is based on historical data. It is also essential to collect primary data. There are several ways of collecting the suitable primary data. Primary data can be collected either through experiment or through survey.

In case of survey, data can be collected by any one or more of the following methods depending upon the nature of investigation, resources available, scope of inquiry and desired level of accuracy.

- (a) By investigator's observation
- (b) Through direct personal interview
- (c) Through indirect oral inquiry
- (d) By mailed questionnaire
- (e) Questionnaire to be filled by the investigator
- (f) Information from local agents and correspondents

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#### **4.8 Analyzing Data :**

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Analyzing the data is a process of inspecting, cleaning, transforming and modelling the data with the aim of highlighting useful information and support decision making. Data analysis has multiple approaches in incorporating diverse techniques in different business. The researcher should understand the data carefully and then incomplete information can be edited or deleted. The data required can be condensed into manageable groups useful for further analysis. Tabulation and classification techniques should be utilized to get better insight about the data and its pattern.

Data analysis has two main paradigms viz. verification and discovery. For verification process, we use goodness of fit and testing of hypothesis, ANOVA (Analysis of Variance), etc. In discovery, we use various techniques like correlation, regression, cluster analysis, etc. Thus, depending upon the type of data and purpose of research, various statistical techniques can be utilized for data analysis.

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#### **4.9 Testing of Hypothesis :**

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After data analysis, researcher is in the position to answer whether the data supports the hypothesis or not? Various statistical tests such as Z-test, t-test, F-test, chi square test, etc. can be used for testing of hypothesis. Hypothesis testing will lead to either accepting or rejecting the hypothesis. Depending upon the decision of hypothesis testing, conclusion or inference can be made.

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#### **4.10 Generalisations and Interpretations :**

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If a hypothesis is tested and accepted/rejected several times, researcher may arrive at generalisation or build a theory. If the researcher had not stated the hypothesis, then he should explain his findings on the basis of some theory. It is known as interpretation.

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#### **4.11 Reporting the Results :**

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After all the steps, the researcher finally has to prepare the report. Report writing in professional, technical and business contexts has evolved certain conventions regarding format, style, referencing and other characteristics. The format of report should be as under :

- Cover Sheet
- Title Page
- Abstract
- Table of Contents
- Introduction
- The body of the report
- Conclusion (and recommendations if any)



- References/Bibliography
- Glossary (if needed)
- Appendices

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#### **4.12 Report Writing :**

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Report should be written in a concise manner and lucid language. Charts and illustrations in the main report should be used to present the information in clear but attractive manner.

#### **Check Your Progress :**

1. Verification and Discovery are the two main paradigms of \_\_\_\_\_  
(a) data interpretation                      (b) data analysis
2. Goodness of fit is used for \_\_\_\_\_  
(a) verification                                  (b) discovery
3. Cluster analysis is used for \_\_\_\_\_  
(a) verification                                  (b) discovery
4. Doing experiments to test hypotheses is the foundation of the \_\_\_\_\_.  
a. Scientific Method                              b. Explanatory method  
c. Correlation method
5. \_\_\_\_\_ is an essential for Scientific method.  
a. Reliable thought                              b. Unreliable thought  
c. Both

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#### **4.13 Let Us Sum Up :**

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Research is a scientific inquiry aimed at learning new facts, testing ideas, etc. It is the systematic collection, analysis and interpretation of data to generate new knowledge and answer a certain question or solve a problem. The basic research is necessary to generate new knowledge and technologies to deal with major unresolved problems. On the other hand, applied research is necessary to identify priority problems and to design and evaluate policies and programs that will deliver the greatest benefit, making optimal use of available resources.

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#### **4.14 Answers for Check Your Progress :**

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#### **Check Your Progress :**

1. b                      2. a                      3. b                      4. a                      5. a

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#### **4.15 Glossary :**

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1. **Inference** – Conclusion
2. **Bias** – Partiality
3. **Comparison** – Association

4. **Replication** – Duplication

5. **Perception** – Observation

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**4.16 Assignment :**

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1. Write a note on paradigms of data analysis

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**4.17 Activities :**

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1. Write a note on telephonic survey and data collection

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**4.18 Case Study :**

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1. Prepare a questionnaire for the data analysis of bathing soap

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**4.19 Further Readings :**

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1. Research Methodology C. R. Kothari

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**BLOCK SUMMARY**

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The block explained about the types of research design along with a detailed description of Historical Design and Descriptive Design. It also gave a detailed description on the formation of hypothesis. The topics such as Synopsis Writing and the importance of Computers in researching also added knowledge in the subject. The block discussed about the meaning, need, process of research. The block gave information on spiral scientific research, and research ethics. Another important topic covered in this block was about the Experimental Research. The different Types of experimental research along with the basic principles of research were discussed in detail. The block also enabled to understand the Survey method and different types of tools of survey.

Research design has a great influence on the consistency of the results arrived at and as such comprises the firm basis of the entire structure of the research work.

Even then many don't realise the need for a well thought out research design. The significance which this problem ought to have is not given to it. As a result many researches do not provide the idea for which they are carried out. So, they may even give deceptive conclusions. Lack of consideration in planning the research project might effect in rendering the research exercise unsuccessful. It is, therefore, very important that a competent and suitable design must be equipped before starting research operations. Ethical decisions are based on three main approaches: duty, rights and goal-based. Research studies should be evaluated ethically on three sets of criteria, namely: ethical principles, ethical rules, and scientific criteria. Survey research is a usually used method of collecting information about a population of significance. There are many different types of surveys, several methods to conduct them, and many methods of sampling. There are two main features of survey research are Questionnaires, which is a predefined sequence of questions used to gather information from individuals and sampling which is a method in which a subgroup of the population is chosen to respond to the survey questions. The information collected can be generalized to the whole population of interest. Computers facilitate the research work a lot. A large amount of data can be processed and analyzed by means of greater ease and speed. Moreover, the results obtained are generally correct and reliable. All the above even the design, picture aided graphing and report are being developed with the help of computers.

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## **BLOCK ASSIGNMENT**

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### **Short Questions :**

1. Historical Design
2. Descriptive Design
3. Observational Method
4. Survey Method
5. Spiral Scientific Method
6. Research Ethics
7. Questionnaires
8. Mail survey

### **Long Questions :**

1. Write a note on Research Design ? What is an Exploratory Research Design ?
2. Write a note on formation of hypothesis ?
3. Describe Synopsis writing ?
4. Describe the role of Computers in Research ?

**Basics of  
Research Methods**

❖ **Enrolment No. :**

1. How many hours did you need for studying the units ?

Unit No.	1	2	3	4
No. of Hrs.				

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

3. Any other Comments

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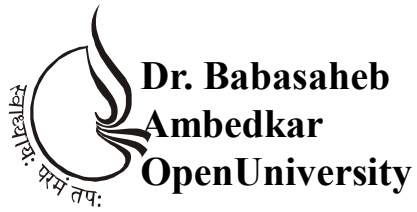
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**BBAR-401**

## **Basics of Research Methods**

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### **BLOCK-3 SAMPLING AND QUANTITATIVE METHODS IN RESEARCH**

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#### **UNIT 1**

SAMPLING THEORY AND FUNDAMENTALS

#### **UNIT 2**

TESTING OF HYPOTHESIS

#### **UNIT 3**

QUANTITATIVE TECHNIQUES

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## **BLOCK 3 : SAMPLING AND QUANTITATIVE METHODS IN RESEARCH**

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### **Block Introduction**

The way in which we select a sample of individuals to be research participants is critical. How participants are selected (random sampling) will determine the population to which we may generalize our research findings. The procedure that we use for assigning participants to different treatment conditions (random assignment) will determine whether bias exists in our treatment groups. Data derived from a sample are treated statistically. Using sample data, it will be able to calculate various statistics, such as the mean and standard deviation. These sample statistics summarize (describe) aspects of the sample data. These data, when treated with other statistical procedures, allow us to make certain inferences. Researchers use two major sampling techniques: probability sampling and non probability sampling. With probability sampling, a researcher can specify the probability of an element's (participant's) being included in the sample. With non probability sampling, there is no way of estimating the probability of an element's being included in a sample.

The block will provide a detailed knowledge about sampling such as its meaning, need and purpose. Different methods of sampling such as Sampling and Non-Sampling and its subdivisions are discussed in detail. The block also gives information about sampling and non sampling errors along with a detailed description on Hypothesis, Type I and Type II error. As a part of attempt to add knowledge in quantitative techniques the block also comprises of the topics such as Regression and Correlation Analysis.

Unit 1 comprises of the need and purpose of sampling. This unit also give a brief explanation about what is a sampling theory. The important sampling distributions and various techniques and methods of sampling are discussed in detail. The unit also provides information on sampling and non-sampling errors.

The attraction of Unit 2 will be the study on Hypotheses Testing. The description on the Type I and Type II errors along with the two tailed and one tailed Tests will add help to add knowledge. The unit also comprise of a detailed study on sampling of attributes and sampling of variables.

Unit 3 gives a brief introduction on quantitative techniques. A detailed study on Regression and Correlation Analysis is also included in this unit. The unit also provides information on Parametric Tests and Non-Parametric Tests and multivariate analysis.

## **Block Objectives**

**After learning this block, you will be able to understand :**

- To add knowledge about different types of Sampling.
- Understand about what is sampling theory.
- Know about Concept of Sampling Errors
- Understand about the Quantitative techniques
- To understand what is multivariate analysis.



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**Block Structure**

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Unit 1 : Sampling Theory and Fundamentals

Unit 2 : Testing of Hypothesis

Unit 3 : Quantitative Techniques



## SAMPLING THEORY AND FUNDAMENTALS

### : UNIT STRUCTURE :

- 1.0 Learning Objectives
- 1.1 Introduction
- 1.2 Need and Purpose of Sampling
- 1.3 Sampling Theory
- 1.4 Important Sampling Distribution
- 1.5 Various Techniques/Methods of Sampling
- 1.6 Sampling and Non-Sampling Errors
- 1.7 Let Us Sum Up
- 1.8 Answers for Check Your Progress
- 1.9 Glossary
- 1.10 Assignment
- 1.11 Activities
- 1.12 Case Study
- 1.13 Further Readings

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#### 1.0 Learning Objectives :

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After learning this unit, you will be able to :

- Understand the Need and Purpose of Sampling
  - Understand about the techniques and methods of sampling
- 

#### 1.1 Introduction :

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Sometimes it is difficult to study a whole group or exceptionally large group. Sampling may be defined as the choosing of some part of a collective or whole on the basis of which a conclusion or inference about the total or sum is made. In other words, the process will help to obtain all information about the whole population by investigative part of it. In almost all research works and surveys, the customary approach happens to be to formulate generalisations or to illustrate inferences on the basis of samples about the parameters of population from which the samples are taken. The researcher quite often selects only a few items from the universe for his study purposes. All this is done on the assumption that the sample data will enable him to estimate the population parameters. The objects so chosen comprise what is theoretically called a sample, their choice process or the method is called sample design and the survey conducted on the base of this sample is called as sample survey. Every sample should be a true representative of characteristics



population that will constitute the random sample; it also involves the use of probability theory, along with prior knowledge about the population parameters, to analyze the data from the random sample and develop conclusions from the analysis. The normal distribution, along with related probability distributions, is most heavily utilized in developing the theoretical background for sampling theory. Sampling theory is a study of relationships existing between a population and samples drawn from the population. Sampling theory is applicable only to random samples. For this purpose the population or a universe may be defined as an aggregate of items possessing a common trait or traits. In other words, a universe is the complete group of items about which knowledge is sought. The universe may be finite or infinite. Finite universe is one which has a definite and certain number of items, but when the number of items is uncertain and infinite, the universe is said to be an infinite universe. Similarly, the universe may be hypothetical or existent. In the former case the universe in fact does not exist and we can only imagine the items constituting it. Tossing of a coin or throwing a dice is examples of hypothetical universe. Existent universe is a universe of concrete objects i.e., the universe where the items constituting it really exist. On the other hand, the term sample refers to that part of the universe which is selected for the purpose of investigation. The theory of sampling studies the relationships that exist between the universe and the sample or samples drawn from it. The theory of sampling is concerned with estimating the properties of the population from those of the sample and with gauging the precision of the estimate. This sort of movement from particular (sample) towards general (universe) is what is known as statistical induction or statistical inference. With the help of sample we attempt to draw inference concerning the universe. In order to be able to follow this inductive method, we first follow a deductive argument which is that we imagine a population or universe (finite or infinite) and investigate the behavior of the samples drawn from this universe applying the laws of probability. The methodology dealing with all this is known as sampling theory.

**Check Your Progress – 2 :**

1. Sampling theory is a study of relationships existing between a population and samples drawn from the population.
  - a. true
  - b. false
2. Finite universe is one which has a indefinite and number of items is uncertain.
  - a. true
  - b. false
3. With the help of sample an attempt is made to draw inference concerning the universe.
  - a. true
  - b. false

---

## 1.4 Understanding Sampling Distribution :

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A sampling distribution is a distribution of all of the probable values of a statistic for a sample size given which is chosen from a population. Goal of data analysis is to make statistical inferences, i.e., use statistics calculated from samples to estimate the values of population parameters. The Sample Mean is a statistic used to estimate the population mean and the Sample Proportion is a statistic used to estimate the population mean.

Some important sampling distributions, which are commonly used, are: (1) sampling distribution of mean; (2) sampling distribution of proportion; (3) student's 't' distribution; (4) *F* distribution; and (5) Chi-square distribution. A brief note on each one of these sampling distribution are given below.

### 1. Sampling Distribution of Mean :

Sampling distribution of mean refers to the probability distribution of all the possible means of random samples of a given size that we take from a population. If samples are taken from a normal population, then the sampling distribution of mean would also be normal. But when sampling is from a population which is not normal (may be positively or negatively skewed), even then, as per the central limit theorem, the sampling distribution of mean tends quite closer to the normal distribution, provided the number of sample items is large i.e., more than 30.

### 2. Sampling Distribution of Proportion :

The mean of the distribution of sample proportions is equal to the population proportion  $p$ . If  $p$  is unknown, we estimate it using  $\hat{p}$ . The standard deviation of the distribution of sample proportions is symbolized by  $SE(\hat{p})$  and equals  $\sqrt{p(1-p)/n}$ ; this is the **standard error of  $\hat{p}$** . The symbol  $\sigma_{\hat{p}}$  is also used to signify the standard deviation of the distribution of sample proportions.

### 3. Student's *t* Distribution :

The ***t* distribution (Student's *t*-distribution)** is a probability distribution that is used to estimate population parameters when the sample size is small and/or when the population variance is unknown.

Student's *t*-distribution is defined as the distribution of the random variable  $t$  which is (very loosely) the "best" that we can do not knowing  $\sigma$ . The Student's *t*-distribution with  $n$  degrees of freedom is implemented as student's T Distribution [ $n$ ]. If  $\sigma = s$ ,  $t = z$  and the distribution becomes the normal distribution. As  $N$  increases, Student's *t*-distribution approaches the normal distribution.

**4. F Distribution :**

The F distribution is the probability distribution associated with the  $f$  statistic. The  **$f$  statistic**, also known as an  **$f$  value**, is a random variable that has an F distribution.

The distribution of all possible values of the  $f$  statistic is called an F **distribution**, with  $\nu_1 = n_1 - 1$  and  $\nu_2 = n_2 - 1$  degrees of freedom.

The curve of the F distribution depends on the degrees of freedom,  $\nu_1$  and  $\nu_2$ . When describing an F distribution, the number of degrees of freedom associated with the standard deviation in the numerator of the  $f$  statistic is always stated first.

**5. Chi-Square Distribution :**

**Definition :** The chi-squared distribution with  $k$  degrees of freedom is the distribution of a random variable that is the sum of the squares of  $k$  independent standard normal random variables. We can call this distribution  $\chi^2(k)$ .

The Chi Square distribution is the distribution of the sum of squared standard normal deviates. The degrees of freedom the distribution is equal to the number of standard normal deviates being summed. Therefore, Chi Square with one degree of freedom, written as  $\chi^2(1)$ , is simply the distribution of a single normal deviate squared. The area of a Chi Square distribution below 4 is the same as the area of a standard normal distribution below 2, since 4 is  $2^2$ . The Chi Square distribution is very important because many test statistics are more or less distributed as Chi Square.

**Check Your Progress – 3 :**

1. \_\_\_\_\_ is a probability distribution that is used to estimate population parameters when the sample size is small and/or when the population variance is unknown.
  - a.  $f$  distribution
  - b.  $t$  distribution
  - c. chi square distribution
2. The Chi Square distribution is the distribution of the sum of squared standard normal deviates.
  - a. true
  - b. false
3. The  $f$  statistic, also known as an  $f$  value, is a random variable that hasan \_\_\_\_\_.
  - a.  $f$  distribution
  - b.  $t$  distribution
  - c. chi square distribution

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## 1.5 Various Techniques/Methods of Sampling :

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Sampling can be mainly divided into two probability sampling and non– probability sampling.

(1) **Probability Sampling :**

(a) **Simple Random Sampling :** Each element of the population has an equal and independent chance of being included in the sample i.e. a sample selected by randomization method is known as simple random sample and this technique is simple randomizing.

(b) **Systematic Sampling :** Systematic sampling is an improvement over the simple random sampling. This method needs the complete information about the population. There should be a list of information of all the individuals of the population in any systematic way.

Let the size of sample is =  $n$  and population size is =  $N$ . Select each  $N/n$  individual from the list and thus we have the desired size of sample which is known as systematic sample. For this technique of sampling population is arranged in any systematic way.

(c) **Stratified Sampling :** In this technique the population is divided into strata on the basis of some characteristics. From each of these smaller homogenous groups (strata) draws at random a predetermined number of units. Researcher should choose that characteristic as criterion which seems to be more relevant in his research work.

i. **Disproportionate :** The size of the sample in each unit is not proportionate to the size of the unit but depends upon considerations relating personal conclusion and convenience.

ii. **Proportionate :** The selection from each sampling unit of a sample that is proportionate to the size of the unit.

iii. **Optimum Allocation :** Here the selection of units is made from each stratum. Above all each stratum should be in proportion to the corresponding stratum the population. Thus sample obtained is known as optimum allocation sample.

(d) **Multiple or Double Repetitive Sampling :** Generally this is not a new method but only a new application of the samplings. This is most frequently used for establishing the reliability of a sample. When employing a mailed questionnaire, double sampling is sometimes used to obtain a more representative sample. This is done because some randomly selected subjects who are sent questionnaires may not return them. Obviously,

the missing data will bias the result of the study, if the people who fail to reply the query differ in some fundamental way from the others in respect to the phenomenon being studied. To eliminate this bias, a selected sample may be drawn at random from the non-respondents and the people interviewed to obtain the desired information. Thus this technique is also known as repeated or multiple sampling. This double sampling technique enables one to check on the reliability of the information obtained from first sample. Thus, double sampling, where in one sample is analyzed and information obtained is used to draw the next sample to examine the problem further.

- (e) **Multi Stage Sampling :** This sample is more comprehensive and representative of the population. In this type of sampling primary sample units are inclusive groups and secondary units are sub-groups within these ultimate units to be selected which belong to one and only one group. Stages of a population are usually available within a group or population, whenever stratification is done by the researcher. The individuals are selected from different stages for constituting the multi stage sampling.
- (f) **Cluster Sampling :** To select the intact group as a whole is known as a cluster sampling. In cluster sampling the sample units contain groups of element (cluster) instead of individual members or items in the population. Rather than listing all elementary school children in a given city and randomly selecting 15 % of these students for the sample, a researcher lists all of the elementary schools in the city, selects at random 15 % of these clusters of units, and uses all of the children in the selected schools as the sample.

**(2) Non-Probability Sampling :**

**Non-Probability Sampling Method :** Samples which are selected through non-random methods are called non probability samples. Depending upon the technique used it is named as follows :

- (a) **Incidental or Accidental Sampling :** The term incidental or accidental are those samples that are taken because they are most frequently available.
- (b) **Judgment Sampling :** The selection of a sample from the population on the basis of available information assuming as if they are representative of the entire population. Here sample may also be selected on the basis of instinct.
- (c) **Purposive Sampling :** Purposive sampling, also called as judgment, selective or subjective sampling is a non-probability sampling method that is characterised by an intentional effort



## Basics of Research Methods

to get representative samples by including groups or typical areas in a sample.

The purposive sampling is selected by some arbitrary method because it is known to be representative of the total population, or it is known that it will produce well matched groups.

- (d) **Quota Sampling** : A quota sample a type of non-probability sample in which a fixed quota is selected. That is, units are selected into a sample on the basis of pre-specified characteristics so that the total sample has the same distribution of characteristics supposed to exist in the population being studied
- (e) **Snowball Sampling** : This sampling method is used by researchers if the sample for the study is very rare or is limited to a very small subgroup of the population. The peculiarity of this type of sampling technique is that it works like chain referral. After observing the initial subject, the researcher asks for assistance from the subject to help identify people with a similar trait of interest.

### Check Your Progress – 4 :

1. Each element of the population has an equal and independent chance of being included in the sample.
  - a. simple random sample
  - b. Multi Stage Sampling
  - c. non probability samples
2. \_\_\_\_\_ is an improvement over the simple random sampling. This method needs the complete information about the population.
  - a. non probability samples
  - b. Systematic sampling
  - c. simple random sample
3. In this technique the population is divided into strata on the basis of some characteristics.
  - a. Systematic sampling
  - b. Stratified sampling
  - c. Multi Stage Sampling
4. In this type of sampling primary sample units are inclusive groups and secondary units are sub-groups within these ultimate units to be selected which belong to one and only one group.
  - a. Systematic sampling
  - b. Stratified sampling
  - c. Multi Stage Sampling
5. A quota sample a type of non-probability sample in which a fixed quota is selected.
  - a. true
  - b. false



**Check Your Progress – 4 :**

1. a                      2. b                      3. b                      4. c                      5. d

**Check Your Progress – 5 :**

1. a                      2. b

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**1.9 Glossary :**

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1. **Aggregate** – Collective
  2. **Inference** – Conclusion
  3. **Strata** – Division
  4. **Optimum** – Highest
  5. **Arbitrary** – Random
- 

**1.10 Assignment :**

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1. Which are the various methods of sampling ?
- 

**1.11 Activities :**

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1. Write a note on multi stage sampling.
- 

**1.12 Case Study :**

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1. Apply cluster sampling technique for the zones to be quarantined during covid pandemic.
- 

**1.13 Further Readings :**

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1. Research Methodology C. R. Kothari



**: UNIT STRUCTURE :**

- 2.0 Learning Objective**
- 2.1 Introduction**
- 2.2 Hypotheses Testing**
- 2.3 Basic Concepts Concerning Testing of Hypotheses**
- 2.4 Type I and Type II Errors**
- 2.5 Two Tailed and One Tailed Tests**
- 2.6 Sampling of Attributes and Sampling of Variables**
- 2.7 Let Us Sum Up**
- 2.8 Answers for Check Your Progress**
- 2.9 Glossary**
- 2.10 Assignment**
- 2.11 Activities**
- 2.12 Case Study**
- 2.13 Further Readings**

---

**2.0 Learning Objectives :**

- To understand the concept of hypothesis
- To understand about Hypotheses Testing
- To understand about Type I and Type II Errors
- To understand about Two Tailed and One Tailed Tests

---

**2.1 Introduction :**

In simple words, hypothesis can be defined as the precise and testable statement of the research study, where the researchers can predict an outcome. In other words, we can say that hypothesis is an idea that can be suggested as the possible explanation for something but has not yet been found to be true or correct. Hypothesis can be tested through study and experimentation. A scientific hypothesis can be considered as something more than a random guess, but less than a well established theory.

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**2.2 Hypotheses Testing :**

Hypothesis can be considered as mere assumption or some supposition to be proved or disproved for a researcher hypothesis is a formal question that he intends to resolve. Thus a hypothesis may be defined as a proposition or a set of proposition set forth as an explanation

for the occurrence of some specified group of phenomena either asserted merely as a provisional conjecture to guide some investigation or accepted as highly probable in the light of established facts. Quite often a research hypothesis is a predictive statement, capable of being tested by scientific methods, that relates an independent variable to some dependent variable. We may conclude that a hypothesis states what we are looking for and it is a proposition which can be put to a test to determine its validity.

**Characteristics of Hypothesis :** Hypothesis must possess the following characteristics :

- (i) Hypothesis should be clear and precise. If the hypothesis is not clear and precise, the inferences drawn on its basis cannot be taken as reliable.
- (ii) Hypothesis should be capable of being tested. In a swamp of untestable hypotheses, many a time the research programmes have bogged down. Some prior study may be done by researcher in order to make hypothesis a testable one. A hypothesis is testable if other deductions 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 relational hypothesis.
- (iv) Hypothesis should be limited in scope and must be specific. A researcher must remember that narrower hypotheses are generally more testable and he should develop such hypotheses.
- (v) Hypothesis should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned. But one must remember that simplicity of hypothesis has nothing to do with its significance.
- (vi) Hypothesis should be consistent with most known facts i.e., it must be consistent with a substantial body of established facts. In other words, it should be one which is accepted as being the most likely.
- (vii) Hypothesis should be amenable to testing within a reasonable time. One should not use even an excellent hypothesis, if the same cannot be tested in reasonable time for one cannot spend a life-time collecting data to test it.
- (viii) Hypothesis must explain the facts that gave rise to the need for explanation. This means that by using the hypothesis plus other known and accepted generalizations, one should be able to deduce the original problem condition. Thus hypothesis must actually explain what it claims to explain; it should have empirical reference.

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### **2.3 Basic Concepts Concerning Testing of Hypotheses :**

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**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  $H_0$  and the alternative hypothesis as  $H_a$ .

**Check Your Progress – 1 :**

1. Hypothesis should be clear and precise
  - a. true
  - b. false
2. Hypothesis can be considered as mere assumption or some supposition to be proved or disproved.
  - a. true
  - b. false
3. The null hypothesis is generally symbolized as
  - a.  $H_0$
  - b.  $H_a$
4. The alternative hypothesis is symbolized as
  - a.  $H_0$
  - b.  $H_a$

**2.4 Type I and Type II Errors :**

Type I error, also known as a ‘false positive’ : the error of rejecting a null hypothesis when it is actually true. In other words, this is the error of accepting an alternative hypothesis (the real hypothesis of interest) when the results can be attributed to chance. It occurs when we are observing a difference when in truth there is none (or more specifically – no statistically significant difference). When the null hypothesis is true and you reject it, you make a type I error. The probability of making a type I error is  $\alpha$ , which is the level of significance you set for your hypothesis test. An  $\alpha$  of 0.05 indicates that you are willing to accept a 5% chance that you are wrong when you reject the null hypothesis. To lower this risk, you must use a lower value for  $\alpha$ . However, using a lower value for alpha means that you will be less likely to detect a true difference if one really exists

**Null Hypothesis**

Decision	True	False
Fail to reject	Correct Decision (probability = $1 - \alpha$ )	<b>Type II Error</b> – fail to reject the null when it is false (probability = $\beta$ )
Reject	<b>Type I Error</b> – rejecting the null when it is true (probability = $\alpha$ )	Correct Decision (probability = $1 - \beta$ )

**Type II error**, also known as a "false negative": the error of not rejecting a null hypothesis when the alternative hypothesis is the true state of nature. In other words, this is the error of failing to accept an

alternative hypothesis when you don't have adequate power. Plainly speaking, it occurs when we are failing to observe a difference when in truth there is one. When the null hypothesis is false and you fail to reject it, you make a type II error. The probability of making a type II error is  $\alpha$ , which depends on the power of the test. You can decrease your risk of committing a type II error by ensuring your test has enough power. You can do this by ensuring your sample size is large enough to detect a practical difference when one truly exists.

**Check Your Progress – 2 :**

1. Type I error, is also known as
  - a. False positive
  - b. False negative
2. Type II error, is also known as
  - a. False positive
  - b. False negative
3. The error of rejecting a null hypothesis when it is actually true.
  - a. Type I error
  - b. Type II error
4. The error of not rejecting a null hypothesis when the alternative hypothesis is the true state of nature.
  - a. Type I error
  - b. Type II error

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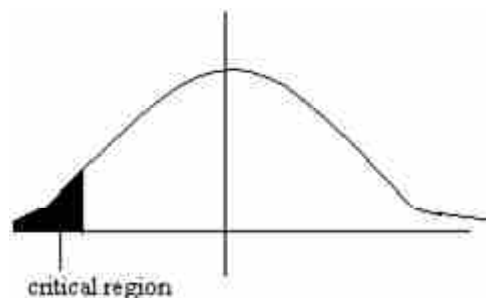
**2.5 Two Tailed and One Tailed Tests :**

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There are two types of tests, one tailed test and two tailed test. A one-tailed test looks for an increase or decrease in the parameter whereas a two-tailed test looks for any change in the parameter (which can be any change-increase or decrease).

❖ **One-Tailed Test :**

A test of a statistical hypothesis , where the region of rejection is on only one side of the sampling distribution called a one-tailed test. Let's take an example where the null hypothesis states that the mean is less than or equal to 10. The alternative hypothesis would be that the mean is greater than 10. The region of rejection would consist of a range of numbers located on the right side of sampling distribution; that is, a set of numbers greater than 10. In a one-tailed test, the critical region will have just one part. If our sample value lies in this region, we reject the null hypothesis in favour of the alternative.

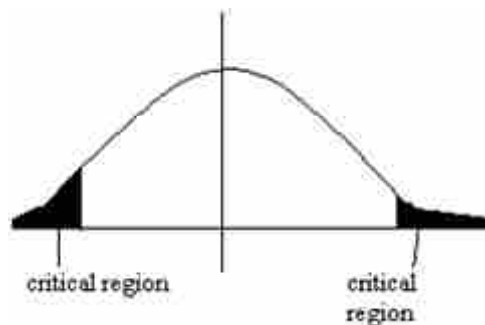


Suppose we are looking for a definite decrease. Then the critical region will be to the left. Note, however, that in the one-tailed test the value of the parameter can be as high as you like.

❖ **Two-Tailed Test :**

A test of a statistical hypothesis, where the region of rejection is on both sides of the sampling distribution, is called a two-tailed test. Suppose the null hypothesis states that the mean is equal to 10. The alternative hypothesis would be that the mean is less than 10 or greater than 10. The region of rejection would consist of a range of numbers located on both sides of sampling distribution; that is, the region of rejection would consist partly of numbers that were less than 10 and partly of numbers that were greater than 10.

In a two-tailed test, we are looking for either an increase or a decrease.

**Check Your Progress – 3 :**

1. A test of a statistical hypothesis, where the region of rejection is on only one side of the sampling distribution called
  - a. a one-tailed test
  - b. a two-tailed test
  - c. None of these
2. A test of a statistical hypothesis, where the region of rejection is on both sides of the sampling distribution, is called
  - a. a one-tailed test
  - b. a two-tailed test
  - c. none of these

---

**2.6 Sampling of Attributes and Sampling of Variables :**


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Attribute sampling means that an item being sampled either will or won't possess certain qualities, or attributes. Attribute plans are generally easier to use than variables plans. A sample of  $n$  units is selected randomly from a lot of  $N$  units. If there are fewer defectives, accept the lot. If there are more than  $c$  defectives, reject the lot. For example, suppose you have a shipment of 10,000 bolts. You will inspect 89 of them. If there are 0, 1, or 2 defective bolts, then you may accept the shipment. If there are more than 2 defectives, then reject the entire lot of bolts.

Variables sampling plan is an acceptance sampling technique. Plans for variables are intended for quality characteristics that are measured in a continuous scale. This plan requires the knowledge of the statistical model e g: normal distribution.

For variables sampling plans, you can only examine one measurement per sampling plan. For example, if you need to inspect for wafer thickness





8. **Arbitrary** – Chance
9. **Predictive** – Projecting
10. **Attribute** – Quality

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**2.10 Assignment :**

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1. Describe one tailed test with an illustration.
- 

**2.11 Activities :**

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1. Describe one tailed test with an illustration.
- 

**2.12 Case Study :**

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1. “A blood sample from human body helps a doctor to determine the disease”. Comment on this words in the context of sampling ?
- 

**2.13 Further Readings :**

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1. Research Methodology C.R. KOTHARI
2. Research in Education JOHN BEST
3. Research Design PHILIP BERNARD
4. Scientific Research Procedure P. V. YOUNG



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: UNIT STRUCTURE :  
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- 3.0 Learning Objectives**
- 3.1 Introduction**
- 3.2 Regression and Correlation Analysis**
  - 3.2.1 Types of Correlation**
  - 3.2.2 Coefficient of Correlation**
  - 3.2.3 Rank Correlation**
  - 3.2.4 Regression**
- 3.3 Parametric Tests**
- 3.4 Non-Parametric**
- 3.5 Multivariate Analysis**
- 3.6 Let Us Sum Up**
- 3.7 Answers for Check Your Progress**
- 3.8 Glossary**
- 3.9 Assignment**
- 3.10 Activities**
- 3.11 Case Study**
- 3.12 Further Readings**

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**3.0 Learning Objectives :**

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**After learning this unit, you will be able to :**

- Understand what is regression
- Understand about regression
- Understand about Parametric and Non Parametric test
- Understand about multivariate analysis

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**3.1 Introduction :**

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Statistical methods are systematic and built by several experts on firmly established theories and consequently they would enable to overcome the uncertainties associated with future occasions. While it is true that a statistical analysis, by itself, cannot solve all the problems faced by an organization, it will definitely enable a manager to comprehend the ground realities of the situation. Different statistical techniques which are suitable for different requirements are presented in this unit in a simple style. Depending on the situation and the requirement, one may have to deal with the data of just one variable (univariate data), or data on two

variables (bivariate data) or data concerning several simultaneous variables (multivariate data). The interpretation of the results from statistical analysis occupies an important place. Statistics is concerned with the aggregates and not just the individual data items or isolated measurements of certain variables. Therefore the conclusions from a statistical study will be valid for a majority of the objects and normal situations only.

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### 3.2 Regression and Correlation Analysis :

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Correlation means the average relationship between two or more variables. When changes in the values of a variable affect the values of another variable, we say that there is a correlation between the two variables. The two variables may move in the same direction or in opposite directions. Simply because of the presence of correlation between two variables, we cannot jump to the conclusion that there is a cause–effect relationship between them. We say that the correlation is simple if the comparison involves two variables only.

#### 3.2.1 Types of Correlation :

- (a) **Positive Correlation** : If two variables  $x$  and  $y$  move in the same direction, we say that there is a positive correlation between them. In this case, when the value of one variable increases, the value of the other variable also increases and when the value of one variable decreases, the value of the other variable decreases. Eg. The age and height of a child.
- (b) **Negative Correlation** : If two variables  $x$  and  $y$  move in opposite directions, we say that there is a negative correlation between them. i.e., when the value of one variable increases, the value of the other variable decreases and vice versa. eg. The price and demand of a normal good.
- (c) **Perfect Positive Correlation** : If changes in two variables are in the same direction and the changes are in equal proportion, we say that there is a perfect positive correlation between them.
- (d) **Perfect Negative Correlation** : If changes in two variables are in opposite directions and the absolute values of changes are in equal proportion, we say that there is a perfect negative correlation between them.
- (e) **Zero Correlation** : If there is no relationship between the two variables, then the variables are said to be independent. In this case the correlation between the two variables is zero.
- (f) **Linear Correlation** : If the quantum of change in one variable always bears a constant ratio to the quantum of change in the other variable, we say that the two variables have a linear correlation between them.

### 3.2.2 Coefficient of Correlation :

The coefficient of correlation between two variables X, Y is a measure of the degree of association (i.e., strength of relationship) between them. The coefficient of correlation is usually denoted by 'r'.

#### ❖ Pearson Product–Moment Correlation :

Correlation coefficients measure the strength of association between two variables. The most common correlation coefficient, called the **Pearson product–moment correlation coefficient**, measures the strength of the linear association between variables.

The sign and the absolute value of a Pearson correlation coefficient describe the direction and the magnitude of the relationship between two variables.

- The value of a correlation coefficient ranges between  $-1$  and  $1$ .
- The greater the absolute value of a correlation coefficient, the stronger the *linear* relationship.
- The strongest linear relationship is indicated by a correlation coefficient of  $-1$  or  $1$ .
- The weakest linear relationship is indicated by a correlation coefficient equal to  $0$ .
- A positive correlation means that if one variable gets bigger, the other variable tends to get bigger.
- A negative correlation means that if one variable gets bigger, the other variable tends to get smaller.

**A formula for computing a Pearson correlation coefficient is given below.**

The correlation  $r$  between two variables is :  $r = \frac{\Sigma(xy)}{\sqrt{[\Sigma x^2] * [\Sigma y^2]}}$

- where  $\Sigma$  is the summation symbol,  $x = x_i - \bar{x}$ ,
- $x_i$  is the  $x$  value for observation  $i$ ,
- $\bar{x}$  is the mean  $x$  value,
- $y = y_i - \bar{y}$ ,
- $y_i$  is the  $y$  value for observation  $i$ ,
- $\bar{y}$  is the mean  $y$  value.

Keep in mind that the Pearson correlation coefficient only measures linear relationships. Therefore, a correlation of  $0$  does not mean zero relationship between two variables; rather, it means zero *linear* relationship. (It is possible for two variables to have zero linear relationship and a strong curvilinear relationship at the same time.)

### 3.2.3 Rank Correlation :

#### ❖ Spearman's Rank Correlation Coefficient :

The Spearman's rank–order correlation is the nonparametric version of the Pearson product–moment correlation. Spearman's correlation coefficient, ( $\rho$ , also signified by  $r_s$ ) measures the strength of association between two ranked variables. If ranks can be assigned to pairs of observations for two variables X and Y, then the correlation between the ranks is called the rank correlation coefficient.

The formula for when there are no tied ranks is :

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

Where  $d_i$  = difference in paired ranks and  $n$  = number of cases.

The formula to use when there are tied ranks is :

$$\rho = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}}$$

Where  $i$  = paired score.

### 3.2.4 Regression :

In the pairs of observations, if there is a cause and effect relationship between the variables X and Y, then the average relationship between these two variables is called regression, which means 'stepping back or return to the average'. The linear relationship giving the best mean value of a variable corresponding to the other variable is called a regression line or line of the best fit. The regression of X on Y is different from the regression of Y on X. Thus, there are two equations of regression and the two regression lines are given as follows:

There are two lines of regression– that of Y on X and X on Y. The line of regression of Y on X is given by  $Y = a + bX$  where  $a$  and  $b$  are unknown constants known as intercept and slope of the equation. This is used to predict the unknown value of variable Y when value of variable X is known.

$$Y = a + bX$$

On the other hand, the line of regression of X on Y is given by  $X = c + dY$  which is used to predict the unknown value of variable X using the known value of variable Y. Often, only one of these lines make sense.

#### Check Your Progress – 1 :

- Correlation means the average relationship between two or more variables.
  - true
  - false

2. If two variables  $x$  and  $y$  move in the same direction, we say that there is a \_\_\_\_\_ Between them.
  - a. Positive correlation
  - b. Negative correlation
  - c. none of these
3. If two variables  $x$  and  $y$  move in opposite directions, we say that there is a \_\_\_\_\_ Between them
  - a. Positive correlation
  - b. Negative correlation
  - c. none of these
4. The coefficient of correlation between two variables  $X, Y$  is a measure of the degree of association.
  - a. true
  - b. false

---

### **3.3 Parametric Tests :**

---

Parametric and nonparametric are two broad classifications of statistical procedures. Parametric statistical procedures rely on assumptions about the shape of the distribution (i.e., assume a normal distribution) in the underlying population and about the form or parameters (i.e., means and standard deviations) of the assumed distribution. Parametric tests involve specific probability distributions (e.g., the normal distribution) and the tests involve estimation of the key parameters of that distribution (e.g., the mean or difference in means) from the sample data. Parametric methods deal with the estimation of population parameters such as mean. Clearly stating, the data distribution is mostly significant while choosing between parametric and non-parametric procedures. If the populations are normally distributed then we use parametric methods.

Some of the parametric tests are

- (a) **1-sample  $t$ -test :** One sample  $t$ -test is a statistical procedure used to examine the mean difference between the sample and the known value of the population mean. In one sample  $t$ -test, we know the population mean. We draw a random sample from the population and then compare the sample mean with the population mean and make a statistical decision as to whether or not the sample mean is different from the population mean.
- (b) **2-sample  $t$ -test :** 2-Sample  $t$  calculates a confidence interval and conducts a hypothesis test of the difference between two population means when standard deviations are unknown and samples are drawn independently from each other. This procedure is based on the  $t$ -distribution, and for small samples it works best if the data were drawn from distributions that are normal or close to normal. You can have increasing confidence in the results as the sample sizes increase.
- (c) **One-Way ANOVA :** The one-way analysis of variance (ANOVA) is used to determine whether there are any significant differences

between the means of two or more independent (unrelated) groups. The following assumptions are made

- (a) The dependent variable should be measured at the interval or ratio level
- (b) The independent variable should consist of two or more categorical, independent groups.
- (c) There should be independence of observations
- (d) There should be no significant outliers.
- (e) The dependent variable should be approximately normally distributed for each category of the independent variable
- (f) There needs to be homogeneity of variances.

### Check Your Progress – 2 :

1. If the populations are normally distributed then we use \_\_\_\_\_.  
 a. Parametric methods                      b. non parametric methods  
 c. both
2. Parametric tests involve specific probability distributions.  
 a. true    b. false
3. \_\_\_\_\_ is a statistical procedure used to examine the mean difference between the sample and the known value of the population mean.  
 a. 2-Sample  $t$ -test                              b. One sample  $t$ -test  
 c. Analysis of Variance (ANOVA).
4. The one-way analysis of \_\_\_\_\_ is used to determine whether there are any significant differences between the means of two or more independent (unrelated) groups.  
 a. 2-Sample  $t$ -test                              b. One sample  $t$ -test  
 c. Variance (ANOVA).

---

### 3.4 Non-Parametric Tests :

---

Nonparametric statistical procedures rely on nil or few assumptions about the shape or parameters of the population distribution from which the sample was drawn. Nonparametric tests are sometimes called distribution-free tests because they are based on fewer assumptions. They rely on ordering or ranking of observations. If we are not sure or we suspect that they do not behave normally then we use non-parametric methods.

Some of the non parametric tests are as follows

- (a) **1-sample Wilcoxon** : The Wilcoxon signed-rank test is a non parametric test used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ. It can be used as an



alternative to the paired students t test, t-test for matched pairs, or the t-test for dependent samples when the population cannot be assumed to be normally distributed.

- (b) **Mann–Whitney test** : Mann–Whitney U test is the alternative test to the independent sample t-test. It is a non-parametric test that is used to compare two population means that come from the same population, it is also used to test whether two population means are equal or not. It is used for equal sample sizes, and is used to test the median of two populations. Usually the Mann–Whitney U test is used when the data is ordinal.

**Check Your Progress – 3 :**

1. Nonparametric tests are sometimes called distribution-free
  - a. true
  - b. false
2. The \_\_\_\_\_ test is a non-parametric test used when comparing two related samples
  - a. Wilcoxon signed-rank
  - b. Mann-Whitney test
3. \_\_\_\_\_ is a non-parametric test that is used to compare two population means that come from the same population.
  - a. Wilcoxon signed-rank
  - b. Mann-Whitney test

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**3.5 Multivariate Analysis :**

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Multivariate analysis is essentially the statistical process of simultaneously analyzing multiple independent variables with multiple dependent variables using matrix algebra.

Multivariate Data Analysis refers to any statistical technique used to analyze data that arises from more than one variable. This essentially models reality where each situation, product, or decision involves more than a single variable. The information age has resulted in masses of data in every field. Despite the quantum of data available, the ability to obtain a clear picture of what is going on and make intelligent decisions is a challenge. When available information is stored in database tables containing rows and columns, Multivariate Analysis can be used to process the information in a meaningful fashion.

Importance is usually based upon how much common or shared variance can be extracted from the data. Variance is a numerical representation of the distribution of a trait (behaviour, emotion, cognition, etc.) in the population. We assume it represents how much of that trait is present in each individual. If two variables are associated or correlated with one another, then they share some common underlying trait/factor that causes some equality in how they vary on the scores in the data set. That underlying trait is causing them to co-vary together. In other words, it is leading to similar variations in scores which is measured as variance. We can extend this concept to include two sets of variables that are correlated. If these two sets of variables share a significant degree

of variance, we can see which combination of variables (often called structure) best explain their co-variation.

Multivariate analysis may be conducted either in a classic experimental design or in non-experimental designs. Whether one is seeking causality or association depends upon the research question, but both are valid in multivariate analysis. Most of the time, a data matrix will be analyzed—the form usually consists of rows representing each subject and columns representing each variable; however, the matrix can also be a correlation matrix, a variance/covariance matrix, or a sum-of-squares/cross-product matrix. The matrix is then solved simultaneously through matrix (linear) algebra, and yields linear composite scores which are linear combinations of the variables upon which the final solution is based.

#### Check Your Progress – 4 :

1. Multivariate Data Analysis refers to any statistical technique used to analyze data that arises from more than one variable.
  - a. true
  - b. false
2. \_\_\_\_\_ is a numerical representation of the distribution of a trait
  - a. research
  - b. variance
  - c. data analysis
3. Multivariate analysis may be conducted either in a classic experimental design or in non-experimental designs.
  - a. true
  - b. false

---

#### 3.6 Let Us Sum Up :

To conclude, quantitative techniques are needed to process the information needed for effective planning, leading organizing and controlling. Qualitative and quantitative methods are productive tools in solving organizational problems. They are behavioral and mathematical techniques respectively that can provide a diversity of knowledge. Quantitative analysis concentrates on facts, data and numerical aspects associated with the problem. In case of non-availability of past data where quantitative data is limited, qualitative factors play a major role in making decisions. Qualitative factors are important in situations like the introduction of breakthrough technologies. In today's complex and competitive global market, use of quantitative techniques with support of qualitative factors is paramount. Different types of correlation are positive correlation, negative correlation, perfect positive correlation, perfect negative correlation, zero correlation, linear correlation. The linear relationship giving the best mean value of a variable corresponding to the other variable is called a regression line or line of the best fit. Parametric and nonparametric are two broad classifications of statistical procedures. Nonparametric statistical procedures rely on nil or few assumptions about the shape or parameters of the population distribution from which the

sample was drawn multivariate data analysis refers to any statistical technique used to analyze data that arises from more than one variable

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**3.7 Answers for Check Your Progress :**

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**Check Your Progress – 1 :**

1. a            2. a            3. b            4. a

**Check Your Progress – 2 :**

1. a            2. c            3. b            4. c

**Check Your Progress – 3 :**

1. a            2. a            3. b

**Check Your Progress – 4 :**

1. a            2. b            3. a
- 

**3.8 Glossary :**

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1. **Comprehend** – Understand
  2. **Simultaneous** – Immediate
  3. **Isolated** – Remote
  4. **Rely** – Depend
  5. **Nil** – Zero
  6. **Trait** – Attribute
- 

**3.9 Assignment :**

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1. Write about parametric and non-parametric tests ?
- 

**3.10 Activities :**

---

1. Describe types of Correlation ?
- 

**3.11 Case Study :**

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1. Write about one-way Anova ?
- 

**3.12 Further Readings :**

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1. Research Methodology C.R. KOTHARI.

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## **BLOCK SUMMARY**

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The block explained about the need and purpose of sampling. The block provided a detailed description on sampling theory. The different types of sampling distributions were discussed in detail. Various methods adopted by the researchers in sampling were also detailed in this block. The block gave knowledgeable information about what is a sampling and non sampling error. The concept of Type I and Type II error was also discussed in this chapter.

A description on the two tailed and one tailed tests was also a high light in this block. The block also provided the basic knowledge on Regression and Correlation Analysis, Parametric Tests Non-Parametric and Multivariate Analysis

Researchers use two major sampling techniques: probability sampling and non probability sampling. With probability sampling, a researcher can specify the probability of a participant's being included in the sample. With non probability sampling, there is no way of estimating the probability of an element's being included in a sample. Sampling is the process whereby some elements in the population are selected for a research study. The population consists of all individuals with a particular characteristic that is of interest to the researchers. If data are obtained from all members of the population, then we have a census; if data are obtained from some members of the population, then we have a sample. With probability sampling, a researcher can specify the probability of an element's being included in the sample. With non probability sampling, there is no way of estimating the probability of an element's being included in a sample. 4. Although often more difficult and expensive, probability sampling is a methodologically more precise method to obtain a sample that is representative of the population. Appropriate sample size depends on various considerations, including population variability, statistical issues, economic factors, and availability of participants. In general, with larger samples you will have a smaller margin of error and you can detect smaller differences.

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**BLOCK ASSIGNMENT**

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**Short Questions :**

1. Sampling theory
2. Student's  $t$
3. Chi Square distribution
4. Type I error
5. Parametric Tests
6. Two-Tailed Test

**Long Questions :**

1. What is the need and purpose of sampling ?
2. Write about different type of sampling distributions ?
3. Write about Regression and Correlation Analysis ?

**Basics of  
Research Methods**

❖ **Enrolment No. :**

1. How many hours did you need for studying the units ?

Unit No.	1	2	3
No. of Hrs.			

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

3. Any other Comments

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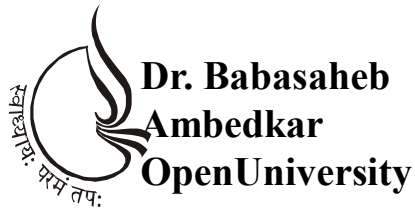
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**BBAR-401**

## **Basics of Research Methods**

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### **BLOCK-4 DATA ANALYSIS AND RESEARCH REPORTING**

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#### **UNIT 1**

STATISTICAL DATA AND TECHNIQUES USED IN DATA ANALYSIS

#### **UNIT 2**

DATA INTERPRETATION AND ANALYSIS

#### **UNIT 3**

APPLICATION OF STATISTICAL TOOLS

#### **UNIT 4**

RESEARCH REPORTING



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## **BLOCK 4 : DATA ANALYSIS AND RESEARCH REPORTING**

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### **Block Introduction**

The key objective of statistics in research is to function as a tool in designing research, help to analyze its data and draw conclusions. The end of each research studies result in a huge volume of raw data which must be properly summarized so that the same can be read easily and can be used for further analysis. The analysis is the computation of certain indices or measures along with searching for patterns of relationship that exist among the data groups. A report is a written document on a selected subject, which pass on information and ideas and along with making some recommendations. Reports often form the source of vital decision making. Incorrect, imperfect and poorly written reports fail to attain their purpose and reflect on the conclusions, which will ultimately be made.

The block will provide a detailed knowledge on the Data Analysis and Interpretation. The role of statistical analysis in the research methodology has clearly explained in this block. Different methods adopted in data representation and data analysis also have been described. The block also provides knowledge on the importance of report writing. The structure and tepsin report writing are also described in detail.

Unit 1 and 2 provide an introduction to statistical data and analysis of statistical data with a special reference to geographical and graphical representation of data. Different types methods used for analysis such as measures of Central Tendency, Measures of Dispersion, Regression and Correlation, and Chi-Square Test are also discussed in detail.

Unit 3 gives a detailed overview of the statistical tools used in research methodology. The description about the importance of statistical packages will help to add knowledge about the innovative statistical methods .Different Tools of Argument are also discussed in this unit.

Unit 4 provides an Introduction to the research reporting. The study on report structure, style and contents will help to understand how a report should be. Different writing styles such as Chicago, APA and MLA along with the Citation Styles, Footnotes and References are also provided in this unit. The unit also provides information on the evaluation of research and the Current Trends in LIS research.

## **Block Objectives**

**After learning this block, you will be able to understand :**

- About Data Analysis and Interpretation
- What is Geographical and Graphical Representation of Data
- What is Research Reporting
- About different Style Manuals
- About different types of Citation Styles
- What is Evaluation of Research

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**Block Structure**

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Unit 1 : Statistical Data Techniques used in Data Analysis

Unit 2 : Data Interpretation and Analysis

Unit 3 : Application of Statistical Tools

Unit 4 : Research Reporting



# STATISTICAL DATA TECHNIQUES USED IN DATA ANALYSIS

## : UNIT STRUCTURE :

- 1.0 Learning Objectives**
- 1.1 Introduction**
- 1.2 Types of Data**
- 1.3 Levels of Data**
- 1.4 Sources of Data**
- 1.5 Let Us Sum Up**
- 1.6 Answers for Check Your Progress**
- 1.7 Glossary**
- 1.8 Assignment**
- 1.9 Activities**
- 1.10 Case Study**
- 1.11 Further Readings**

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### **1.0 Learning Objectives :**

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**After learning this unit, you will be able to :**

- Understand what is Statistical Data
- Understand about types of data and differentiate between them
- Understand about levels of data

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### **1.1 Introduction :**

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In our day to day life, we frequently use the word data and information. Both are types of knowledge or something used to get knowledge. Depending on the circumstances, the meaning and usage of these words are different. The word "Data" is derived from Latin word "Datum". It means "to give". The smallest entity of the field of inquiry is called data. It is a raw input which can be facts, analysis, statistics, symbols, images, characters, numbers, etc. The collection of these raw inputs, which convey some meaningful idea, is known as information. It is also derived from the Latin word "Informare" which means "to instruct". The organized meaningful form of data is called information. Information may be perception, representation, knowledge or may be instruction. Let us take an example of population survey. During the population survey, the form consists of raw information about the family members, their age, occupation, education, etc. This raw information is called data. These data can be used to generate different types of information. The government can use it to determine the literacy rate

in the country, which is known as information. It is more meaningful than data. We can summarise the difference between data and information as under :

- Data consists of unrecognized facts that need to be processed, whereas information is organized, well structured or presented in a given context so as to make them useful.
- Data is the first level of field of inquiry or knowledge whereas information is the second level of knowledge.
- Data alone has no significance whereas information is significant by itself.
- Observations or recordings are done to obtain data whereas to obtain the information, analysis is carried out.

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### **1.2 Types of Data :**

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Statistical Data are the basic material for any statistical analysis. The collection and use of input data is extremely important to make an effective decision in a particular situation. One can collect large amount of data on a subject of interest in a precise form from the internet. However, the reliability of such data is always questionable. Thus, before relying on any interpreted data, one should check whether the source from which the data is taken is unbiased or not. One should also check whether the data represents the population or not. Nowadays, almost all data processing and data analysis work is carried out on computer and hence the data fed in computer must come from valid source. So the decision maker can arrive at definite conclusions. In order to design an experiment or conduct any survey, one should understand the different types of data and their measurement levels.

In any survey or study, the investigator develops a method to ask several questions to deal with variety of characteristics of the population. These characteristics in which one is interested to do the investigation and analysis is termed as a variable. So the variable is a quantity which varies from unit to unit. The observed outcomes of these variables are called data. Thus, the data may refer the several aspects of a study which are measurable, quantifiable, countable or classifiable. The various examples of the variable include height of a person, age of a person, profit or loss of a company, consumer behaviour, job satisfaction, leadership ability, etc. the following table gives the summary of the types of variables in relation to the nature of data information and measurement.

<b>Data Type</b>	<b>Information Type</b>	<b>Measurement Type</b>
<b>Qualitative (categorical)</b>	<b>Do you drink coffee ?</b>	<b>Yes/No</b>
<b>Quantitative (discrete)</b>	<b>How many members are there in your family ?</b>	<b>Number</b>
<b>Numerical Quantitative (continuous)</b>	<b>What is your height ?</b>	<b>Feet/inches/cm</b>

It may be noted that qualitative data are those which are not expressed in terms of numeric value like religion, feelings, gender, etc. whereas quantitative data are those which are expressed in terms of numeric value like age, height, price, income, weight, etc. These data are categories in two types viz. discrete and continuous. Discrete data are numerical measurements that are derived from a process of counting. Numbers of students in a class, number of employees in a factory, number of accidents on a particular road, etc are the examples of continuous data. Thus, continuous data are numerical measurements that arise from a process of measuring. If a variable can take only certain fixed value, then it is called discrete variable and if a variable can take any value within a specified interval, then it is called continuous variable.

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### **1.3 Levels of Data :**

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There are four levels in the data which are classified as under:

1. Nominal Level
2. Ordinal Level
3. Interval Level
4. Ratio Level

The characteristics of the above mentioned measurement scales are summarized in the following table :

<b>Types of scale</b>	<b>Characteristics of data</b>	<b>Basic Empirical Relation</b>	<b>Example</b>
<b>Nominal</b>	It is used to categorize the data. It has no order, distance or unique origin	Determination of equality	Roll No. Assigned to the students
<b>Ordinal</b>	It is used to rank the data value	Determination of greater or lesser value without magnitude	The first, second and seventh person in a race

**Basics of  
Research Methods**

<b>Interval</b>	It has both, order and distance but equality has no unique origin	Determination of degree in intervals or differences	Temperature
<b>Ratio</b>	It has all; classification, order, distance and unique origin	Determination of equality of ratio	Age of person

**1.4 Sources of Data :**

There are two main sources of collecting data :

- i. Primary Source
- ii. Secondary Source

The choice of data collection method from a particular source depends on so many factors like amount of money available, time span of study, accuracy required in analysis, etc. These factors depend upon the availabilities of resources and nature of study. This is how the source of data collection is selected. The data collected by the investigator himself is called primary data, while the data obtained by any other person is called secondary data. The primary data are those which are collected a fresh for the first time and thus happen to be original in character and the secondary data are those which have been collected by someone else and which have already been processed statistically. The major differences between Primary Data and Secondary Data can be stated as under :

<b>Primary Data</b>	<b>Secondary Data</b>
1. Primary data are obtained for the first time and hence they are original.	1. Secondary data are obtained by another person. Hence, they are not original.
2. Primary data are extensive and in raw form.	2. Secondary data are in systematic and concise form.
3. More time, money and labour are used for collecting the primary data.	3. Secondary data are in readymade form. So it saves time, money and labour.
4. Primary data are obtained from the units under inquiry. So they are relevant, accurate and reliable	4. Secondary data are obtained from other sources. So they may not be in relevant form and are not much accurate and reliable.
5. Primary data are independently collected by investor or his enumerator. example : population survey	5. Secondary data are collected by other persons or agencies.





**Basics of  
Research Methods**

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**1.9 Activities :**

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1. Collect the data using questionnaire and classify it into scales and levels.
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**1.10 Case Study :**

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1. Explain the difference between data and information
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**1.11 Further Readings :**

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1. C. R. Kothari Research Methodology



**UNIT STRUCTURE :**

- 2.0 Learning Objectives**
- 2.1 Introduction**
- 2.2 Geographical and Graphical Representation of Data**
  - 2.2.1 Geographical Representation**
  - 2.2.2 Graphical Representation**
- 2.3 Statistical Analysis**
  - 2.3.1 Measures of Central Tendency**
  - 2.3.2 Measures of Dispersion**
  - 2.3.3 Regression and Correlation**
  - 2.3.4 Chi-Square Test**
- 2.4 Let Us Sum Up**
- 2.5 Answers for Check Your Progress**
- 2.6 Glossary**
- 2.7 Assignment**
- 2.8 Activities**
- 2.9 Case Study**
- 2.10 Further Readings**

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**2.0 Learning Objectives :**

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**After learning this unit, you will be able to :**

- Understand what Data Analysis is.
- Understand about measures of central tendency.
- Understand measures of dispersion.
- Understand regression and correlation.

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**2.1 Introduction :**

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In the process of analysis, relationships or differences supporting or conflicting with original or new hypotheses should be subjected to statistical tests of significance to determine with what validity data can be said to indicate any conclusions. The data once collected must be processed and analysed according to the purpose of the already prepared research plan. This is vital for a scientific study and for making sure that we have all significant data for making comparisons and analysis. More precisely speaking it involves editing, coding, classification, and tabulation of collected data so that they are open to analysis. The term

analysis refers to the working out of certain measures along with searching for patterns of relationship that exist among data-groups.

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## **2.2 Geographical and Graphical Representation of Data :**

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### **2.2.1 Geographical Representation :**

To represent quantitative data visually with the help of a map or else, we must come up with illustration objects that represent theoretical concepts in a clear and understandable manner. So when the display quantitative information is made on a map, we combine visual displays of both theoretical and physical data. Geographical data on the other hand is physical. The important stories that numbers have to tell often involve location where things are or where they've occurred. Quantitative information is theoretical so it doesn't have physical form. When we display it, we do our best to represent those physical characteristics of earth masses, bodies of water, topography, roads, and so on, that concern us. Diverse representations of geography are required for diverse tasks. Cartographers spend years learning how to design maps to specifically and effectively support their many uses. The approaches to displaying geographical data on maps that usually works best.

The following figure shows a country that is divided into states, and that various intensities of the color black are being used to encode average household income. Where the colour is darker greater is the income. This approach displays a cumulative measure for each state rather than a measure for each household.



**Fig. 2.1 : Geographical Representations**

Geographical displays of this type are called choropleth maps.

Another type of map displayed below uses circles that vary in size to determine differences in value, i.e., the larger circle shows the greater. Suppose each circle represents a retail store and that their sizes indicate the amount of sales at each.



**Fig. 2.2 : Geographical Representations**

In this case, rather than displaying an aggregated value per state, each circle marks the location of an individual store. This design allows us to see a level of detail that would be lost had we color-encoded entire regions as done on the choropleth map. Both are suitable approaches and they simply serve dissimilar needs.

### 2.2.2 Graphical Representation :

Graphs are one of the most important devices for presenting statistical data. A large variety of graphs are used in presenting statistical data. The data presented with the help of graph is simple to understand.

A graph is a visual form of presentation of statistical data. A graph is more attractive than a table of figure. Even a common man can understand the message of data from the graph. Comparisons can be made between two or more phenomena very easily with the help of a graph.

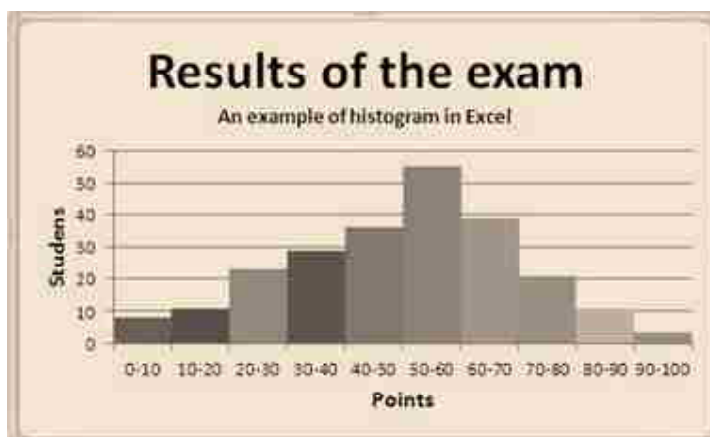
However here we shall discuss only some important types of Graphs which are more popular and they are

1. Histogram
2. Frequency Polygon
3. Frequency Curve
4. Ogive

1. **Histogram** : A histogram is a bar chart or graph showing the frequency of occurrence of each value of the variable being analysed. In histogram, data are plotted as a series of rectangles. Class intervals are shown on the – X-axis' and the frequencies on the – Y-axis'.

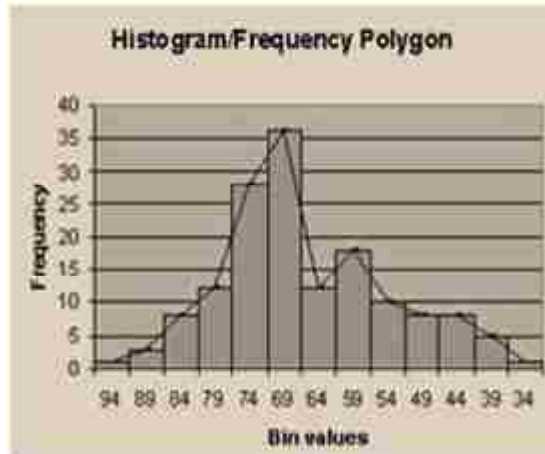
The height of each rectangle represents the frequency of the class interval. Each rectangle is formed with the other so as to give a continuous picture. Such a graph is also called staircase or block diagram.

However, we cannot construct a histogram for distribution with open-end classes. It is also quite misleading if the distribution has unequal intervals and suitable adjustments in frequencies are not made.



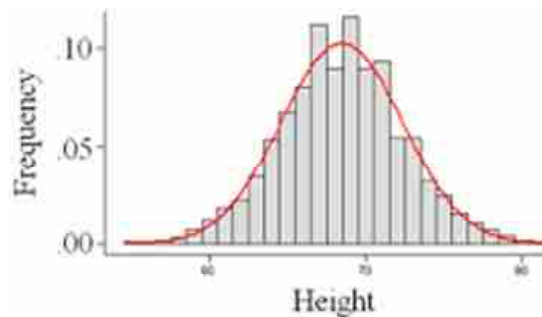
**Fig. 2.3 : Result of the Exam**

2. **Frequency Polygon :** If we mark the midpoints of the top horizontal sides of the rectangles in a histogram and join them by a straight line, the figure so formed is called a Frequency Polygon. This is done under the assumption that the frequencies in a class interval are evenly distributed throughout the class. The area of the polygon is equal to the area of the histogram, because the area left outside is just equal to the area included in it.



**Fig. 2.4 : Histogram/Frequency Polygon**

3. **Frequency Curve :** If the middle point of the upper boundaries of the rectangles of a histogram is corrected by a smooth freehand curve, then that diagram is called frequency curve. The curve should begin and end at the baseline.



**Fig. 2.5**

4. **Cumulative Frequency Curves or Ogive Curves :** If we need to know the number of items whose values are less than or more than an amount we first find out the cumulative frequency. The table of this frequency is called cumulative frequency table. If we plot these cumulative frequencies in graph we will get a cumulative frequency curve or Ogive. Ogive is a graphical representation of cumulative frequency distribution of a continuous series.

The Ogives are constructed by following two methods

- (a) **Less than Ogive :** An ogive representing a cumulative frequency distribution of less than type is called a less than ogive. Here the less than frequencies against the upper limit of the class interval are plotted in the graph.

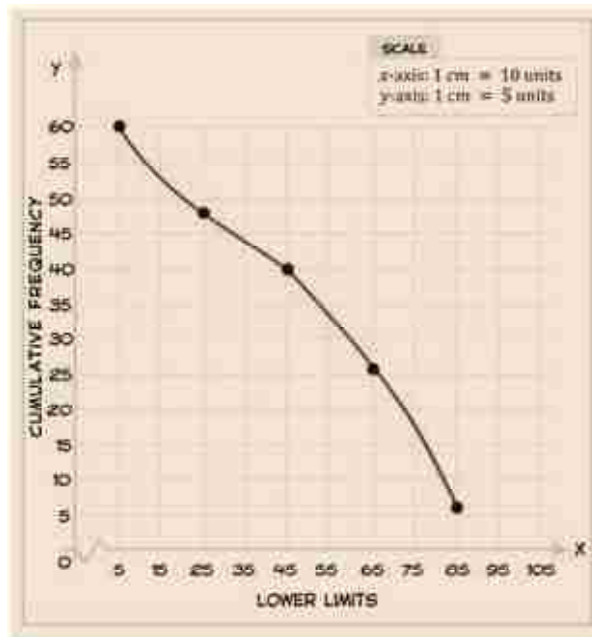


Fig. 2.6

- (b) **More Than Ogive** : An ogive representing a cumulative frequency distribution of 'more than' type is called a more than ogive. Here the frequencies against the lower limit of the class interval are plotted in the graph.

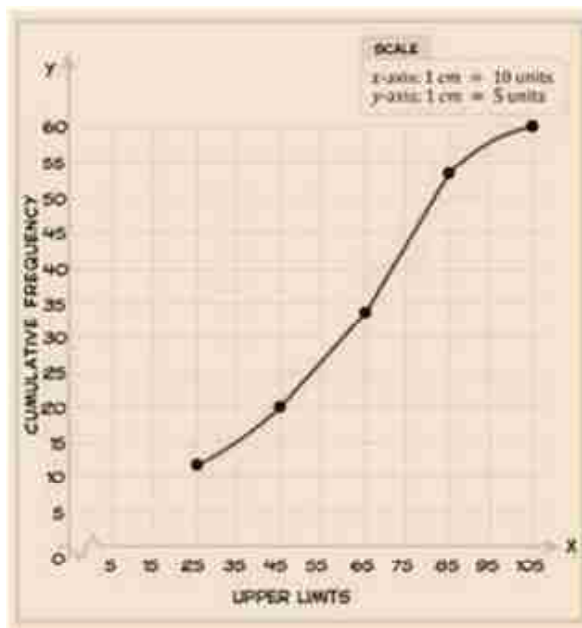


Fig. 2.7

**Check Your Progress – 1 :**

- The approaches to displaying geographical data are Variations in color intensity and variations in size or both.
  - true
  - false
- A \_\_\_\_\_ is a visual form of presentation of statistical data.
  - graph
  - histogram
  - Frequency Polygon

3. A \_\_\_\_\_ is a bar chart or graph showing the frequency of occurrence of each value of the variable being analysed.  
a. graph            b. histogram      c. Frequency Polygon
4. The midpoints of the top horizontal sides of the rectangles in a histogram and join them by a straight line, the figure so formed is called a \_\_\_\_\_.  
a. graph            b. histogram      c. Frequency Polygon

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### **2.3 Statistical Analysis :**

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Statistical analysis is a component of data analytics. Statistical analysis involves collecting and scrutinizing every data sample in a set of items from which samples can be drawn. A sample, in statistics, is a representative selection drawn from a total population.

Statistical analysis can be broken down into five discrete steps, as follows :

- Describe the nature of the data to be analyzed.
- Explore the relation of the data to the underlying population.
- Create a model to summarize understanding of how the data relates to the underlying population.
- Prove (or disprove) the validity of the model.
- Employ predictive analytics to run scenarios that will help guide future actions.

Statistical analysis is fundamental to all experiments that use statistics as a research methodology. Most experiments in social sciences and many important experiments in natural science and engineering need statistical analysis. Statistical analysis is also a very useful tool to get approximate solutions when the actual process is highly complex or unknown in its true form.

#### **2.3.1 Measures of Central Tendency :**

A measure of central tendency is a single value that attempts to describe a set of data by identifying the central position within that set of data. As such, measures of central tendency are sometimes called measures of central location. They are also classed as summary statistics. The mean (often called the average) is most likely the measure of central tendency that you are most familiar with, but there are others, such as the median and the mode.

The mean, median and mode are all valid measures of central tendency, but under different conditions, some measures of central tendency become more appropriate to use than others. In the following sections, we will look at the mean, mode and median, and learn how to calculate them and under what conditions they are most appropriate to be used.

**(a) Mean (Arithmetic) :**

The mean (or average) is the most popular and well known measure of central tendency. It can be used with both discrete and continuous data, although its use is most often with continuous data. The mean is equal to the sum of all the values in the data set divided by the number of values in the data set. So, if we have  $n$  values in a data set and they have values  $x_1, x_2, \dots, x_n$ , the sample mean, usually denoted by (pronounced  $x$  bar), is :

$$\bar{X} = \frac{X_1 + X_2 + X_3 \dots X_N}{N}$$

Where

$\bar{X}$  = the mean

$X_1$  = the first value

$X_2$  = the second value

$X_3$  = the third value

$X_N$  = the last value

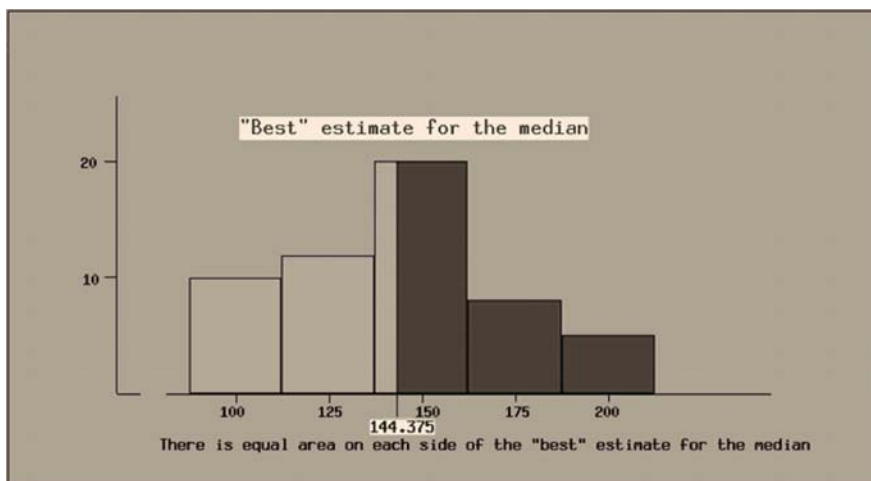
$N$  = the number of value

This formula can be written in a slightly different manner using the Greek capitol letter, pronounced "sigma", which means "sum of..." :

$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

**(b) Median :**

The median is the middle score for a set of data that has been arranged in order of magnitude. It is a positional average which is extensively used in statistical analysis. Median is the value which divides the series into two equal divisions. If there is an odd number of observations, the median is the middle value. If there is an even number of observations, the median is the average of the two middle values.





## Basics of Research Methods

### (c) Mode :

The mode is a positional measure which is the most common item of a series.

It is the value that appears largest times in series.

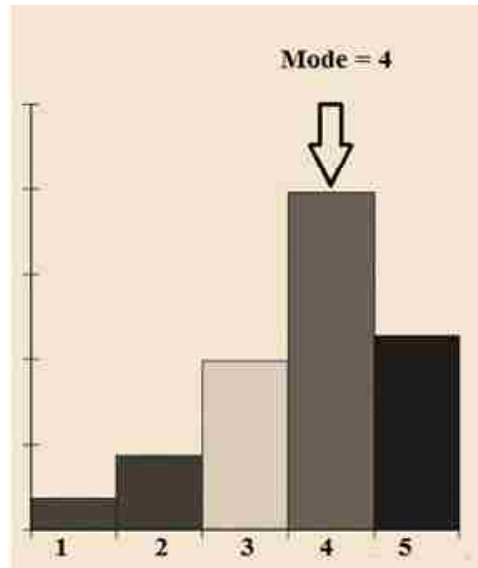


Fig. 2.8

### 2.3.2 Measures of Dispersion :

The measures of central tendency are not adequate to describe data. Two data sets can have the same mean but they can be entirely different. Thus to describe data, one needs to know the extent of variability. The key purpose of measures of dispersion is to find out how spread out the data values is on the number line. It can be called as the measures of spread. This is given by the measures of dispersion. Range, inter quartile range, and standard deviation are the three commonly used measures of dispersion. Usually, a small value of dispersion indicates that measure of central tendency is more reliable previous representative of data series and vice-versa.

#### (a) Range :

The range is the difference between the largest and the smallest observation in the data. The prime advantage of this measure of dispersion is that it is easy to calculate. On the other hand, it has lot of disadvantages. It is very sensitive to outliers and does not use all the observations in a data set. It is more informative to provide the minimum and the maximum values rather than providing the range. Being a positional measure it accounts only the difference between the highest and the lowest observation.

#### (b) Inter Quartile Range :

Inter quartile range is defined as the difference between the 25th and 75th percentile (also called the first and third quartile). Hence the inter quartile range describes the middle 50% of observations. If the inter quartile range is large it means that the middle 50% of observations are

spaced wide apart. The important advantage of inter quartile range is that it can be used as a measure of variability if the extreme values are not being recorded exactly (as in case of open– ended class intervals in the frequency distribution). Other advantageous feature is that it is not affected by extreme values. The main disadvantage in using inter quartile range as a measure of dispersion is that it is not amenable to mathematical manipulation.

**(c) Mean Deviation :**

Mean deviation is an absolute measure of dispersion but unlike range or quartile deviation it is a calculative : measure of dispersion which gives it some advantages over them.

$$\text{Mean deviation from mean} = \frac{\Sigma |X - \bar{X}|}{N}$$

**(d) Standard Deviation :**

Standard deviation (SD) is the most commonly used measure of dispersion. It is a measure of spread of data about the mean. SD is the square root of sum of squared deviation from the mean divided by the number of observations.

This formula is a definitional one and for calculations, an easier formula is used. The computational formula also avoids the rounding errors during calculation.

In both these formulas  $n - 1$  is used instead of  $n$  in the denominator, as this produces a more accurate estimate of population SD.

The reason why SD is a very useful measure of dispersion is that, if the observations are from a normal distribution, then 68% of observations lie between mean  $\pm 1$  SD 95% of observations lie between mean  $\pm 2$  SD and 99.7% of observations lie between mean  $\pm 3$  SD

The other advantage of SD is that along with mean it can be used to detect skewness. The disadvantage of SD is that it is an inappropriate measure of dispersion for skewed data.

$$SD = \sqrt{\frac{\Sigma(\chi - \bar{\chi})^2}{n - 1}}$$

$$SD = \sqrt{\frac{\Sigma\chi^2 - \frac{(\Sigma\chi)^2}{n}}{n - 1}}$$

**(e) Quartile Deviation :**

Quartile deviation is another positional and absolute measure of data dispersion in any series which try to minimise the error of range as a measure of dispersion) minimise the error of range as a measure of dispersion.

Symbolically it is estimated using following formula,

$$\text{Quartile Deviation (QD)} = (Q3 - Q1)/2$$

### **2.3.3 Regression and Correlation :**

#### **(a) Correlation :**

Correlation means the average relationship between two or more variables. Correlation is a bivariate analysis that measures the strengths of association between two variables. When changes in the values of a variable affect the values of another variable, we say that there is a correlation between the two variables. The two variables may move in the same direction or in opposite directions. In statistics, the value of the correlation coefficient varies between +1 and -1. When the value of the correlation coefficient lies around  $\pm 1$ , then it is said to be a perfect degree of association between the two variables. As the correlation coefficient value goes towards 0, the relationship between the two variables will be weaker. Usually, in statistics, we measure three types of correlations: Pearson correlation, Kendall rank correlation and Spearman correlation.

#### **(b) Regression :**

In the pairs of observations, if there is a cause and effect relationship between the variables X and Y, then the average relationship between these two variables is called regression, which means – stepping back or ‘return to the average’. Regression analysis is the statistical approach to forecasting change in a dependent variable (for example sales revenue) on the basis of change in one or more independent variables (eg. population, income). Known also as curve fitting or line fitting because a regression analysis equation can be used in fitting a curve or line to data points, in a manner such that the differences in the distances of data points from the curve or line are minimized. The linear relationship giving the best mean value of a variable corresponding to the other variable is called a regression line or line of the best fit. Relationships shown in a regression analysis are, however, associative only, and any cause–effect inference is purely subjective. The regression of X on Y is different from the regression of Y on X.

### **2.3.4 Chi-Square Test :**

There are many situations in which it is not possible to make any rigid assumption about the distribution of the population from which samples are being drawn. This limitation has led to the development of a group of alternative techniques known as non–parametric tests. Chi–square test of independence and goodness of fit is a prominent example of the use of non–parametric tests.

#### **❖ Uses of $\chi^2$ test :**

The main uses of  $\chi^2$  test are:

- i.  $\chi^2$  test as a test of independence :** With the help of  $\chi^2$  test, we can find out whether two or more attributes are associated or not.



## Basics of Research Methods

statistical methods in all their details and results. The approaches to displaying geographical data on maps are denoted by the variations in color intensity and variations in size. The data presented with the help of graph is simple to understand as it's a visual form of presentation of statistical data. The important types of graphs which are more popular and they are Histogram, Frequency Polygon, Frequency Curve, Ogive. Statistical analysis involves collecting and scrutinizing every data sample in a set of items from which samples can be drawn. The measures of dispersion are also called as the measures of spread helps to find out how spread out the data values is on the number line. The measures of dispersion along with mean, median and mode which are the measures of central tendency which are used for data analysis.

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### 2.5 Answers for Check Your Progress : :

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#### Check Your Progress – 1 :

1. a                      2. a                      3. b                      4. c

#### Check Your Progress – 2 :

1. a                      2. a                      3. a                      4. b  
5. c                      6. a                      7. a                      8. a

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### 2.6 Glossary :

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1. **Topography** – Geography
2. **Precisely** – In Particular
3. **Cartography** – Study and practice of making maps
4. **Visual** – Illustration

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### 2.7 Assignment :

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1. Create a distribution of your own and represent the median graphically using a bar diagram.

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### 2.8 Activities :

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1. Do the Google maps help to represent the geographical data effectively? Explain.

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### 2.9 Case Study :

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1. Represent the statistical data the covid patients of Gujarat who have been infected, recovered and dead using pie chart

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### 2.10 Further Reading :

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1. Research Methodology C. R. Kothari

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**: UNIT STRUCTURE :**

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**3.0 Learning Objectives****3.1 Introduction****3.2 Statistical Package****3.3 Tools of Argument****3.4 Let Us Sum Up****3.5 Answers for Check Your Progress****3.6 Glossary****3.7 Assignment****3.8 Activities****3.9 Case Study****3.10 Further Readings**

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**3.0 Learning Objectives :**

- To understand the various statistical tools and their applications.
  - To understand the applications of various statistical tools in the fields of social sciences, health sciences, market research, etc.
  - To understand the applications of statistical tools in descriptive and bi-variate statistics.
  - To understand numeral outcome prediction and thereby come to the particular inference theory.
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**3.1 Introduction :**

Various statistical tools are available in the market for the analysis of data. Some of them are simple, some are complicated and some of them are often very specific for certain purposes. The most important common operation is the comparison of data or sets of data as far as analysis of data is concerned. Its main purpose is to quantify accuracy (bias) and precision. The "*t*-test", the "*F*-test", and regression analysis, etc. are a few simple convenient statistical tools used for the above purpose. The results of these statistical procedures are recorded and can be retrieved.

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**3.2 Statistical Package :**

The Statistical Package for the Social Sciences (SPSS) is a software package used in statistical analysis of data. It was developed by SPSS Inc. and acquired by IBM in 2009. In 2014, the software was officially renamed IBM SPSS Statistics. The software was originally meant for

## Basics of Research Methods

the social sciences, but has become popular in other fields such as health sciences and especially in marketing, market research and data mining.

The Statistical Package for the Social Sciences is a widely used program for statistical analysis in social sciences, particularly in education and research. However, because of its potential, it is also widely used by market researchers, health-care researchers, survey organizations, governments and, most notably, data miners and big data professionals.

Aside from statistical analysis, the software also features data management, which allows the user to do case selection, create derived data and perform file reshaping. Another feature is data documentation, which stores a metadata dictionary along with the data file.

Statistical methods usable in the software include :

- 3.0 Descriptive statistics – Frequencies, cross tabulation, descriptive ratio statistics
- 4.0 Bivariate statistics – Analysis of variance (ANOVA), means, correlation, non parametric tests
- 5.0 Numeral outcome prediction – Linear regression
- 6.0 Prediction for identifying groups – Cluster analysis (K-means, two-step, hierarchical), factor analysis

### Check Your Progress – 1 :

1. The Statistical Package for the Social Sciences (SPSS) is a software package used in statistical analysis of data.
  - a. true
  - b. false

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### 3.3 Tools of Argument :

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An argument is the most basic complete unit of reasoning, a molecule of reason. An 'argument' is an inference from one or more starting points to an end (a truth claim called a 'conclusion'). 'Arguments' are to be distinguished from 'explanations'. A general rule to keep in mind is that arguments attempt to demonstrate that something is true; explanations attempt to show how something is true. A conclusion can be called as an argument that concludes, the product and outcomes of a chain of inference, that which the reasoning validate and supports.

- (a) **Analysis** : Analysis, particularly in case of survey or experimental data or research, involves estimating the values of unknown parameters of the population and testing of hypotheses for drawing inferences. Analysis is divided as descriptive analysis and inferential analysis. Inferential analysis is often known as statistical analysis. Descriptive analysis is largely the study of distributions of one variable.
- (b) **Synthesis** : To synthesis is to merge two or more elements to form a new total. We all know that according to the literature review, the elements can be called as the findings of the literature we collect

and comprehend; the 'new whole' is the conclusion you draw from those findings. Synthesis is to draw conclusions about the findings in the literature so that we can recognize how the literature addresses our research question. The synthesis is a written discussion that draws on one or more sources. It follows that the ability to write syntheses depends on the ability of the researcher to assume relationships among sources such as different related essays, fiction, articles and verbal sources, such as lectures, interviews, observations.

**The Explanatory Synthesis :** An explanatory synthesis helps to understand a topic. Writers explain when they split a subject into its components and present them in an apparent and methodical style.

**The Argument Synthesis :** The purpose of an argument synthesis helps the researcher to present his own view point backed up by relevant facts, drawn from sources, and presented in a logical manner.

- (c) **Interpretation :** Interpretation refers to the task of drawing inferences from the collected facts after an analytical and experimental study. The mission of interpretation has two key aspects viz., the attempt to set up permanence in research through linking the results of a given study with other studies and the establishment of some explanatory concepts. Interpretation is concerned with relationships within the collected data, somewhat in accordance with the analysis. Thus, interpretation is the device through which the factors that seem to explain what has been observed by researcher in the course of the study can be better understood and it also provides a theoretical conception which can serve as a guide for further researches. Interpretation is necessary for the simple reason that the utility and benefit of research findings lie in proper interpretation. It is being considered a basic component of research process because of the following reasons: It is through interpretation that the researcher can well understand the abstract principle that works beneath his findings. Through this he can link up his findings with those of other studies, having the same abstract principle, and thereby can predict about the concrete world of events. Fresh inquiries can test these predictions later on. This way the continuity in research can be maintained. Interpretation leads to the establishment of explanatory concepts that can serve as a guide for future research studies; it opens new avenues of intellectual adventure and stimulates the quest for more knowledge.

Researcher can better appreciate only through interpretation why his findings are what they are and can make others to understand the real significance of his research findings.

- (d) **Inferences :** Inference is the act or process of deriving logical conclusions from premises known or assumed to be true. The laws



## Basics of Research Methods

of valid inference are studied in the field of logic. After collecting and analyzing the data, the researcher has to carry out the task of drawing inferences followed by report writing. This has to be done very vigilantly, otherwise deceptive conclusions may be drawn and the whole purpose of doing research may get corrupted. Alternatively, inference is defined as the non-logical, but rational means, through observation of patterns of facts, to see new meanings and contexts for understanding indirectly

In case the researcher had no hypothesis to start with, he would try to explain his findings on the basis of some theory. This may at times result in new questions, leading to further researches. All this analytical information and consequential inference(s) may well be communicated, preferably through research report, to the consumers of research results who may be either an individual or a group of individuals or some public/private organisation. Inference does not draw conclusions but opens new paths for inquiry. In this definition of inference, there are two types of inference: inductive inference and deductive inference.

### Check Your Progress – 2 :

1. A \_\_\_\_\_ is the most basic complete unit of reasoning, a molecule of reason.  
a. Analysis                      b. argument                      c. Synthesis
2. \_\_\_\_\_ involves estimating the values of unknown parameters of the population and testing of hypotheses for drawing inferences.  
a. Analysis                      b. argument                      c. Synthesis
3. \_\_\_\_\_ is to draw conclusions about the findings in the literature so that we can recognize how the literature addresses our research question.  
a. Analysis                      b. argument                      c. Synthesis
4. \_\_\_\_\_ refers to the task of drawing inferences from the collected facts after an analytical and experimental study.  
a. Interpretation                      b. Inference                      c. Synthesis
5. \_\_\_\_\_ is the act or process of deriving logical conclusions from premises known or assumed to be true.  
a. Interpretation                      b. Inference                      c. Synthesis

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### 3.4 Let Us Sum Up :

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Research report is considered a key component of the research study for the research task remains incomplete unless the report has been presented and written. 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. The general opinion is in favour of treating the presentation of research results or the writing of report as part and

parcel of the research project. Writing of report is the last step in a research study and requires a set of skills somewhat different from those called for in respect of the earlier stages of research.

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### **3.5 Answers for Check Your Progress :**

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#### **Check Your Progress – 1 :**

1. a

#### **Check Your Progress – 2 :**

1. b
  2. a
  3. c
  4. a
  5. b
- 

### **3.6 Glossary :**

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1. **Scrutinize** – Examine
  2. **Approximate** – Estimated
  3. **Discrete** – Separate
  4. **Amenable** – Agreeable
  5. **Comprehend** – Understand
- 

### **3.7 Assignment :**

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1. Write a note on Statistical analysis
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### **3.8 Activities :**

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1. Differentiate between explanatory and argumentative synthesis
- 

### **3.7 Case Study :**

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1. Use the suitable statistical tool for testing the independence of attributes between the patients who have been given vaccine and who have not been given vaccine yet and the survival–death possibility from the past records.
- 

### **3.8 Further Readings :**

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1. Research Methodology C.R. KOTHARI



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: UNIT STRUCTURE :  
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**4.0 Learning Objectives**

**4.1 Introduction**

**4.2 Structure, Style and Contents**

**4.2.1 Different Steps in Writing Report**

**4.2.2 Contents of a Report**

**4.3 Style Manuals (Chicago, APA, MLA)**

**4.4 Citation Styles**

**4.4.1 Footnotes**

**4.4.2 References**

**4.5 Evaluation of Research**

**4.5.1 Types of Evaluation**

**4.6 Current Trends in LIS Research**

**4.7 Let Us Sum Up**

**4.8 Answers for Check Your Progress**

**4.9 Glossary**

**4.10 Assignment**

**4.11 Activities**

**4.12 Case Study**

**4.13 Further Readings**

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**4.0 Learning Objectives :**

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**After learning this unit, you will be able to :**

- Understand the structure and contents of report writing
  - Understand different style manuals
  - Understand about referencing
  - Understand about current Trends in LIS research
- 

**4.1 Introduction :**

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At the end of collecting and analyzing the data, the researcher has to carry out the task of drawing inferences followed by report writing. This has to be done very vigilantly, otherwise deceptive conclusions may be drawn and the whole purpose of doing research may get vitiated. With the help of this interpretation that the researcher can expose relations to the processes that underlie his findings. Research report is considered

a key factor of the research study for the research undertaking remains imperfect 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. Writing of report is the last step in a research study and requires a set of skills somewhat different from those called for in respect of the earlier stages of research. This task should be accomplished by the researcher with utmost care; he may seek the assistance and guidance of experts for the purpose.

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## **4.2 Structure, Style and Contents :**

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### **4.2.1 Different Steps in Writing Report :**

Research reports are the product of slow, painstaking, accurate inductive work. The usual steps involved in writing report are :

- (1) Logical Analysis of the Subject–Matter :** 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 :** 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.
  - (b) Chronologically :** 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.
- (2) Preparation of the Final Outline :** It is the next step in writing the research report? Outlines are the framework upon which long written works are constructed. They are an aid to the logical organisation of the material and a reminder of the points to be stressed in the report
- (3) Preparation of the Rough Draft :** 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.

- (4) **Rewriting and Polishing** : 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. In addition the researcher should give due attention to the fact that in his rough draft he has been consistent or not. He should check the mechanics of writing grammar, spelling and usage.
- (5) **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. Research Methodology 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.
- (6) **Writing the Final Draft** : As the name denotes it's the final step of the whole process.

#### **4.2.2 Contents of a Report :**

##### **(a) Title Page :**

Titles are designed to **inform readers on the content of the work**. Aim for a title that is informative and **specific** to the research. The researcher should make sure that the title clearly indicates and reflects the contents of the report. Titles should be concise, descriptive and specific. A Sub–title (where appropriate), Date, Author, Organization, Logo can also be added in this section. It should be noted that abbreviations should not be used in titles.

##### **(b) Background :**

A History behind project can be included in this section.

##### **(c) Acknowledgement :**

In this section the researcher thanks people and organization who helped during the project

##### **(d) Summary/Abstract/Synopsis :**

The abstract is a brief summary of the study rationale, methodology and the main findings and conclusions of the report. Make sure to highlight in which way your paper is contributing to the field. An abstract should be self–contained. Do not copy your introduction in your abstract. An introduction is merely introducing your paper, while the abstract is summarizing the whole paper and its conclusions. Although some

terminology will be inevitable, ensure that your abstract is written accessibly. Do not include general background information in the abstract. As abstracts should contain a limited number of words (400 or less), they should convey the essential information found in the research paper.

A condensed version of a report – outlines salient points, emphasizes main conclusions and (where appropriate) the main recommendations.

**(e) Table of Contents :**

The purpose of the table of contents is to give an overview of the subject matter and the structure of the report, so that readers can easily jump to a specific part of the text containing the information they need. The structure of the table of contents needs to be logical and transparent. Use "Contents" as a header for the table of contents. Use the correct indentation: main titles (Contents, Introduction, Conclusion and Appendices) should be left-aligned and titles of sections should be indented from the left margin. For each additional level, you should set an additional indent. Ensure your table of contents is structured in an orderly fashion. Make sure that titles or headings are as significant as possible. Divide all subjects in subtopics, but take into account that each subtopic could belong to only one subject of a higher level. Lists of tables, figures and graphs guide readers to find the information they are looking for in the body of the text. A list of symbols and abbreviations enables readers to quickly find the meaning of each symbol and abbreviation. The lists of tables, figures, graphs, symbols, formulas and abbreviations are generally provided after the table of contents.

**(f) Introduction :**

An introduction should capture the audience's attention. Introductions generally start by identifying and situating a problem in the existing literature. Next, introductions describe how the project or research was conducted, formulate the purpose of the research or paper and highlight in which way it is making a new contribution to the field. Finally, the introduction indicates the main points as well as the outline of the report. Writing a strong introduction helps to describe the problem statement and situate the problem in its wider context. If appropriate, the introduction defines key concepts and explains new concepts. The researcher should frame research within the existing literature and refer to previous work. Present a comprehensive yet brief literature review and cite the sources you have used both in the text and in a reference list. A brief overview of your methodology or the procedures followed. The outline of the report with explicit reference to the different chapters and/or sections should be indicated.

**(g) Body :**

The body of the text explains in detail how the study was conducted, reports key findings and provides evidence supporting your conclusion.

**Organizing the Body of the Text :** Divide the main body of the text in chapters. Chapters should follow a logical outline and usually

## Basics of Research Methods

include the following three main parts: methodology, results and discussion and interpretation

**Methods :** Describing the project, while explaining the key working principle applied. The method section elaborates on the methodology used and makes objective arguments to justify the approach taken.

**Results :** Reporting results and analyses, focusing on key results and interpretations, acknowledging limitations and implications for the interpretation of results. The line of reasoning should be clear and well-supported and assumptions should be justified.

**Discussion :** Discussing main points in relation to the problem statement, analyzing and interpreting main findings through consistent reasoning and argumentation, eliminating alternative explanations and pointing to the significance of the results.

### (h) Conclusions :

The main text ends with a concluding section. It should be noted that the potential readers would look into this part first and therefore it should be independent of the main body of the text. The sum up your main findings, general conclusions and contribution is to be added. Briefly discuss your results if appropriate and provide an answer to the problem statement. It will be attractive if the researcher concludes with the recommendations for improvement and suggestions for further research.

### (i) References :

A section of a report, which provides full details of publications mentioned in the text, or from which extracts have been quoted. The reference section comprises a list of all sources that were cited in the text. The reference list should be alphabetical according to the first author's last name

### (j) Appendix :

The purpose of an appendix is to supplement the information contained in the main body of the report

### Check Your Progress – 1 :

1. The \_\_\_\_\_ development is made on the basis of mental connections and associations between the one thing and another by means of analysis.  
a. Chronological      b. logical      c. none of these
2. \_\_\_\_\_ development is based on a connection or sequence in time or occurrence.  
a. Chronological      b. logical      c. none of these
3. The researcher should make sure that the title clearly indicates and reflects the contents of the report.  
a. true      b. false

4. The \_\_\_\_\_ of the text explains in detail how the study was conducted.
  - a. Appendix
  - b. Body
  - c. References
5. A section of a report, which provides full details of publications mentioned in the text, or from which extracts have been quoted
  - a. Appendix
  - b. Body
  - c. References

### 4.3 Style Manuals (Chicago, APA, MLA) :

A style manual (also known as a style guide or stylebook) is a set of editing and formatting standards for the usage of researchers, students all other professionals. Style manuals are indispensable reference works for scholars who necessitate documenting their sources in footnotes, endnotes, parenthetical citations, and bibliographies. Because style manuals also deal with some of the finer points of usage, spelling, punctuation, and mechanics, they should be useful to *all* writers. The academic major or area of professional interest determines which style manual one should use. For example, the MLA guides (*The MLA Handbook* and *MLA Style Manual*) are the main source for citation guidelines in the fields of literature, languages, and the humanities. Students and researchers in the social and behavioral sciences conventionally depend on the APA guide (*Publication Manual of the American Psychological Association*).

#### (a) The Chicago Manual of Style :

The Chicago Manual of Style (abbreviated in writing as **CMS** or **CMOS** [the version used on its website], or, by some writers as **Chicago**) is a style guide for American English published since 1906 by the University of Chicago Press. Its sixteen editions have prescribed writing and citation styles widely used in publishing. It is "one of the most widely used and respected style guides in the United States." **CMOS** deals with aspects of editorial practice, from American English grammar and use for document preparation.

#### (b) APA (American Psychological Association) :

APA (American Psychological Association) style is most commonly used to cite sources within the social sciences. This resource, revised according to the 6th edition, second printing of the APA manual, offers examples for the general format of APA research papers, in-text citations, endnotes/footnotes, and the reference page

##### i. General APA Guidelines :

Your matter should be typed, double-spaced on standard-sized paper (8.5" x 11") with 1" margins on all sides. You should use a clear font that is highly readable. APA recommends using 12 pt. Times New Roman font.

Include a **page header** (also known as the "**running head**") at the top of every page. To create a **page header/running head**, insert page numbers flush right. Then type "TITLE OF YOUR PAPER" in the



## Basics of Research Methods

header flush left using all capital letters. The **running head** is a shortened version of your paper's title and cannot exceed 50 characters including spacing and punctuation

### (c) **MLA (Modern Language Association) :**

MLA (Modern Language Association) style is most commonly used to write papers and cite sources within the liberal arts and humanities.

#### **i. General Format :**

MLA style specifies guidelines for formatting manuscripts and using the English language in writing. MLA style also provides writers with a system for referencing their sources through parenthetical citation in their essays and Works Cited pages.

Writers who properly use MLA also build their credibility by demonstrating accountability to their source material. Most importantly, the use of MLA style can protect writers from accusations of plagiarism, which is the purposeful or accidental uncredited use of source material by other writers.

If you are asked to use MLA format, be sure to consult the *MLA Handbook for Writers of Research Papers* (7th edition). Publishing scholars and graduate students should also consult the *MLA Style Manual and Guide to Scholarly Publishing* (3rd edition). The *MLA Handbook* is available in most writing centers and reference libraries; it is also widely available in bookstores, libraries, and at the MLA web site. See the Additional Resources section of this handout for a list of helpful books and sites about using MLA style.

#### **ii. Paper Format :**

The preparation of papers and manuscripts in MLA style is covered in chapter four of the *MLA Handbook*, and chapter four of the *MLA Style Manual*. Below are some basic guidelines for formatting a paper in *MLA style*.

#### **iii. General Guidelines :**

1. Type your paper on a computer and print it out on standard, white 8.5 x 11 inch paper.
2. Double-space the text of your paper, and use a legible font (e.g. Times New Roman). Whatever font you choose, MLA recommends that the regular and italics type styles contrast enough that they are recognizable one from another. The font size should be 12pt.
3. Leave only one space after periods or other punctuation marks (unless otherwise instructed by your instructor).
4. Set the margins of your document to 1 inch on all sides.
5. Indent the first line of paragraphs one half-inch from the left margin. MLA recommends that you use the Tab key as opposed to pushing the Space Bar five times.

6. Create a header that numbers all pages consecutively in the upper right-hand corner, one-half inch from the top and flush with the right margin. (**Note** : Your instructor may ask that you omit the number on your first page. Always follow your instructor's guidelines.)
7. Use italics throughout your essay for the titles of longer works and, only when absolutely necessary, providing emphasis.
8. If you have any endnotes, include them on a separate page before your Works Cited page. Entitle the section Notes (centered, unformatted)

**Check Your Progress – 2 :**

1. \_\_\_\_\_ are indispensable reference works for scholars who necessitate documenting their sources in footnotes, endnotes, parenthetical citations, and bibliographies.
  - a. Titles
  - b. Contents
  - c. Style manuals
2. The \_\_\_\_\_ is a style guide for American English published since 1906 by the University of Chicago Press.
  - a. Chicago Manual of Style
  - b. APA (American Psychological Association)
  - c. MLA (Modern Language Association)
3. \_\_\_\_\_ style is most commonly used to cite sources within the social sciences.
  - a. Chicago Manual of Style
  - b. APA (American Psychological Association)
  - c. MLA (Modern Language Association)
4. \_\_\_\_\_ style is most commonly used to write papers and cite sources within the liberal arts and humanities.
  - a. Chicago Manual of Style
  - b. APA (American Psychological Association)
  - c. MLA (Modern Language Association)

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**4.4 Citation Styles :**

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An article citation generally includes the author or authors of the article, the title of the article, the name of the periodical or journal in which the article appears, the date the journal was published, the volume and/or issue number of the journal, and the page number (or range of page numbers) for the article.

The APA style is commonly used by fields in the social sciences such as psychology, linguistics, and education. APA publishes the Publication Manual of the American Psychological Association, a pocket guide, and instructor and student manuals.

The first two styles are known as "in-text" citation styles, which means that you give some information about the source directly after

## **Basics of Research Methods**

the quotation, but leave the rest to a list of References (APA) or Works Cited (MLA) at the end of the paper. (1) MLA style, defined by the Modern Language Association, is most common in the humanities. Because humanities research highlights how one piece of writing influences another, MLA style emphasizes the author's name and the page in the original text you're using. This information allows scholars to track down easily the exact sentences you're analyzing. (2) APA style, defined by the American Psychological Association, is most common in the social sciences. Although the author's name is an important element in APA citations, this style emphasizes the year the source was published, rather than the page number, which allows a reader to see quickly how the research you're writing about has evolved over time.

The alternative to in-text citation is to use footnotes, which give source information at the bottom of the page. The footnote style we demonstrate here is called Chicago style, defined by the University of Chicago. Chicago style is especially popular in historical research. When developing a historical explanation from multiple primary sources, using footnotes instead of inserting parenthetical information allows the reader to focus on the evidence instead of being distracted by the publication information about that evidence. The footnotes can be consulted if someone wants to track down your source for further research. Chicago style is more flexible than MLA and APA formats, and therefore more complicated to explain

### **4.4.1 Footnotes :**

Footnotes are notes placed at the bottom of a page. They cite references or comment on a designated part of the text above it. When the reader comes across the footnote in the main text of the paper, he or she could look down at your comments right away, or else continue reading the paragraph and read your comments at the end. Because this makes it convenient for your reader, most citation styles require that you use either footnotes or end notes. Footnotes only serve one purpose, to allow the reader to access with ease and confidence the source that you have used. Any citation form that does well this is appropriate, but most disciplines insist on their own particular way of citing information, and you must follow those preferences

Footnotes are notes placed at the bottom of a page. They cite references or comment on a designated part of the text above it. Footnote references should be placed outside punctuation, but inside the closing parenthesis when referring to matter within parentheses. It makes no distinction between numeric or symbol footnotes. It makes no distinction between a single word or phrase. Footnotes should begin with the numbers indented 1 cm space.

### **4.4.2 References :**

Reference is a relation between objects in which one object designates, or acts as a means by which to connect to or link to, another object.

The first object in this relation is said to refer to the second object. Referencing is the act of mentioning something in speech or in writing i.e. it's the act of referring to something or someone. Avoiding plagiarism is every researcher's responsibility, and there are penalties for failing to do so. It may prompt legal action from the copyright owner of any work that is not acknowledged. Referencing may show the respect for and acknowledges the work of other scholars. It shows observance to academic writing standards and provides evidence that the researcher has read and considered the relevant literature thus gives work credibility.

#### **4.4.2.1 The need for Referencing :**

A reference or citation is required in the following cases

- Cite by quoting another person word for word. It doesn't matter whether it is a phrase, sentence or paragraph, the researcher should provide a reference to the source
- cite by paraphrasing or shortening of ideas or data taken from another source
- use statistical figures taken from another source (e.g. population, results of surveys)
- use tables, figures, diagrams or images created by another person

Failure to reference, or poor referencing can be classified as academic misconduct. It is a standard required of scholarly communication

#### **4.4.2.2 How to Reference :**

1. As the researcher carries on his work, he should record and keep the details of each source he has used which includes details such as author, title, publication date, publisher, place of publication, journal title, volume, issue, page numbers, date viewed or accessed, URL, data base, etc.
2. **In-text Citations :** Both the Harvard AGPS and APA referencing styles used at USQ are author-date styles. The in-text citations will consist mainly of the authors' surnames and the year (and page numbers if appropriate). If there is no discernable author, the title and date are used
3. **List of References :** More ample details for each source are put in the list of references at the end of the assignment. This enable the reader to trace and verify your sources.

#### **Check Your Progress – 3 :**

1. In-text citation styles, which means that you give some information about the source directly after the quotation.
  - a. true
  - b. false
2. Footnotes are notes placed at the top of a page.
  - a. true
  - b. false

3. \_\_\_\_\_ is a relation between objects in which one object designates, or acts as a means by which to connect to or link to, another object.
- a. foot note                      b. Reference                      c. none of these

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#### **4.5 Evaluation of Research :**

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Evaluation is a methodological area that is closely related to, but apparent from more traditional social research. Evaluation develops many of the identical methodologies used in conventional social research, but because evaluation takes place within a political and organizational situation, it need group expertise, management aptitude, political deftness, sensitivity to multiple stakeholders and other skills that social research in general does not rely on as much.

Evaluation is the systematic assessment of the worth or merit of some object. There are many types of evaluations that do not necessarily result in an assessment of worth or merit – descriptive studies, implementation analyses, and formative evaluations etc. Evaluation is the systematic attainment and assessment of data to give useful feedback about some object. The above definitions agree that evaluation is a methodical effort and both use the intentionally unclear term 'object' which might denote a program, policy, technology, person, need, activity, and soon.

##### **4.5.1 Types of Evaluation :**

There are many different types of evaluations depending on the object being evaluated and the purpose of the evaluation. Perhaps the most significant fundamental division in evaluation types is that between formative and summative evaluation.

**Formative Evaluations** strengthen or improve the object being evaluated — they help form it by examining the delivery of the program or technology, the quality of its implementation, and the assessment of the organizational context, personnel, procedures, inputs, and so on.

Formative evaluation includes several evaluation types :

- **Needs assessment** determines who needs the program, how great the need is, and what might work to meet the need
- **Evaluability assessment** determines whether an evaluation is feasible and how stakeholders can help shape its usefulness
- **Structured conceptualization** helps stakeholders define the program or technology, the target population, and the possible outcomes
- **Implementation evaluation** monitors the fidelity of the program or technology delivery
- **Process evaluation** investigates the process of delivering the program or technology, including alternative delivery procedures

**Summative evaluations**, in contrast, examine the effects or outcomes of some object – they summarize it by describing what happens subsequent to delivery of the program or technology; assessing whether the object can be said to have caused the outcome; determining the overall impact of the causal factor beyond only the immediate target outcomes; and, estimating the relative costs associated with the object.

Summative evaluation can also be subdivided :

- **Outcome evaluations** investigate whether the program or technology caused demonstrable effects on specifically defined target outcomes
- **Impact evaluation** is broader and assesses the overall or net effects – intended or unintended – of the program or technology as a whole
- **Cost–effectiveness** and cost–benefit analysis address questions of efficiency by standardizing outcomes in terms of their dollar costs and values
- **Secondary analysis** re examines existing data to address new questions or use methods not previously employed
- **Meta–analysis integrates** the outcome estimates from multiple studies to arrive at an overall or summary judgement on an evaluation question

**Check Your Progress – 4 :**

1. \_\_\_\_\_ is the systematic assessment of the worth or merit of some object.
  - a. true
  - b. false
2. \_\_\_\_\_ strengthen or improve the object being evaluated.
  - a. Formative evaluations
  - b. Summative evaluations
  - c. both
3. \_\_\_\_\_ in contrast, examine the effects or outcomes of some object.
  - a. Formative evaluations
  - b. Summative evaluations
  - c. both

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**4.6 Current Trends in LIS Research :**

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Library services are increasingly migrating to the digital environment in both the building of collections and in patron interactions. The findings vividly indicate that the growth of literature in library and information science is on increase. Professionals and researchers all over the world have embraced the scholarly publication revolution from various disciplines, to which library and information science is no exception. Nations all over the world have noticed an abrupt spurt in scholarly publications. Not only developed nations but the developing nations, too, from time to time and in a variety of forms have realized the need and importance of scholarly literature as they bring varied ideas from masterminds in their respective fields. This migration has encouraged the emergence of

## **Basics of Research Methods**

new LIS disciplines that have various titles such as digital librarianship or emerging technologies librarianship. Working in this environment requires technological skills and experience, an understanding of metadata, and an ability to create and manage digital content. There is a close relationship between the Digital Services and the Emerging Technologies pathways. The Digital Services pathway focuses on the technical and usability aspects of building digital platforms for users. The Emerging Technologies: Issues and Trends pathway focuses on the user experience now and in the future. Students might want to consider classes from both pathways and explore the options in the Web Programming and Information Architecture pathway.

### **Global Trends in LIS Research :**

In the field of Library Science research, US made the premier attempt. The study entitled 'A Guide to Sources of 17th century English History in Selected Reports of the Royal Commission on Historical Manuscripts' by Eleanor. S. Upton was awarded PhD by the Chicago University in 1930. It is considered as the 1st doctoral degree in Library Science. During 1950s universities namely, Illinois, Michigan, Columbia, Western Reserve, California & Rutgers produced 129 PhD dissertations. Library schools in USA focused their research during 1990s in the following areas :

- Management Utilization of variety of communication media & technologies in Library & Information Centres,
- Acquisition & processing Information systems, documentation and IT,
- Information storage & data processing. User studies LIS education Micrographics Databases

### **Research in UK :**

Library science research in UK was started during 1930s. The 1st doctoral thesis accepted by the London School of Economics was on a core Library science subject in 1935. The title of the thesis was 'The Public library Service under English Local Government'. The areas of research selected by library schools include : Novel methods of representing & storing of data. Chemical structure of information for manipulation & retrieval User studies Systems evaluation. Organizational problems in the application of IT Technology transfer & policies **Information systems in developing countries**

Education & training of information specialists in the computer based aids for online education were introduced in the developing. The introduction of Computer in libraries was a land mark in the LIS researches. This helped the use of automatic classification methods and classification techniques for document retrieval.

## **Library Science Research in India :**

## **Research Reporting**

Research is a careful critical study or examination in seeking facts or principles; intelligent & diligent investigation in order to ascertain something. In India, individual research started in 1930s with Dr. S.R. Ranganathan who was actively involved in various areas of librarianship viz. classification, cataloguing, documentation, library administration, etc. LIS education in India though started as early as in 1911 & was gradually recognized as a full-fledged discipline. Separate departments were set up in the universities offering courses leading to bachelors & master degrees. This eventually set the stage for formal research activities in the subject. At present, formal research in LIS is conducted at 4 levels, viz. MLISc, Mphil, PhD & D.Litt.

Library science in India was initiated by Dr. S.R. Ranganathan in 1931, with the formulation of Five Laws of Library science. He even graded them as Normative principles, Fundamental laws, Canons, Principles & postulates. Ranganathan cut new grounds & blazed new trails in Library science initially by solo – research. Ranganathan's era is characterized by a period of intellectual contribution to the theory of Library Science, particularly library classification. The 1st PhD in Library science was awarded to Dr. D.B. Krishna Rao for his study on 'Facet analysis and depth classification of agriculture under the guidance of Dr. S.R. Ranganathan & S. Dasguptain 1957. Dr. J.S. Sharma, was the 1st Indian & one of the 1st few to earn doctorate from USA. He was awarded PhD by Michigan University for his thesis Mahatma Gandhi : A Descriptive Bibliography'. The 2nd PhD in LIS in India was awarded in 1977 by Dr. Pandey S.K. Sharma for his thesis 'Expansion and modification of Dewey Decimal Classification for classifying indological books with special reference to Indian Philosophy, and Indian religion by Punjab university. The study conducted by Varalekshmi on research areas & trends in LIS in India pointed out, there is a shortage of investigation in subject areas such as information storage & retrieval, methods to increase resource sharing, scientific communication & its channelization, education for LIS. According to National Knowledge Commission (NKC) report 'India has a long tradition of libraries & has contributed to the development of basic concepts in the discipline such as fundamental principles of library services & knowledge organization tools, R & D activities in LIS today are extremely limited. This is utmost concern for the growth of LIS profession in India. Every year the Indian Association of Teachers of Library & Information Science (IATLIS) holds a seminar on topics of Library education & research. The literature on Library education & research is enormous, though repetitive & inflated. But in India usually the blame is wholly put on the lack of infrastructure & unavailability of funds.



**Check Your Progress – 5 :**

1. The 1st doctoral thesis accepted by the London School of Economics was on a core Library science subject in 1935 was received by
  - a. Eleanor. S. Upton
  - b. Dr. Pandey S. K. Sharma
  - c. Dr. S. R. Ranganathan
2. The 1st PhD in Library science was awarded to \_\_\_\_\_ for his study on Facet analysis and depth classification of agriculture.
  - a. Dr. D.B. Krishna Rao
  - b. Dr. Pandey S. K. Sharma
  - c. Dr. S. R. Ranganathan

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**4.7 Let Us Sum Up :**

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To sum up, Research reports vary greatly in length and type. In each individual case, both the length and the form are largely dictated by the problems at hand. Research report is a channel of communicating the research findings to the readers of the report. A good research report is one which does this task efficiently and effectively. With the help of this interpretation the researcher can expose relations to the processes that underlie his findings. Research report is considered a key factor of the research study for the research undertaking remains imperfect till the report has been presented and/or written. Interpretation refers to the task of drawing inferences from the collected facts after an analytical and experimental study.

In fact, it is a search for broader meaning of research findings. The task of interpretation is not an easy job, rather it requires a great skill and dexterity on the part of researcher. Interpretation is an art that one learns through practice and experience. The researcher may seek the guidance from experts for accomplishing the task of interpretation. An article citation generally includes the author or authors of the article, the title of the article, the name of the periodical or journal in which the article appears, the date the journal was published, the volume and/or issue number of the journal, and the page number (or range of page numbers) for the article. The MLA style emphasizes the author's name and the page in the original text you're using where as APA style, defined by the American Psychological Association, is most common in the social sciences. . Footnotes only serve one purpose, to allow the reader to access with ease and confidence the source that you have used. Referencing gives respect for and acknowledges the work of other scholar and it shows adherence to academic writing standards providing evidence that the researcher has read and considered the relevant literature. To any research productivity, the contributions of the researcher & their guide is highly significant. So it is time to remember Dr. S.R. Ranganathan and many other professionals those who have contributed much to the development of the profession as well as knowledge and skill.

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**4.8 Answers for Check Your Progress :**

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**Check Your Progress – 1 :**

1. b            2. a            3. b            4. c

**Check Your Progress – 2 :**

1. a            2. a            3. b            4. c

**Check Your Progress – 3 :**

1. a            2. b            3. b

**Check Your Progress – 4 :**

1. a            2. a            3. b

**Check Your Progress – 5 :**

1. a            2. a
- 

**4.9 Glossary :**

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1. **Retrieval** – Recovery
  2. **Migrate** – Transfer
  3. **Acknowledge** – Accept
  4. **Parentheses** – Addition
  5. **Emphasis** – Importance
  6. **Plagiarism** – Copying
  7. **Comprehensive** – Complete
  8. **Abbreviation** – ShortForm
  9. **Contributing** – Causal
  10. **Logical** – Rational
  11. **Pertinent** – Pertinent
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**4.10 Assignment :**

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1. Write down about the various style manuals ?
- 

**4.11 Activities :**

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1. Describe APA (American Psychological Association) type of referencing ?
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**4.12 Case Study :**

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1. Take a definition from any book and reference it in APA style, MLA style and Chicago referencing styles ?
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**4.13 Further Readings :**

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1. Research Methodology C.R. KOTHARI.
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**BLOCK SUMMARY**

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The block explained about different methods of data analysis and interpretation. The different methods of statistical analysis such as measures of central tendency, measures of dispersion, etc were discussed in detail. The block also gave a description on the statistical packages. Detailed description on the subject tools of argument along with its definition and a special note on analysis, synthesis, interpretation, inference helped to add knowledge on the topic. The block also provided a detailed study on research reporting and the style

,structure and contents of a report. Different styles manuals such as Chicago, APA, and MLA were also discussed in detail. The block also provided information regarding Footnotes, References; Evaluation of Research. The block also provided knowledge about the current trends in LIS research.

At the end of the data collection, the researcher has to analyse the data according to the objective of the research .This analysis of data needs a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences. The unmanageable data should fundamentally be condensed into a few convenient groups and tables for extra analysis. Analysis after tabulation is usually based on the calculation of a variety of percentages, coefficients, etc., by applying a variety of well defined statistical formulae. In the course of analysis, associations or differences sustaining or contradictory with unique or new hypotheses should be subjected to tests of importance to decide with what validity data can be said to designate any conclusion(s).So the real value of research lies in its capability to reach up to certain generalizations. If the researcher had no hypothesis to start with, he might try to explain his findings on the basis of some theory called interpretation. The procedure of interpretation may often activate off new questions which in turn may lead to further researches.

Research in LIS briefly means the collection and analysis of original data on a problem of librarianship, done within the library schools according to scientific & scholarly standards. Research in this connection broadly includes investigations, studies, surveys, academic work at the doctoral level & research by practicing librarians & information professionals, etc.

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## **BLOCK ASSIGNMENT**

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### **Short Questions :**

1. Chicago Manual of Style
2. APA (American Psychological Association)
3. MLA (Modern Language Association)
4. Footnotes
5. References
6. Evaluation of Research
7. In-text citations

### **Long Questions :**

1. Write a brief note on the Contents of a Report ?
2. Write down the different Citation Styles ? Explain shortly the need for referencing ?
3. Describe the Global trends in LIS research ?

**Basics of  
Research Methods**

❖ **Enrolment No. :**

1. How many hours did you need for studying the units ?

Unit No.	1	2	3	4
No. of Hrs.				

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

3. Any other Comments

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