BPCC-134

STATISTICAL METHODS AND PSYCHOLOGICAL RESEARCH

School of Social Sciences
Indira Gandhi National Open University

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Table of Contents

COURSE INTRODUCTION

The course on Statistical Methods and Psychological Research (BPCC134) is a core course offered in 4th Semester of BA Psychology General Programme, under Bachelors Degree Programme of IGNOU. The course is of 06 Credits, comprising Theory (04 Credits) and Practical (02 Credits). The main objective of the course is to acquaint learners with basics of psychological research and statistics and also to introduce the learners to psychological testing.

The course is divided into five blocks. The first four blocks represent a specific theme which is discussed in terms of units. The units are arranged in a logical sequence so as to cover the main aspects of each theme. The last Block covers practical.

Before proceeding to read the units, you are advised to go through instructions about how to read the course material. Given below is the explanation of the organization and sequencing of the unit.

Organization and Sequencing of a Unit

The following is the structure of each unit:

1.0 Objectives

1.1 Introduction

1.2 Section (Theme of the section)

1.2.1 Subsection of 1

…….

Check Your Progress I

1.3 Section (Theme of the section)

1.3.1 Subsection of 2

…….

Check Your Progress II

Let Us Sum Up

References

Key Words

Answers to Check Your Progress

Unit End Questions

As the scheme suggests, each unit is divided into sections for easy reading and better comprehension. The numbering and length of each section and subsection may vary from one unit to the other, depending upon the depth of information in each unit. Each section is indicated by **BOLD CAPITALS** and each sub-section by a **relatively smaller but bold typeface**. Divisions within the sub-sections are in **relatively smaller bold typeface** so as to make it easy for you to understand.

Let us now discuss each section of a unit.

Objectives

We begin each unit with the section Objectives. It tells you briefly about the objectives of the unit what you will learn after you study the unit.

Introduction

The section Introduction will mainly focus on introducing the theme of the present unit.

Illustration

There are several illustrations in each unit in the form of figures and diagrams. The main purpose of these illustrations is to make the study comprehensive and interesting.

Check Your Progress

We have given self-check exercises under the caption Check Your Progress at the end of main sections. You can provide your answers in the space give below each question/ exercise.

You will be tempted to have a glance of the main text as soon as you come across an exercise. But we do hope that you will resist this temptation and turn to the main text only after completing the answers.

You should read each unit and note the important points in the margin provided in the course material. This will help in your study. It will also help you to answer the self-check exercises and the assignment questions, as well as help in revising your course before appearing for your Term End Examination (TEE).

Let Us Sum Up

This section of each unit under the heading Let Us Sum Up summarises the whole unit for the purpose of ready reference and recapitulation.

References

We have given a list of references at the end of each unit. This is a list of books and articles used by the course writers to prepare the units. This reflects that your course material is based on a wide spectrum of literature available on a particular theme, related to your course. This also informs you of the wide literature available in the particular area of study. If interested in widening your knowledge, you may look for the mentioned references. Each reference mentions the name of the author, year of publication, title of the book/article, name of publisher and place of publication. Suggested readings help you to increase your level of understanding of a particular theme in each unit.

Key words

The key words at the end of the unit explain the basic ideas, technical terms and difficult words.

Answer to check Your Progress.

Answer to check your progress are given under this Section.

Unit End Questions

Besides Check Your Progress, we have given Unit End Questions in each unit. Practicing these questions will help you in answering assignments and Term End Examination Question Paper, though the pattern and style of questions asked may not be similar.

Audio and Video Aids

Some Units have been selected for the audio and video programmes to supplement the printed material. This will help you to understand the units with greater clarity.

Apart from this, you may also access IGNOU's FM radio channel, Gyanvani (105.6 FM), which is available across many cities in India, for regular programmes, related to themes on Psychology. You can listen to the live discussions by faculty and experts on the topic of the day and interact with them through telephone, email, and through chat mode.

You may also watch Gyandarshan TV channel (free to air educational channel), for programmes related to topics on Psychology. The schedule of Gyanvani and Gyandarshan is displayed on www.ignou.ac.in. The radio and TV channels may also be accessed on Gyandhara, webcast facility for Gyanvani and Gyandarshan, provided by the University.

Practical

The course on Statistical Methods and Psychological Research will include practical. In Practical, any one Indian standardised tool for measuring interest (e.g. Vocational Interest Inventory)/ aptitude (e.g. Differential aptitude test)/ attitude (e.g. social distance) is to be conducted and written in the journal. The details of the practical are given in the last block (Block 5) of this course material.

Assignment

You will receive a set of assignments for the whole programme. These are Tutor Marked Assignments, which are to be submitted to the respective Study Centre after completion. These assignments will be evaluated by academic counsellor from your Study Centre. Ensure that you complete all your assignments because the grades that you get in each of these assignments are included in the final evaluation of your degree. Before answering the assignments, read all the units and additional material (if available).

Guidelines for assignments

While working on the assignments, kindly ensure the following points,

1) Clearly write your Enrollment number.

2) Answer them in your handwriting and in your own words **(do not copy the sentences from the course material or any other source)**.

3) Write clearly and neatly so that it is easy to read your answers,

4) Leave margins on one side of your answer-sheets so that evaluator may write his/ her comments on your performance.

5) Organise your answers well based on the question asked.

6) You will submit the assignments at your Study Centre on or before the date mentioned as per the admission cycle. Kindly check the dates from www.ignou.ac.in or your Regional Centre website.

Term End Examination (TEE)

Consider the following points while answering TEE.

1) Questions need to be answered in **one's own words** and they need to be focused based on the question asked.

2) Answer the questions keeping in mind the word limit.

3) Organise answers well based on the question asked and also keep in mind any bifurcation given in the marks.

4) Ensure that you mention correct question numbers for respective answers.

Preparation of Course Material

The syllabus of course material BPCC 134 is designed by an Expert Committee (see page 2 of this course) and prepared by Course Preparation Team which comprises the author(s) of units, content editor(s), language editor, and the course coordinator. The expert committee selected the themes and sub-themes of the blocks and units, keeping in view the prescribed syllabi of UGC (CBCS model).The authors of units have provided their expertise in elaborating them in the form of the main text of each unit. The content editor has carefully examined the course contents and has made an attempt to make the material clear and comprehendible.

For any query or feedback related to the course, you may kindly contact the course coordinator at,

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COURSE CONTENT

BLOCK 1: RESEARCH IN PSYCHOLOGY

Unit 1 : Introduction to Research in Psychology

Definition, goals, principles of psychological research
Ethical issues in psychological research
Deductive and inductive methods
Statement of the problem and formulation of hypotheses
Descriptive research, hypothesis testing, one-tailed, two-tailed tests and errors in hypothesis testing
Constructs, variables, operational definition of variables

Unit 2 : Introduction to Sampling

What is sampling?
Sampling techniques
Sampling error and standard error

BLOCK 2: QUANTITATIVE AND QUALITATIVE RESEARCH

Unit 3 : Quantitative Research

Introduction to quantitative research
Methods of quantitative research

Unit 4 : Qualitative Research

Meaning of qualitative research
Methods of qualitative research
Mixed approach research

Unit 5 : Observation, Interview and Case Study

Observation
Interview
Case study

Unit 6 : Introduction to Psychological Testing

Psychological testing: Definition and nature
Characteristics of a good psychological test
Reliability and validity
Types of tests
Standardisation and norms

BLOCK 3: STATISTICAL METHODS I

Unit 7 : Introduction to Statistics

Meaning of statistics
Role of statistics in research
Limitations and misinterpretations of statistics
Scales of measurement
Descriptive and inferential statistics

Unit 8 : Data Organisation and Graphical Representation

Classification and tabulation of qualitative and quantitative data
Construction of frequency distribution
Cumulative frequency distribution
Percentile and percentile ranks
Graphical representation of data

Unit 9 : Introduction to Measures of Central Tendency

Concept of central tendency of data
Different measures of central tendency: mean, median and mode
Properties, advantages and limitations of mean, median and mode
Computation of measures of central tendency in ungrouped and grouped data

Unit 10 : Introduction to Measures of Variability

Concept of variability in data
Different measures of variability: Range, quartile deviation, average deviation, standard deviation, variance
Properties, advantages and limitations of range, quartile deviation, average deviation, standard deviation, variance

Unit 11 : Computation of Measures of Variability

Computing different measure of variabilty.

BLOCK 4: STATISTICAL METHODS II

Unit 12 : Correlation: An Introduction

Concept of correlation, direction and magnitude of correlation
Properties, uses and limitations of correlation
Other methods of correlation

Unit 13 : Computation of coefficient of correlation

Pearson's product moment coefficient of correlation
Spearman's rank order correlation

Unit 14 : Normal Probability Distribution

Concept of probability
Concept, nature and properties of normal probability distribution
Standard scores: concept, properties and computation
Divergence from normality: Kurtosis and Skewness

BLOCK 5: PRACTICALS

Procedure to be followed by the Academic counsellor
Practical notebook
Evaluation
Interest
Aptitude
Attitude

BLOCKS INTRODUCTION

Dear Learner,

In the first semester of this programme you must have developed a fair idea about basics and principles of psychology as a subject area. In the fourth semester, one of the courses that you will study is Statistical Methods and Psychological Research. The main objective of this course is to acquaint learners with basics of psychological research and statistics and to introduce the learners to psychological testing.Thus, in this course we will cover psychological research as well as statistical methods.

To provide an overview of this course, the course structure is divided in to four blocks.

Block I: In the very first block of this course we will introduce research in psychology. The block is divided in to two units, unit 1 that is titled Introduction to research in psychology and unit 2 is titled Introduction to sampling. Unit 1 will mainly focus on the definition, goals, principles of psychological research as well as the ethical issues in psychological research. The deductive and inductive methods will also be discussed. Further the statement of the problem and formulation of hypotheses will also be explained. The unit will also cover descriptive research, hypothesis testing, one tailed, two tailed tests and errors in hypothesis testing. Constructs, variables and operational definition of variables will also be highlighted in the unit.

In unit two, sampling and sampling techniques will be covered. Sample can be described as the group of individuals who participate in the research and sampling can be described as the process of taking a sample from the population. There are various sampling techniques that are used in order to draw a sample and that as well will be discussed in this unit.

Block 2: Block 2 constitutes four units, Unit 3, 4, 5 and 6. Unit 3 focuses on the quantitative research methods and Unit 4 will focus on qualitative research methods. Unit 5 will cover observation, interview and case study and Unit 6 will discuss about psychological testing.

Research can be categorised in to quantitative and qualitative research. And understanding what these categories are and their methods is important being a student of psychology. Thus, in unit three, we will discuss in detail about what is quantitative research and will also focus on the characteristics, strengths, limitations and methods of quantitative research. In unit four we will focus on the qualitative research. In this unit we will discuss the meaning of qualitative research with a focus on its history and philosophy and characteristics. Difference between quantitative and qualitative research will also be discussed. We will then explain the methods of qualitative research. Lastly, the unit will focus on mixed approach research, under which the characteristics, uses and limitations of mixed approach research will be discussed.

Unit five in this block is titled Observation, Interview and Case study and these three methods will be covered in this unit. The types, advantages and limitations of observation and interview will be discussed along with the characteristics, advantages and limitations of case study.

In the last unit of this block (unit 6), psychological testing will be discussed. Besides the definition and nature of psychological testing, characteristics of a good psychological test will also be covered. The unit will also explain the two important concepts, namely, reliability and validity. Types of tests will also be explained. The unit will also highlight standardisation and norms in the context of psychological testing. This unit is also important when you carry out practicals and will serve as a framework when you learn how to administer psychological tests.

Block 3: The third block is titled 'Statistical methods I', and is further divided in to five units. In the very first unit of this block (unit 7) you will learn about what statistics is and also its role in research. Limitations and misinterpretations of statistics will also be covered in this unit. Further, this unit will also introduce you to the scales of measurement and will focus on two significant terms, descriptive and inferential statistics. Unit 8 will focus on the data organisation and graphical representation, which is important when you have raw data with you and want to make it meaningful. The unit will cover subtopics like classification and tabulation of qualitative and quantitative data, construction of frequency distribution, cumulative frequency distribution, percentile and percentile ranks and graphical representation of data. Unit 9 is about the measures of central tendency and will cover, concept of central tendency of data, the different measures of central tendency, namely, mean, median and mode, their properties, advantages and limitations and their computation. Unit 10 is titled measures of variability and deals with the concept of variability in data, the different measures of variability, viz, range, quartile deviation, average deviation, standard deviation and variance, their properties, advantages and limitations. Unit 11 will deal with the computation of various measures of variability.

Block 4: The fourth block is titled 'Statistical methods II' and will include three units, 12, 13 and 14. Unit 12 will focus on the concept of correlation, its direction and magnitude, its properties, uses and limitations and unit 13 will discuss the computation of coefficient of correlation with the help of Pearson's product moment coefficient of correlation and Spearman's rank order correlation. the last unit of this block is unit 14, which will cover the concept of probability, the concept, nature and properties of normal probability distribution, standard scores: concept, properties and computation and divergence from normality, namely, skewness and kurtosis.

It is very important that you read all the units very carefully and try to understand the subject matter. Knowledge of statistics is important in Psychology as the same can be applied to carry our data analysis while carrying out quantitative research.

Block 5: Block 5 of this course mainly focuses on practical. As stated earlier, this course is of 6 credits, the theory is of 4 credits and the practical is of 2 credits. In practical the learner is expected to administer any one Indian standardised tool for measuring Interest (for example, Vocational Interest Inventory) or Aptitude (for example, Differential Aptitude Test) or attitude (for example, Social Distance).

Some suggestions and tips to enhance your study of this course are as follows:

1) Ensure that your basic concepts, given in this course, are clear, whether it is the term psychological research, statistics or terms mean, median, mode,

normal probability curve etc. If you don't understand the terms, read again. The first unit is a foundation to rest of the units, so ensure that you read and learn this unit first.

2) Another important aspect is to understand the formulae and also the steps in computing various statistical techniques. These have been discussed with the help of examples. Practicing these steps along with the formulae will help you learn them in a better way.

3) Besides the above, you also need to develop an understanding about when to use which technique. For example, when to compute mean, when to compute median and when to compute Pearson's product moment correlation and when to compute Spearman's rank order correlation. While reading the unit, try to focus on when a certain statistics technique is computed.

4) Answering the exercises given in Check Your Progress (given in each unit) will help you practice and learn the subject matter and the method for computing various statistical techniques.

BLOCK 1
RESEARCH IN PSYCHOLOGY

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UNIT 1 INTRODUCTION TO RESEARCH IN PSYCHOLOGY*

Structure

1.0 OBJECTIVES

After reading this unit, you will be able to,

- define psychological research and discuss its goals and principles;
- describe the ethical issues in psychological research;
- explain deductive and inductive methods;
- discuss the statement of problem and formulation of hypotheses;
- describe descriptive research, hypothesis testing, one tailed, two tailed tests and errors in hypothesis testing; and
- elucidate constructs, variables and operational definition of variables.

1.1 INTRODUCTION

There are a number of problems and issues in the society that can be directly or indirectly related to human behaviour, be it aggressive behaviour in terms of road rage, bullying or even cyberbullying, overindulgence in social networking, lack of effective communication and interpersonal relationship, suicidal ideation and so on. Such problems and issues need to be researched further in order to not only develop better understanding about them including factors leading to them and to develop suitable intervention strategies to deal with them effectively.

Research is an important aspect of any subject area. In psychology as well, research is carried out in order to further broaden the scope and knowledge area of the subject. In the present course, we will mainly focus on psychological

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research. The very first unit of this course is titled, introduction to research in psychology and this unit will lay foundation to the subsequent units in which we will further discuss about various aspects of psychological research.

In this unit, we will define psychological research and discuss its goals and principles. Further, the ethical issues in psychological research will also be described. The deductive and inductive methods will then be dealt with in detail. Problem and hypotheses are important components of psychological research and these will also be elucidated. Besides, descriptive research, hypothesis testing, one tailed, two tailed tests and errors in hypothesis testing will also be explained. Lastly, in this unit we will discuss constructs, variables and operational definition of variables.

1.2 DEFINITION, GOALS AND PRINCIPLES OF PSYCHOLOGICAL RESEARCH

Before we go on to discuss various aspects of psychological research, it is important that we define research.

Research in simple terms can be explained as adding to the existing fund of knowledge. The term research is derived from the French word '*recherche'* which means to travel through or survey. Research can be described as an enquiry that is not only critical but complex as well. Research can also be described as an analysis and recording of controlled observation that is objective and systematic in nature. And this analysis and recording can result in generalisations, and also development of theories.

Some of the definitions of research are given as follows:

Kerlinger (1995, page 10) defines scientific research as "a systematic, controlled, empirical and critical investigation of natural phenomenon guided by theory and hypotheses about the presumed relations among such phenomena".

Research, in simple terms, can be defined as "a systematic investigation to find answers to a problem" (Burns, 2000).

Best and Khan (1999) have defined research as "systematic and objective analysis and recording of controlled observation that may lead to the development of generalisation, principles or theories, resulting in prediction and possibly ultimate control of events".

Some of the key points in the above given definitions of research are as follows:

1) **It is systematic in nature:** Psychological research is systematic as well as scientific in nature and follows a pattern and scientific process. It is important that research is carried out in systematic and scientific manner so as to ensure that the outcome of the research can be relied on and the researcher(s) have confidence in the outcome of the research.

2) **It is objective:** Objectivity is a significant characteristics of any research and care needs to be taken that no subjectivity creeps in so that the internal validity of the research is maintained. Thus, the subjective beliefs of the researcher should not interfere in the research process or the outcome, rather the focus needs to be on reality that is objective in nature.

3) **It seeks answers to certain problem:** Psychological research is carried out with an objective that needs to be clear and specific. There could be certain problems and issues that the researcher(s) may come across and may seek answers to.

4) **With the help of research, generalisations can be made and theory and principles can also be developed:** Based on the research findings generalisations can be made. Further, based on the findings, theory and principles can also be developed.

1.2.1 Goals of Psychological Research

The main goal of psychological research is to comprehend human and animal behaviour. And the more the researchers are able to decipher human behaviour, the more it will benefit the society in general and individuals in specific. For example, developing a better understanding about aggressive behaviour amongst youth, can help develop suitable intervention. Let us now look at certain specific goals of psychological research, that are discussed as follows:

1) **Description:** This is one of the prominent goals of research that involves description of behaviour in a systematic manner. Description involves information about what exactly is happening in a situation, where and with whom is it happening. In description a certain phenomenon/ event or issue is identified and reported. For example, safety behaviour of employees can be observed and described.

2) **Explanation:** This mainly involves explaining why a certain behaviour/ phenomenon is taking place. For example, if employees in an organisation are not using safety devices, then explanation can be generated as to why they are doing so.

3) **Prediction:** Yet another goal of psychological research is prediction. Based on research certain predictions can be made about the behaviour under study. In prediction, the factors that may be correlated or related with certain behaviour or phenomenon are identified. For example, predictions are made with regard to why employees are not using safety devices based on previous research and information.

4) **Control:** Control is also an objective of research which involves bringing about a change in the behaviour with the help of suitable intervention strategies. For example, suitable intervention strategies can be developed to promote use of safety devices amongst the employees.

5) **Application:** Inferences can be drawn based on the results obtained by carrying out the research and these can then be applied for problem solving as well as decision making.

1.2.2 Principles of Psychological Research

A good psychological research is systematic and scientific in nature. It also needs to be valid as well as verifiable and replicable. A good psychological research needs to be logical as well and it should be possible to make generalisations or develop theories and principles based on the research outcomes. Thus, a research

could be carried out to systematically and scientifically test certain hypothesis(es) and theories and this is done by controlling the influence of extraneous or confounding variables.

An adequate psychological research needs to have the following characteristics:

- **The purpose and objective(s) of the research needs to be stated in clear and specific manner:** It is important that the purpose and the objective(s) of the research are stated clearly and specifically, as the choice of research design and other aspects of the research will depend on the objectives of the research.

- **In order to ensure objectivity, the research procedure needs to be planned adequately:** Any research needs to be adequately planned. Even while building a house, a plan is to be drawn that is followed. In a similar manner while carrying out research as well, a plan is to be drawn. That is the reason why often a research proposal or synopsis is created that provides details about the problem, objectives, hypothesis(es), sample, research design, tools for data collection and data analysis.

- **Research design needs to be appropriately selected based on the purpose and objective(s) of the research:** Research design provides a structure to the research and it is important to adequately select a research design based on the statement of problem stated in the research. Suitable selection of research designs can ensure high internal validity.

- **Appropriate tools need to be used for data analysis:** Data analysis is an equally important aspect of a psychological research and again based on the purpose and objective(s) of the research suitable techniques of data analysis need to be employed.

1.2.2.1 Steps in Research process

There are various steps that are involved in a research process, these are described as follows:

Step 1 Research idea needs to be developed: The very first step in research process is developing the research idea. Thus, an issue or problem needs to be identified that can be subjected to research. One can obtain research ideas by observing one's surrounding or even through interaction with certain experts in the subject area. Though, it is important to go through existing review or studies that have been carried out on the issue or problem that the researcher is interested in studying. And this can be done by referring to articles, research papers, books etc. on the subject area. Reviewing literature is important in order to avoid any duplication of the research, as it is possible that the issue or problem has been well researched and need not be subjected to further investigation. Though based on the review obtained, further research on the same problem or issue can be carried out that will provide insight in to new dimension(s) regarding the problem or issue. Review of literature also helps in selecting suitable design for one's research and will also provide latest information and developments in the area that one is interested in researching. For example, a researcher wants to study care givers of chronically ill patients, he/ she may first go through the review of literature, identify relevant variables and then may come up with a topic, for

instance, "Resilience, Psychological Wellbeing, and Adjustment amongst Caregivers of Chronically Ill Patients".

Step 2 Stating the problem and formulating the hypothesis(es): Once the research idea is identified and the researcher has fair idea about the existing review of literature, a statement of problem can be stated and hypotheses can be formulated. Based on the example that was discussed under step 1, the statement of problem could be "To study the resilience, psychological wellbeing and adjustment amongst caregivers of chronically ill patients". There could also be certain objectives based on the problem, for instance, "To study relationship between resilience and psychological wellbeing of caregivers of chronically ill patients" or "To study the effect of gender on resilience, psychological wellbeing and adjustment of caregivers of chronically ill patients". Based on the statement of problem, hypothesis(es) can also be formulated. These are tentative statements that are tested with the help of scientific research. For instance, "There will be significant correlation between resilience and psychological wellbeing of caregivers of chronically ill patients". Hypothesis could also be "Gender difference will exist with regard to resilience of the caregivers of chronically ill patients". (Both the hypotheses are alternative hypothesis. We will discuss about types of hypothesis in later sections of this unit).

Step 3 Research design that is appropriate needs to be selected: Based on the problem, the researcher needs to select suitable research design. Research design denotes structure of the research. As stated by Kerlinger (1995, page 280) "Research designs are invented to enable researchers to answer research questions as validly, objectively, accurately and economically as possible". Research designs not only help in obtaining answers to the research problem but also helps in variance control, that includes maximisation of true variance (variance in independent variable leads to variance in dependent variable) and minimisation of error variance (variance in dependent variable that can be attributed to extraneous variable). There are various types of research designs, for example, factorial deign, small n designs and so on that can be selected based on the requirement of the research and research problem (refer to table 1.1) . In the example that we discussed under step 1 and 2, the research designs could be correlational design where an attempt is made to study the relationship between resilience, psychological wellbeing and adjustment amongst caregivers of chronically ill patients. Further, research could be qualitative or quantitative in nature or may employe a mixed approach.

Table 1.1: Research Designs

Sr. No.	Research Design	Description	Example
1	True designs	• Independent variable (s)[IV] can be manipulated • High control (of extraneous variables) • Randomisation possible • Can be used for studies in laboratory set up	Effect of temperature (IV) on Performance of the participants. Temperature can be manipulated as warm, normal and cold.

2	Faulty designs	• Independent variable (s) cannot be manipulated as they have already taken place. • Low control • Randomisation not possible • Used in field studies	Caregivers burden of caretakers of individuals with terminal illness (IV). Here IV is the terminal illness that has already occurred and not under the control of the researcher.
3	Quasi Experi-mental designs	• Quasi means resembling • This design resembles true designs • Independent variable(s) can be manipulated • Control is possible to some extent • No randomisation • Used in field experiments	Two teaching methods, lecture and group discussion, (IV) given to two different classes to see their impact on students' learning.
4	Factorial designs	• Used to study the effect of more than two independent variable (s) on the dependent variable (DV). • Main effect (of each variable separately) as well as interactional effect (of all the IVs) studied	Effect of gender (IV1) and Socio-Economic Status (IV2) on Self Esteem (DV) of adolescents.
5	Small n designs	• Small sample • In-depth study • Same sample studied over a period of time	Study on soldiers having Post Traumatic Stress Disorder

Step 4: Data Collection: Once the statement of problem is stated, hypothesis(es) formulated and research design is finalised, one can then move to the next step that is data collection. In this step, though, one has to first of all identify the population and sample. In the case of our example, the population that is being studied is 'caregivers of chronically ill patients'. The researcher will have to select a sample size and also a sampling technique to carry the study on (this will be discussed in detail in the next unit).

Further, tools for data collection also need to be finalised, that could range from interview, observation to psychological tests. In the case of the example, discussed by us, a researcher may decide to use standardised psychological tests to measure resilience, psychological wellbeing and adjustment. Once the sample and tools for data collection are finalised, the researcher can then carry out data collection.

Step 5: Data analysis: The data thus obtained in step 4 will be subjected to data analysis. Data analysis also can be qualitative or quantitative. If the researcher employed interview or observation as a method of data collection, then the data will be qualitatively analysed. If he/ she used standardised psychological tests,

then the obtained raw score can be subjected to statistical analysis (We will discuss some of the statistical techniques in later units of this course).

Step 6: Deriving conclusions and making generalisations: Based on the data analysis, the researcher can then draw conclusions and make generalisations, that is, the results generated from the sample (representative) can then be generalised to the population.

It is also important at this stage to adequately report the findings of the research for the benefit of other researchers, experts, students and society in general.

A simplified version of research process, can be seen in figure 1.1 that looks like an hour glass, where the process starts with a general research idea that the researcher may have in mind. For example, a researcher may have an idea to carry out research on caregivers of chronically ill patients. From this general research idea, after referring to review of literature, the researcher will identify specific variables and then follow the other steps of research from stating the problem, formulating hypothesis(es), finalising research design to data collection and data analysis. The results thus obtained can then be used to draw conclusions and make generalisations.

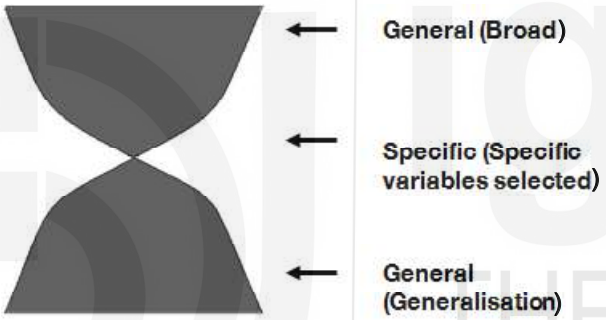

Fig. 1.1: Research Process

Check Your Progress I

1) Define Research.

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2) List the goals of research.

a) .....

b) .....

c) .....

d) .....

e) .....

1.3 ETHICAL ISSUES IN PSYCHOLOGICAL RESEARCH

Research in psychology is necessarily carried out on humans and animals and in this regard it is important to follow certain ethical issues while carrying out research, in order to ensure that they are treated in respectful way.

Before we go on to discuss various ethical issues, let us look at two of the experiments that raised questions related to ethics in research.

A research was carried out by John Watson in order to study whether emotional responses are learned. The study was carried out on a young child named Albert. In the study Albert was repeatedly exposed to a white rat. Initially, he did not show any negative reaction to the white rat. However, when the exposure to the white rat was accompanied repeatedly with a loud noise, Albert displayed negative reaction to the white rat. Further, as the study continued, Albert displayed negative reactions towards stimuli that were similar to white rat like white rabbit and fur coat.

This study raised some serious ethical issues as there is no mentions whether any informed consent was taken from the parents/guardian of Albert (Albert being a minor). Further, ethical issues can also be raised with regard to whether it was really fair to subject Albert to such conditions and instilling fear in him, that could have repercussions later in his life.

Yet another study was carried out by Zimbardo and is known as Stanford Prison Experiment. In this research, Zimbardo attempted to study participant's group behaviour, how they adopted the abusive roles in the process of following certain orders. In this study, a simulation of prison was created and the participants were divided in to two groups, prisoners and guards. The participants also signed a contract and received monitory benefits. The guards were give instructions by Zimbardo (who acted as a warden of the prison) to maintain order amongst the prisoners (though any physical aggression was not allowed). The experiment had to be ended within a few days as role was internalised by the participants to such an extent that the guards were displaying aggressive behavior that negatively affected the participants who played the role of prisoners.

This experiment as well raised certain ethical issues, as the beneficence of the participant was at stake.

Thus, the above two experiments and many more led to more and more focus on ethical issues in research in order to ensure wellbeing of the participants.

As such, the origin of ethical codes can be found in the Hippocratic oath that was written way back in 400 BC. Though, ethics in research received attention mainly after certain studies, as discussed above, raised questions regarding safety as well as welfare of the participants in research. The experiments carried out by Nazis during World War II also lead to development of the Nuremberg Code (that mainly focused on informed consent and coercion) that was a result of the Nuremberg war crime trials. Besides, there were other studies as well that raised ethical issues, like the Tuskegee syphilis study that was conducted by the U. S. Public Health Services in 1930s on African Americans, having low income, who suffered from syphilis. The participants were not aware that they were suffering from syphilis and were not given any treatment (Penicillin) as they participated in the study.

Yet another study on how development of children is affected by social interaction, was carried out by René Spitzin 1940s. The study involved two groups of children whose development were studied from birth onwards. One of these groups were babies in orphanages who were deprived of any human contact and appropriate care. The other group of babies (from prison nursery) belonged to incarcerated mothers, who received care from their mothers. The results of the study indicated that social deprivation had an impact on the development of the children.

Thus, such studies brought ethical issues and concern for safety and welfare of participants in the light. The Belmont Report was presented by U.S. Department of Health, Education and Welfare in 1979, where three ethical principles were highlighted:

- **Respect for persons:** Recognising the autonomy of the participants and protecting those with lower autonomy.
- **Beneficence:** Maximising benefits and minimising any harm and risk to the participants.
- **Justice:** Fairness in terms of who receives the benefits of research and faces risks.

These ethical principles were later stated as regulations by Department of Health and Human Services and the Food and Drug Administration. In 1991, they were adopted by the Federal Policy for the Protection of Human Subjects.

American Psychological Association proposed their own ethical standards in 1953, that were revised from time to time. And these are the ethical issues that we mainly follow while we conduct research.

Ethics as such are relevant at every stage of research. Any research is to be carried out keeping in mind the risk and benefit ratio. If the risks are high and benefits are low, there is no point in carrying out the research. If the benefits are high and risks are low, provided that the minimal risks are taken care of, the research can be initiated. If the benefits and risks both are low, then again there is no use of carrying out the research. If the benefits and risks, both are high, then the decision with regard to whether the research should be carried out or not is difficult. But such researches can be carried out by managing the risks. Besides the vulnerability of the population also needs to be kept in mind. For example, children can be considered as vulnerable population.

Further, in psychological research deception is also used. Deception can be defined as "efforts by researchers to withhold or conceal information about the purpose of a study from the persons who participate in it" (Baron and Byrne, 1995, page. 31). Though deception needs to be avoided, it may not be possible to do so in case of certain researches. Using deception could also raise certain ethical issues as the participants may not be pleased when they come to know about the actual objective(s) of the research and may in fact resent for participating in research and may avoid participating in any research in future. Further, deception may lead to the participants being subjected to stress and anxiety. If deception cannot be totally avoided then it should be ensured that the participants dont face any serious risk during the research and debriefing needs to be provided. In debriefing, after the data is collected from the participants, information about the research is provided to them, their doubts are clarified and privacy and confidentiality are assured.

There are certain significant ethical issues that need to be considered before any research is carried out, these are discussed as follows:

- **Beneficence and Non-maleficence:**A research needs to be carried out by keeping in mind its benefits to the participants (beneficence) and it should be ensured that the participants are not subjected to any harm (non-maleficence). Thus, any risk to the participants is to be identified and eliminated and if there is any minimal risk, the participants need to be informed about the same and their consent for participation in the research needs to be taken,
- **Privacy and Confidentiality:** In any research, privacy and confidentiality of the participants is to be maintained. The researcher needs to take adequate care to ensure that the identity of the participants is not revealed. The participants may seek privacy and may not want others to know that they participated in the research. For instance, an employee may participate in certain research being carried out in his/ her organisation but may not want other employees to know about the same. Confidentiality is equally important as is privacy, where, information and details regarding the participants are not shared by the researcher with others. One way in which privacy and confidentiality can be assured is by using codes instead of the names of the participants.
- **Anonymity:** Anonymity denotes that even the researcher may not be able to identify the participant. In anonymity, the participants may have objection to others knowing that they participated in the research, but may have no problem with their performance details being shared.
- **Informed Consent:**As discussed earlier, the participants need to be informed about the details of the research, and this is done by taking informed consent from the participants. According to Berg (1998, page 47) informed consent means "the knowing consent of individuals to participate as an exercise of their choice, free from any elements of fraud, deceit, duress, or similar unfair inducement or manipulation".Though, when deception is used in psychological research, obtaining informed consent could be a challenge, as is also true when a study is carried out with the help of naturalistic observation. An informed consent needs to provide details about the research including the duration, procedure and benefits of participating (including incentives, if any) in research. It also needs to mention the participants right to decline from participating in research or to leave or withdraw even after the research has started. Any consequences with regard to denying to participate in research or withdrawing from the research also need to be explained in the informed consent. The participants also need to be updated with any risks that they may face during their participation. If there are any limitations with regard to confidentiality, the same also needs to be mentioned in the informed consent. Lastly, the details of contact person whom the participants can contact in case if they have any query also need to be mentioned in the informed consent.

For detailed information on the Principles of Psychologists and Code of Conduct given by American Psychological Association, refer to the following link https://www.apa.org/ethics/code

With regard to research on animals as well, ethical guidelines need to be followed. An assessment of cost and benefit needs to be carried out before such a research is carried out and due care needs to be taken in acquiring, caring, maintaining as well as disposal of the animals. Care also needs to be taken to ensure minimal discomfort and pain to the animals. Guidelines in this regard as well have been provided by the American Psychological Association.

Ethical issues are significant at every stage of research right from selecting the research problem, finalising the research design, sample to data collection and analysis and reporting of the research. While the research is being written and reported, the researcher needs to ensure that there is no plagiarism and that the sources cited in the research are duly acknowledged.

Check Your Progress II

1) Define deception?

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2) What is informed consent?

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1.4 DEDUCTIVE AND INDUCTIVE METHODS

Deductive and inductive methods are two important methods in research. These are discussed as follows:

Deductive method: Deductive method is also termed as a 'top-down' approach or method of explanation/verification. It mainly involves testing of a theory. Based on a theory, hypothesises are formulated, that are then tested in order to validate or invalidate the theory. The focus of this method is on cause and effect relationship between the variables. Deductive methods mainly rely on the quantitative approach to research, though in certain situations qualitative approach may also be employed. Deductive method is more structured (as there is a clear and specific aim that is to be achieved) and is less time consuming when compared to inductive method. In deductive method, a larger sample size is taken in order to facilitate generalisation of the results.

Inductive method: Inductive method is also termed as 'bottom-up' approach or method of discovery. It mainly involves deriving a new theory. This method usually starts with a research question that is aimed to specify the scope of the research. The method mainly involves exploration of a novel phenomenon/ event or studying the phenomenon/event from a new perspective. In doing so inductive method may make use of qualitative methods of research. Inductive method is less structured and more time consuming when compared with deductive method. Inductive method is less concerned with generalisation and focuses on comprehending the context of the research.

Table 1.1: Difference between Deductive and Inductive Method

Deductive Method	Inductive Method
Main focus on testing a theory	Main focus on building a new theory
Top- down approach is adopted	Bottom-up approach is adopted
A large sample is taken in order to facilitate generalisation of the findings	Less focus on generalisation
More structured	Less structured
Less time is consumed	Time consuming process

The decision whether to use deductive or inductive method will mainly depend on the purpose of the research, whether, a research problem needs to be answered, a hypothesis is to be tested or a new theory is to be explored. Though, in certain cases, both the methods may be used in a research.

Check Your Progress III

1) Explain deductive method.

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1.5 STATEMENT OF THE PROBLEM AND FORMULATION OF HYPOTHESES

Two important components of any research are stating the problem and formulation of hypotheses. It is important to discuss problem and hypothesis because, the investigation carried out by the researcher is directed by the problem and hypothesis and they help researcher in knowing what he/ she is supposed to do. Problem and hypothesis also play an important role in confirmation or disconfirmation of a certain theory, which in turn adds to the existing fund of knowledge of the subject area.

1.5.1 Statement of the Problem

In order to be able to seek answers to questions, it is important to know what exactly the questions are.Thus, as researcher seeks answers to certain problem or issue, having a statement of problem that is clear and specific is an important aspect of any research. Problem can be described as a statement that is interrogative in nature and focuses on the objective or purpose of the research. A problem necessarily manifests when a researcher finds a gap in knowledge related to the subject area, when the results obtained after several research on a certain issue or problem are contradictory, thus, indicating need for further research in order to rest the contradictions and when a fact needs to be scientifically explained.

Three main criteria have been stated by Kerlinger (1995) that determine a good statement of problem:

1) It focuses on relationship between two or more variables in the research.
2) It needs to be stated clearly and should lack any ambiguity.
3) It should be possible to subject it to scientific testing.

1.5.2 Formulation of Hypotheses

Hypothesis is a tentative statement with regard to the research problem that is investigated by the researcher. Kerlinger (1995, page 17) defined hypothesis as "a conjectural statement of the relation between two or more variables". Hypothesis (es) also needs to be formulated in a clear and unambiguous manner in such a way that it can be empirically tested.

Types of Hypothesis: There are two types of hypothesis:

Null hypothesis: Once a researcher finalises his research topic and variables after reviewing literature, he/ she will have to formulate hypothesis based on the problem statement. Null hypothesis is also referred to as hypothesis of 'no difference' as null hypothesis implies that there is no difference between two groups. For example, if a researcher wants to study the significant difference in job satisfaction of public and private bank employees, he/ she will formulate a null hypothesis as

'No significant difference exists in job satisfaction of government and private bank employees'. And then based on the results obtained the hypothesis will be rejected or accepted.

Alternative hypothesis: Alternative hypothesis can be termed as a counter proposition to the null hypothesis (Veeraraghavan and Shetgovekar, 2016). It is formulated by a researcher based on a theory. The hypothesis states that there is a significant difference between two groups. For example, the researcher can formulate the alternative hypothesis as 'There will be a significant difference in job satisfaction of public and private bank employees'. This is also a neutral alternative hypothesis that does not provide any direction and thus is termed as nondirectional hypothesis. Alternative hypothesis can also be directional. For example, 'Public bank employee have higher (or lower) job satisfaction when compared with private bank employees'. Such hypotheses are formulated based on the review of literature.

Check Your Progress IV

1) List the three main criteria that determine a good statement of problem.

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2) Explain problem and hypothesis.

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1.6 DESCRIPTIVE RESEARCH, HYPOTHESIS TESTING, ONE-TAILED, TWO-TAILED TESTS AND ERRORS IN HYPOTHESIS TESTING

There are various types of research in psychology like, experimental research, non-experimental research, field research, field studies, correlational research, survey research, descriptive research and so on. Of these, in the present section of this unit, we will focus on descriptive research.

As the name suggests, descriptive research involves description of certain phenomenon or event. It mainly involves observation and recording about the phenomenon or event. Descriptive research helps researcher describe certain behavioural patterns and it can be effectively used when manipulation of variables that are being studied is not possible.

The data that is collected in descriptive research could either be qualitative, quantitative or both. Qualitative data can be organised on the basis of emerging patterns and descriptive statistics (discussed in later units of this course can be used to analyse the quantitative data.

There are three main categories of descriptive research, viz, naturalistic observation, case study and surveys. These are discussed as follows:

1) **Naturalistic Observation:** This involves observation as well as recording of behaviour in a natural setting. As such there is no control and the researcher is involved in mere observation of the phenomenon or event. For example, researcher can observe a group of children playing or may want to study crowd behaviour. In such a case, he/ she can effectively use naturalistic observation, that will provide valuable information about how individuals behave in a natural set up. Naturalistic observation has higher ecological validity (that is, findings can be applied in realistic situations).

2) **Case Study:** In case study, a single individual or situation is studied in an in-depth manner. For example, a person having certain psychological disorder or a rare chronic illness is studied. As such it is not possible to make any predictions based on the case study method. While using this method, the researcher's bias could creep in, that can have an impact on the way research is carried out.

3) **Survey method:** In survey method, it is possible to contact a large number of individual and carry out a survey. For example, a survey can be carried to get feedback about a certain product from general public. Questionnaires or interview can be used to collect data from the participants. It is important that the questions that have been framed are adequate, clear and easy to understand.

1.6.1 Hypothesis Testing

One of the significant aspects of research is hypothesis testing. Hypothesis is a tentative statement that is investigated during the process of research. Hypothesis pertains to certain phenomenon and is based on a theory. Data is then collected by the researcher in order to validate the hypothesis. Thus, the hypothesis is rejected or accepted by a researcher based on the results obtained. Hypothesis testing is also referred to as a process involving statistical decision making with regard to population value that is based on the sample value (Veeraraghavan and Shetgovekar, 2016, page 9). Though, while drawing inference one needs to ensure that hypothesis is not incorrectly accepted or rejected due to results that are influenced by chance factor or confounding factors.

Steps in Hypothesis testing: The steps involved in hypothesis testing are as follows:

Step 1 : Null hypothesis(es)/ alternative hypothesis(es) are specified.

Step 2 : A level of significance is selected. This level of significance could be 0.05 level or 0.01 level. The term significance in the context of statistics implies 'probably true' that indicates that results are free from chance factor at the specified level of significance. For example, if there exists a significant difference in job satisfaction of public and private bank employees then the researcher could either be 95% (0.05 level of significance, $P<0.05$) confident or 99% (0.01 level of significance, $P<0.01$) confident about the results obtained. This is because when carrying out research with human participants, 100% accuracy cannot be achieved. Thus, there could be 5% or 1% chance that the results are due to chance or confounding factors. Whether the null hypothesis is accepted or rejected will depend on whether the statistical value obtained after data analysis is more or less than the table value (tables for various statistical techniques are provided at the end of any book on Statistics) specified at 0.05 or 0.01 level of significance. If the obtained value is higher than the table value, then the null hypothesis is rejected, and if the obtained value is less than the table value than the null hypothesis is accepted.

Step 3 : Based on the parameter specified in the null hypothesis (es), the statistic is calculated. A sample is taken by the researcher and the data is

collected. Statistic that is thus obtained from the sample (representative) is then used in order to make an estimation about the population parameters.

Step 4 : Decision is made whether to accept or reject the null hypothesis (es). In this regard, the P value or probability level is computed as has been discussed under step 2 and accordingly decision is taken by the researcher, whether to accept or reject the null hypothesis.

1.6.2 One-Tailed and Two-Tailed Tests

Any hypothesis can also be one tailed or two tailed. It is termed as one- tailed when certain direction is given to the hypothesis or the hypothesis is directional. For example, if the researcher is studying whether gender difference exists with regard to emotional intelligence, a one-tailed hypothesis would be "Females have higher emotional intelligence than males" or "Males have higher emotional intelligence than females". Refer to figure 1.2 that provides the figure for both 0.05 and 0.01 levels of significance. In one-tailed test, in order to reject a null hypothesis, the score needs to fall in the upper tail, that is in the top 5% of the distribution. A one-tailed test can be tested in either of the direction.

In case of two- tailed hypothesis, the hypothesis is nondirectional and will be stated as "Gender difference will exist with regard to emotional intelligence". In case of two-tailed test, a null hypothesis can be rejected when the score falls in the either of the top 2.5% of the distribution. Thus, the level of significance is maintained at 0.05 level (refer to figure 1.2).

As the level of significance is taken as 0.05 level, it can be taken at 0.01 level as well, in which case the prediction will be based on the lower tail.

1.6.3 Errors in Hypotheses Testing

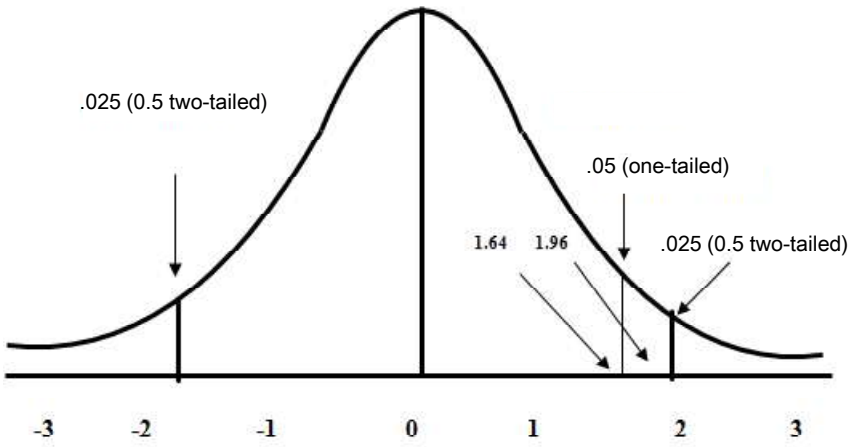
Type I and Type II Errors: In the process of hypothesis testing, two errors could occur, type I and type II errors. These will be more clear from table 1.5.

Table 1.5 Type I and Type II Errors

	Null Hypothesis is true	**Null Hypothesis is false**
Null Hypothesis is Rejected	Type I error	Decision is correct
Null Hypothesis is Accepted	Decision is correct	Type II

As can be seen in table 1.5, a researcher will be making a correct decision when a false null hypothesis is rejected and when a null hypothesis that is true is accepted. However, it may so happen that a null hypothesis is rejected even when it is true and this is termed as type I error. On the other hand, when a false null hypothesis is accepted then it is termed as type II error.

a) .05 level of significance



b) .01 level of significance

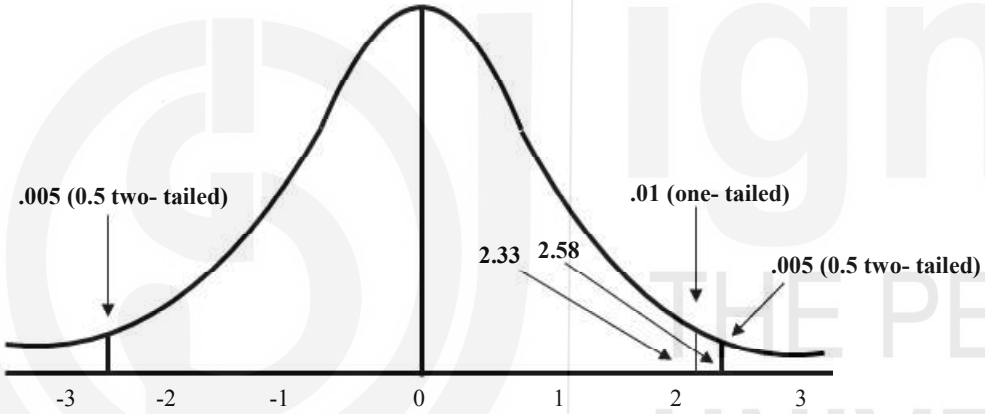


Fig. 1.2: One Tailed and two Tailed tests

Check Your Progress V

1) What is naturalistic observation?

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2) List the steps in hypothesis testing.

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3) In the context of errors in hypothesis testing, when does the researcher takes correct decision?

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1.7 CONSTRUCTS, VARIABLES, OPERATIONAL DEFINITION OF VARIABLES

This section of the unit is divided in to three main aspects, namely, construct, variables and operational definition of variables.

1.7.1 Constructs

When we discuss about constructs, it is also important to understand what is concept in the context of psychological research. As defined by Kerlinger (1995, page. 26), a concept "expresses an abstraction formed by generalisation from particulars". Thus, height can be a concept, that can be expressed in terms of observation of objects that are long or short. To take an example of a psychological variable, adjustment, abstraction can be formed for adjustment based on observations of individual behaviour. In a similar manner various psychological variables can be abstracted based on certain behaviours that can be categorised together.

A construct can be termed as a concept that is adopted for empirical purpose (Kerlinger, 1995). Thus, when adjustment is adopted in a research for empirical purpose, it will be termed as a construct. When a concept is adopted as a construct in a research, it is entered in to the theoretical framework and thus can be related to other constructs in numerous ways. Further, constructs can be subjected to observation and measurement (Kerlinger, 1995). For instance, a standardised scale on adjustment can be used to measure the construct of adjustment.

1.7.2 Variable(s)

Variable means something that varies. It can also be explained as quantity or a number that will vary or will have different values. If a researcheer is carrying out a study on emotional intelligence and self esteem of adolescents in India, in this study, emotional intelligence and self esteem can be termed as variables. Emotional intelligence and self esteem can be high or low. Both these variables can possess varied values. Even gender can be termed as a variable because it will vary in terms of males or females. Different types of variables have been discussed in table 1.3.

Table 1.3: Types of Variables

Independent Variable (IV)	Variable that is manipulated by the researcher is independent variable	In a study on effect of light on performance of individuals, a researcher can manipulate light to bright, dim or normal. Light can be an example of Independent Variable
Dependent Variable (DV)	In a research, variable that is measured for any changes when independent variable is manipulated is dependent variable.	In the above example, performance is an example of dependent variable.
Extraneous Variable (EV)	Variables that may impede or interfere in the relationship between independent variable and dependent variable are called extraneous variables.	In the above example, noise can interfere in relationship between IV and DV and it is possible that changes in DV, that is performance is due to EV, that is, noise rather than IV, that is, light.
Quantitative Variable	This is a variable that is numerically represented.	Intelligence Quotient (IQ), weight, height.
Qualitative Variable	This has measurable characteristics that are not numerical but categorical.	Gender (Male and Female), Socio Economic Status (High and Low), Religion (Christian, Hindu, Muslim).
Continuous Variable	Such a variable has any value and are continuous in nature.	Weight: 56.98 kg, Age: 2 years 5 months.
Discontinuous or discrete Variable	This is a set of integers that are distinct.	Number of children, number of two wheelers.

1.7.3 Operational Definition of Variables

As stated by Kerlinger (1995), constructs can be defined with the help of words or by describing the behaviours that are implied by the construct. In this context, one can discuss about the constitutive definition and operational definition of construct. In constitutive definition, a construct is defined in terms of other constructs (Kerlinger, 1995, page 25). For example, phobia can be defined as irrational fear. In operational definition, meaning is assigned to the construct by clearly identifying the activities on the basis of which it can be measured (Kerlinger, 1995). For example, Organizational Citizenship Behavior can be defined as "a set of individual behavior that is discretionary, not directly or

explicitly recognised by the formal reward system and that in the aggregate promotes the effective functioning of the organization. By discretionary we mean the behavior is not an enforceable requirement of the role, or the job description, that is, the clearly specifiable terms of the person's employment contract with the organization; the behavior is rather a matter of personal choice, such that its omission is not generally understood as punishable "(Organ, 1988, page. 4).

It is to be noted here that though operational definition is an important aspect of any research, it may not be possible for a researcher to define a construct in such a way that the whole construct or variable is covered. Thus, the constructs as used in a research can be termed as "specific as well as limited in their meaning" (Kerlinger, 1995, page 29).

Operational definition can be categorised in to two:

1) **Measured operational definition:** This definition focuses on how a construct can be measured. For instance, organisational citizenship behaviour can be measured with the help of a standardised scale for organisational citizenship behaviour.

2) **Experimental operational definition:** This definition described how a construct is manipulated by the researcher. For instance, employees can be categorised in two groups, one with high organisational citizenship behaviour and the other with low organisational citizenship behaviour.

Check Your Progress VI

1) What is concept?

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2) List the two categories of operational definition?

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1.8 LET US SUM UP

To summarise, in the present unit, we discussed about psychological research, its definition, goals and principles. Research in simple terms can be explained as adding to the existing fund of knowledge. The term research is derived from the French word '*recherche'* which means to travel through or survey. Research can be described as an enquiry that is not only critical but complex as well. Research can also be described as an analysis and recording of controlled observation that

is objective and systematic in nature. And this analysis and recording can result in generalisations, and also development of theories. The main goals of psychological research are description, explanation, prediction, control and application. Besides covering the characteristics of an adequate psychological research, the steps in research process were also discussed. Another important topic in the context of psychological research, namely, the ethical issues were also discussed in detail with a focus on beneficence and non-maleficence, privacy and confidentiality, autonomy and informed consent. Further, the deductive and inductive methods were also highlighted. Two important aspects of psychological research, statement of problem and formulation of hypothesis(es) were also explained. It is important to discuss problem and hypothesis(es) because, the investigation carried out by the researcher is directed by the problem and hypothesis(es) and they help researcher in knowing what he/ she is supposed to do. Problem and hypothesis also pay an important role in confirmation or disinformation of a certain theory, which in turn adds to the existing fund of knowledge of the subject area. The unit also discussed descriptive research, hypothesis testing, one-tailed and two-tailed tests and errors in hypothesis testing. Lastly, the terms, constructs, variables and operational definition of variables were also described. A construct can be termed as a concept that is adopted for empirical purpose and variable means something that varies. It can also be explained as quantity or a number that will vary or will have different values. In operational definition, meaning is assigned to the construct by clearly identifying the activities on the basis of which it can be measured. Operational definition can be categorised in to measured operational definition and experimental operational definition.

In the next unit we will mainly focus on sampling and sampling techniques

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1.10 KEY WORDS

Concept: A concept expresses an abstraction formed by generalisation from particulars.

Construct:A construct can be termed as a concept that is adopted for empirical purpose.

Deception: Deception can be described as efforts by researchers to withhold or conceal information about the purpose of a study from the persons who participate in it.

Hypothesis: Hypothesis is a conjectural statement of the relation between two or more variables.

Informed consent: Informed consent can be explained as the knowing consent of individuals to participate as an exercise of their choice, free from any elements of fraud, deceit, duress, or similar unfair inducement or manipulation" (Berg) 1998, page 47).

Problem: Problem can be described as a statement that is interrogative in nature and focuses on the objective or purpose of the research.

Research: Research is a systematic, controlled, empirical and critical investigation of natural phenomenon guided by theory and hypotheses about the presumed relations among such phenomena,

Variable: Variable can be explained as quantity or a number that will vary or will have different values.

1.11 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress I

1) Define Research.

Best and Khan (1999) have defined research as "systematic and objective analysis and recording of controlled observation that may lead to the development of generalisation, principles or theories, resulting in prediction and possibly ultimate control of events".

2) List the goals of research.

   a) Description
   b) Explanation
   c) Prediction
   d) Control
   e) Application

Check Your Progress II

1) Define deception?

   Deception can be defined as "efforts by researchers to withhold or conceal information about the purpose of a study from the persons who participate in it" (Baron and Byrne, 1995, page 31)

2) What is informed consent?

   According to Berg (1998, page 47) informed consent means "the knowing consent of individuals to participate as an exercise of their choice, free from any elements of fraud, deceit, duress, or similar unfair inducement or manipulation"

Check Your Progress III

1) Explain deductive method

   Deductive method is also termed as a 'top-down' approach or method of explanation/verification. It mainly involves testing of a theory. Based on a theory, hypothesis (es) are formulated, that are then tested in order to validate or invalidate the theory.

Check Your Progress IV

1) List the three main criteria that determine a good statement of problem.

   Three main criteria that determine a good statement of problem are:

   1) It focuses on relationship between two or more variables in the research
   2) It needs to be stated clearly and should lack any ambiguity.
   3) It should be possible to subject it to scientific testing.

2) Explain problem and hypothesis.

   Problem can be described as a statement that is interrogative in nature and focuses on the objective or purpose of the research and hypothesis is a tentative statement with regard to the research problem that is investigated by the researcher.

Check Your Progress V

1) What is naturalistic observation?

   Naturalistic observation involves observation as well as recording of

behaviour in a natural setting. As such there is no control and the researcher is involved in mere observation of the phenomenon or event.

2) List the steps in hypothesis testing.

The steps involved in hypothesis testing are as follows:

Step 1: Null hypothesis(es)/ alternative hypothesis(es) are specified.

Step 2: A level of significance is selected.

Step 3: Based on the parameter specified in the null hypothesis (es), the statistic is calculated.

Step 4: Decision is made whether to accept or reject the null hypothesis (es).

3) In the context of errors in hypothesis testing, when does the researcher takes correct decision?

A researcher will be making a correct decision when a false null hypothesis is rejected and when a null hypothesis that is true is accepted.

Check Your Progress VI

1) What is concept?

As defined by Kerlinger (1995, page 26), a concept "expresses an abstraction formed by generalisation from particulars".

2) List the two categories of operational definition?

Operational definition can be categorised in to two:

- Measured operational definition
- Experimental operational definition

1.12 UNIT END QUESTIONS

1) Define and discuss the goals of psychological research.
2) Describe the steps in research process.
3) Discuss various ethical issues in psychological research.
4) Define and discuss various types of variables.
5) Explain operational definition of variables.

UNIT 2 INTRODUCTION TO SAMPLING*

Structure

2.0 OBJECTIVES

After reading this unit, you will be able to,

- discuss sampling.
- describe sampling techniques.
- explain sampling error and standard error.

2.1 INTRODUCTION

A quality inspector had to check the quality of the potato chips in a factory. There were freshly cooked potato chips that were packed in packets. In such a case what will inspector do is take a random selection of the chips packets in different boxes and check the quality of the chips. This is necessary as it is not possible to check each and every packet, as it is practically impossible and not feasible as well.

When an individual wants to undergo certain blood tests, a sample of blood is taken by the pathologist or when we want to test the quality of water as well, a sample of water is taken.

In a similar manner, in psychology when we carry out research with human beings, it is not possible to collect data from each and everyone from a certain population. For example, if we want to measure emotional intelligence of adolescents in Mumbai, it is not possible to measure the emotional intelligence of each and every adolescent, so the researcher will take a representative sample from the population and measure emotional intelligence of this sample.

In the previous unit we discussed about psychological research , its definition, goals and principles. Further, the characteristics of an adequate psychological research, and the steps in research process were also discussed besides ethical issues The deductive and inductive methods were also highlighted. Two important

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aspects of psychological research, statement of problem and formulation of hypothesis were also explained. Descriptive research, hypothesis testing, one-tailed and two-tailed tests and errors in hypothesis testing were also highlighted in the unit. The terms, constructs, variables and operational definition of variables were also described.

In the present unit we will focus on what is sampling and also discuss various sampling techniques.

2.2 WHAT IS SAMPLING?

In the very first unit of this course we discussed about basics of psychological research. One of the important aspects of research is the sample on whom the research will be carried out. Thus, the researcher will initially decide about the target population, that is, whether he/ she wants to study elderly, women, adolescents, employees or victims of violence and so on. Once this target population is identified then, the researcher has to decide about whether he/she would like to take the whole population or a sample.

You must have heard about Census of India, that is carried out every ten years. In Census, the whole population of India is covered. However, while carrying out research, it is not possible to collect the data from each and every person in the population. Thus, a sample of the population is taken and the research is carried out on that sample.

Before we go on to discuss about sampling, let us discuss population and sample.

The term population can be used to describe the persons, objects, elements, animals or even reactions that display a pattern of characteristics that is unique. It can also be explained as set of persons, objects, elements animals, reactions that the researcher wants to study. If a researcher wants to carry out a study on adolescents in New Delhi, then his/ her population will be all the adolescents in New Delhi. Population can be finite or infinite in nature (Mohanty and Misra, 2016, page 3). An example of finite population is number of students in a school who have failed in mathematics. And an example of infinite population would be number of stars in the sky. Population could constitute individuals, animals, institutions, events, objects and so on based on the research objectives.

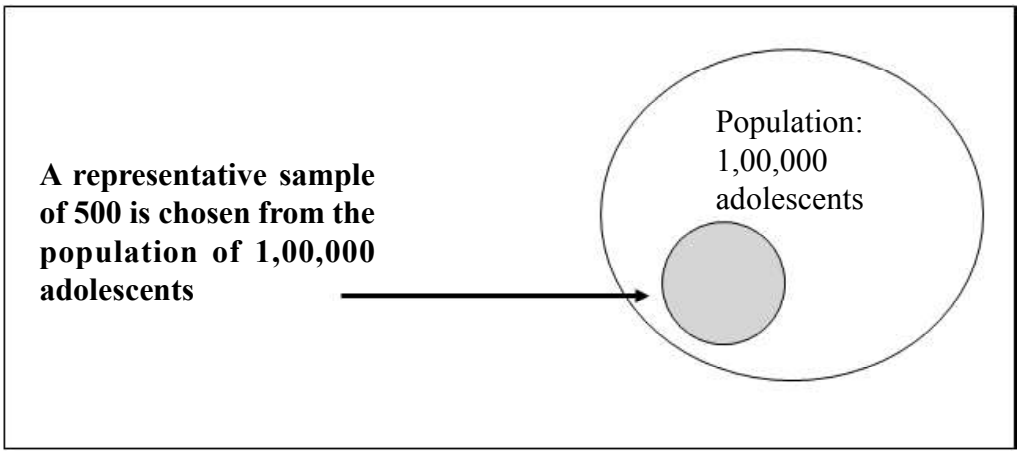

Fig. 2.1: Sample taken from population of adolescents

Population can be categorised in to two, real and hypothetical (Veeraraghavan and Shetgovekar, 2016). With regard to real population, when sampling is carried

out, all the necessary observations can be assessed. Whereas, in hypothetical population, the required observations are not accessible at the time of sampling.

In simple terms, sample can be defined as the group of individuals who participate in the research. If we take the example of adolescents in New Delhi, discussed earlier, it is not feasible for the researcher to contact and collect data from all the adolescents in New Delhi. Thus, the researcher will take a sample (preferably representative)from that population. A sample is a smaller group from the population that participates in the research. It is important that the sample is representative of the population, that is, it is as much as possible similar to the population or possesses the same characteristics or elements as the population (Mohanty and Misra, 2016).

The sample thus selected is then studied by the researcher and the information obtained from the sample can then be used by the researcher in order to draw conclusions with reference to the population. A population could be too large to study hence a sample could be selected. This is mainly based on assumption that conclusions (valid) with regard to the population can be drawn based on the sample. Though it is important to note here that the Sample drawn from the population needs to be representative of that population.

Let us now discuss the term sampling.

Sampling can be explained as the process of taking a sample from the population. Kerlinger (1995, page 110) defined sampling as "taking any portion of a population or universe as representative of that population or universe". Sampling can also be described as an action that involves selection of suitable sample from the population. It can also be termed as a process that involves selection of a sample and can be described as a procedure in which a percentage of the population is drawn (Veeraraghavan and Shetgovekar, 2016). Sampling is to be done in an adequate manner as the population could be heterogenous in nature with individuals belonging to different genders, religions, age, Socio Economic Status and so on.

The sampling process mainly involves identifying the target population, followed by determination of a framework for the sample. Then a suitable sampling technique is to be selected along with suitable sample size.

Sampling plays an important role in to drawing conclusions about population from samples. It is also cheaper and convenient, especially, keeping in mind the time factor within which the research needs to be completed. Further, fewer persons are required when sampling is used as compared to when the whole population is studied. This is especially true when larger studies are carried out(for example studies carried out by organisations like World Health Organisation (WHO) and so on. Also when sampling techniques (to be discussed in the next section) are employed, the accuracy can be estimated rather than probable accuracy. This can be done by looking at the possible range in error of measurement that follows the sampling design employed by the researcher (Majumdar, 2005). Using a sample also allows the researcher to carryout detailed enquiry.

Though, when sampling is carried out, it needs to be carried out appropriately so as to obtain a representative sample.

It is important to keep in mind the following while carrying out sampling (Veeraraghavan and Shetgovekar, 2016):

- It should be a representative sample and each and every member of the population should have an equal chance of being selected for the sample.
- Based on the objectives of the research and nature of the sample, adequate sample size needs to be selected. When carrying out sampling, deciding about a sample size is relevant. A sample size can be determined based on the nature of analysis to be performed, desired precision, number of variables (small sample, more variables) and number of comparisons.
- The sample needs to be unbiased.

Check Your progress I

1) What is sampling?

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2) What are the two categories of population?

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2.3 SAMPLING TECHNIQUES

Sampling techniques can be broadly categorised in to probability and non-probability sampling. In this section of the unit, we will discuss both these terms in detail.

2.3.1 Probability Sampling

Probability sampling mainly involves random selection of the sample from the population. Thus, each and every individual in the population has an equal chance of being selected for the sample. Technique used for such a selection is called randomisation. In probability sampling, every individual who is part of the population has an equal chance of being included in the sample. Sample is thus assumed to be representative of the population. Thus, if the population for a research is students in class 9th of a school, each and every student has equal chance of being selected for the research.

There are various ways in which randomisation can be carried out. One way in which the sample can be randomly selected is by making a list of all the individuals in an alphabetical order and then selecting every 5th or 10th individual based on the sample size required for the research. Thus, if we need to randomly select 20

individuals from amongst 100 individuals, then a list of all the individuals is created in an alphabetical order and then every 5th individual will be selected to be included in the sample. Yet another method uses chits, where the names of the individuals are written on the chits and then put in a bowl and then based on the sample size the chits are picked from the bowl. If the sample size is 20, then 20 chits are picked.

Another method that is used is random number table. Here, the random number is a number that is an outcome of chance and cannot be predicted (Veeraraghavan and Shetgovekar, 2016). In a random number table, there is a list of numbers that includes digits from 0-9 that are arranged randomly and are not related to the numbers that follow or precede them.

As the concept of probability sampling is now clear, we will discuss about various types of probability sampling.

1) **Simple random sampling:** In simple random sampling, participants are randomly selected from the population using methods like lottery method. For example, names or roll numbers of all the students are written on the chits that are then put in a bowl and ten chits are taken out (sample size for research is 10) and these students form the sample of the study.

2) **Systematic random sampling:** In this technique, a list of individuals in the population is created in a random order and sample is selected based on a random integer, keeping in mind the sampling fraction and the interval size. For example, for 50 (N) students in a class, the research may want to take a sample of 10 (n) for the research. Sampling fraction (f) = n/ N= 10/50 = 0.2. Interval size *(i)* = N/n = 50/10= 5. The random integer from 1 to 5 could be 4. Thus, from the 4th student in the list the researcher will select every 5th student (4, 9, 14, 19 and so on) till he/ she gets the sample of 10.

3) **Stratified random sampling:** In stratified random sampling, population is divided in to homogeneous groups and then the sample is selected randomly. For example, if population is divided in to males and females, and for each group sample is randomly selected.

4) **Cluster sampling:** In this sampling, the population is divided in to clusters that are then randomly selected and then all the individuals falling in the selected clusters are taken. For example, in a school, from all the classes, five classes are randomly selected and then all the students in these classes form the sample for the research.

5) **Multistage random sampling:** As the name suggests, here the sampling is carried out at multiple levels. For example, using cluster sampling the classes in a school are selected and then using simple random sampling/ stratified random sampling, sample is selected from these classes.

2.3.2 Non-probability sampling

In non-probability sampling, there is no random selection of the participants to be included in the sample. Hence, the sample may not be representative of the population. For example, if a study is to be carried out on female survivors of domestic violence, then randomisation can not be used and based on the availability and consent of the persons, they are included in the sample.

Let us now discuss various types of non-probability sampling.

1) **Convenient sampling:** In convenient sampling, whether an individual will be included in the sample or not will depend on his/ her availability. For example, the researcher will approach the female survivors of violence and based on their availability, they will be included in the sample.

2) **Voluntary sampling:** In voluntary sampling, participants willing to be part of the research are included in the sample. For example, female survivors of violence who are willing to participate in the research are included in the sample.

3) **Judgement sampling:** In this type of sampling, sample selection is carried out by an individual who has a good idea about the sample. For example, a teacher may identify students who will participate in the research.

4) **Quota sampling:** Here, the sample is selected based on a fixed quota. For example, quota could be 100 junior managers and 50 senior managers from a company (having a total of 150 junior managers and 100 senior managers), that will form the sample of the study.

5) **Snowball sampling:** In snowball sampling, a researcher approaches an individual with characteristics as per the requirement of the sample and then this individual is asked to further refer individuals with similar characteristics. For example, a researcher may contact parents having gifted children and then they may be asked to refer other parents having gifted children.

Check Your Progress II

1) What is systematic random sampling?

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2) Discuss quota sampling.

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2.4 SAMPLING ERROR AND STANDARD ERROR

Any obtained data could be prone to errors, thus the true score constitutes the score obtained plus/ minus the error. This can be denoted as follows:

True score = Obtained score ± Error

Errors here can be categorised in to two,

1) **Measurement error:** This error mainly occur when the measurement tool lacks reliability or consistency.

2) **Statistical error:** This error occurs when the sample is not a representative of the population. This error is related to the sample based estimation of population parameters. These can be further categories in to sampling error and standard error.

a) ***Sampling error:*** The difference that exists between the population mean and sample mean can be denoted as sampling error. Such an error is likely to occur when a sample is taken rather than the whole population.

Sampling error = Population mean (μ) – Sample mean (M)

A high difference between the population mean and sample mean denotes that the sample is not representing the population and a low difference denotes that the sample is representing the population. Sampling error can occur when the sample is not randomly selected and thus the sample is not a representative of the population. Sampling error can be reduced by using randomisation and also by increasing the sample size.

b) ***Standard error:*** Standard error can be described as the standard deviation (SD) of all the standard deviations that have been computed for given number of samples randomly drawn from same population.

Let us try to understand standard error with the help of an example. Suppose a researcher wants to carry out a research on the organisational citizenship behaviour of the employees in public sector banks. Since it in not possible to take the whole population, the researcher randomly takes around 1% of the whole population as a sample. Yet another researcher is also carrying out similar study and also draws 1% from the population. Thus, if many more researchers were carrying out such a study then they would also draw 1% sample from the whole population. The problem, though occurs when the 1% sample that is drawn by each researcher is different from each other. And though each of the 1% sample is representative of the population (that is heterogeneous in nature), they are different from each other. The researchers will also compute means and standard deviations for their respective sample. And in such a case, it is expected that the means and standard deviations would be same, because the sample has been randomly drawn from the same population. But in reality that may not happen and the mean of one sample may be lower or higher than the mean computed for another sample.

The higher the standard error the less the likelihood that the sample is representative of the population. Thus, the difference between the sample needs to be close to zero so as to be sure that they represent the population.

Population mean here can be computed by calculating the mean for all the sample means. Further, if no significant difference exists in the sample means then the researcher can conclude that the mean obtained is almost equal to the population mean. The formula that can be used here is

$$\mu - M_1, \mu - M_2, \mu - M_3, \mu - M_4 \text{ ….. and so on.}$$

Where,

μ = population mean.

M_1, M_2, M_3, M_4….. = Means of different samples.

Ideally the difference between the population mean and sample mean should be obtained as zero and the standard deviation should be obtained as one. But in reality this may not be the case and therefore standard error is computed. Also a higher standard error can be a result of a small sample drawn from a population that is heterogeneous and a lower standard error can be result of a large sample drawn from a population that is homogeneous.

The formula for standard error (SE) is as follows:

$$SE_M \text{ or } \sigma_M = \sigma / \sqrt{N}$$

Where,

SE_M or σ_M = standard error of mean (σ is the SD of the population)

N = the total number of cases in the sample.

Check Your progress III

1) State the two categories of errors.

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2) What is sampling error?

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3) State the formula for standard error.

2.5 LET US SUM UP

To sum up, in the present unit we mainly discussed about what is sampling, sampling techniques and also highlighted sampling error and standard error. Before the term sampling was discussed, we described population and sample. The term population can be used to describe the persons, objects, elements, animals or even reactions that display a pattern of characteristics that is unique. It can also be explained as set of persons, objects, elements animals, reactions that the researcher wants to study. Population can be categorised in to two, real and hypothetical. Sample can be defined as the group of individuals who participate in the research. A sample is a smaller group from the population that participates in the research. It is important that the sample is representative of the population, that is, it is as much as possible similar to the population or possesses the same characteristics or elements as the population. Sampling can be described as an action that involves selection of suitable sample from the population. It can also be termed as a process that involves selection of a sample and can be described as a procedure in which a percentage of the population is drawn. The sampling process mainly involves identifying the target population, followed by determination of a framework for the sample. Then a suitable sampling technique is to be selected along with a suitable sample size. Sampling techniques can be broadly categorised in to probability and non-probability sampling. Probability sampling mainly involves random selection of the sample from the population. Thus, each and every individual in the population has an equal chance of being selected for the sample. Technique used for such a selection is called randomisation. In probability sampling, every individual who is part of the population has an equal chance of being included in the sample. Various types of probability sampling are simple random sampling, systematic random sampling, stratified random sampling, cluster sampling and multistage random sampling. In non-probability sampling, there is no random selection of the participants to be included in the sample. Hence, the sample may not be representative of the population.Various types of non- probability sampling are, convenient sampling, voluntary sampling, judgement sampling, quota sampling, and snowball sampling. Lastly, in this unit we discussed about the sampling error and standard error. Any obtained data could be prone to errors, thus the true score constitutes the score obtained plus/ minus the error. Errors here can be categorised in to measurement error and statistical error. Statistical error is further categorised in to sampling error and standard error. The difference that exists between the population mean and sample mean can be denoted as sampling error. Such an error is likely to occur when a sample is taken rather than the whole population.Standard error can be described as the standard deviation (SD) of all the standard deviations that have been computed for given number of samples randomly drawn from same population.

In the next unit we will focus on quantitative and qualitative research .

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2.7 KEY WORDS

Cluster sampling: In this sampling, the population is divided in to clusters that are then randomly selected and then all the individuals falling in the selected clusters are taken.

Convenient sampling: In convenient sampling, whether an individual will be included in the sample will depend on his/ her availability.

Judgement sampling: In this type of sampling, sample selection is carried out by an individual who has a good idea about the sample.

Measurement error: This error mainly occur when the measurement tool lacks reliability or consistency.

Multistage random sampling: As the name suggests, here the sampling is carried out at multiple levels.

Non-probability sampling: In non-probability sampling, there is no random selection of the participants to be included in the sample. Hence, the sample may not be representative of the population.

Population: population can be described as the persons, objects, elements, animals or even reactions that display a pattern of characteristics that is unique. It can also be explained as set of persons, objects, elements animals, reactions that the researcher wants to study.

Probability sampling: Probability sampling mainly involves random selection of the sample from the population. Thus, each and every individual in the population has an equal chance of being selected for the sample.

Sample: Sample can be defined as the group of individuals who participate in the research.

Sampling: Sampling can be explained as the process of taking a sample from the population. Sampling can also be described as an action that involves selection of suitable sample from the population.

Sampling error: The difference that exists between the population mean and sample mean can be denoted as sampling error.

Simple random sampling: In simple random sampling, participants are randomly selected from the population using methods like lottery method.

Snowball sampling: In snowball sampling, a researcher approaches an individual with characteristics as per the requirement of the sample and then this individual is asked to further refer individuals with similar characteristics.

Statistical error: This error occurs when the sample is not a representative of the population. This error is related to the sample based estimation of population parameters.

Standard error: Standard error can be described as the standard deviation (SD) of all the standard deviations that have been computed for given number of samples randomly drawn from same population.

Stratified random sampling: In stratified random sampling, population is divided in to homogeneous group and then the sample is selected randomly. For example, if population is divided in to males and females, and for each groups sample is randomly selected.

Systematic random sampling: In this technique, a list of individuals in the population is created in a random order and sample is selected based on a random integer, keeping in mind the sampling fraction and the interval size.

Quota sampling: In quota sampling, the sample is selected based on a fixed quota.

Voluntary sampling: In voluntary sampling, participants willing to be part of the research are included in the sample.

2.8 ANSWERS TO CHECK YOUR PROGRESS

Check Your progress I

1) What is sampling?

   Sampling can be defined as taking any portion of a population or universe as representative of that population or universe.

2) What are the two categories of population?

   Population can be categorised in to two (Veeraraghavan and Shetgovekar, 2016), real and hypothetical.

Check Your Progress II

1) What is systematic random sampling?

   In systematic random sampling, a list of individuals in the population is created in a random order and sample is selected based on a random integer, keeping in mind the sampling fraction and the interval size.

2) Discuss quota sampling.

In quota sampling, the sample is selected based on a fixed quota. For example, quota could be 100 early adolescents and 150 late adolescents, that will form the sample of the study (from population of 200 early adolescents and 250 late adolescents).

Check Your progress III

1) State the two categories of errors.

Measurement error

Statistical error

2) What is sampling error?

The difference that exists between the population mean and sample mean can be denoted as sampling error.

3) State the formula for standard error.

$$SE_M \text{ or } \sigma_M = \sigma/\sqrt{N}$$

2.9 UNIT END QUESTIONS

1) Explain sampling with the help of suitable example.
2) Discuss probability sampling.
3) Describe the types of non-probability sampling with suitable example.
4) Explain errors in measurement with suitable examples.
5) What is standard error?