Indira Gandhi National Open University
School of Extension and Development Studies

# MDV-106
# Research Methodology in Development Studies

Block

# 1

## FUNDAMENTALS OF SOCIAL SCIENCE RESEARCH

**UNIT 1**
**Social Science Research: An Overview** **5**

**UNIT 2**
**Components of Social Science Research** **20**

**UNIT 3**
**Research Designs** **35**

**UNIT 4**
**Research Project Formulation** **48**

## PROGRAMME DESIGN COMMITTEE


Prof. Amita Shah
Gujarat Institute of Development Research, Ahmedabad

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

Prof. J. S. Gandhi (Rtd)
Jawaharlal Nehru University, New Delhi

Prof. Gopal Krishnan (Rtd)
Punjab University, Chandigarh

Prof. S. Janakrajan
Madras Institute of Development Studies, Chennai

Prof. Kumar B. Das
Utkal University, Bhubaneswar

Prof. Nadeem Mohsin (Rtd)
A.N.Sinha Institute of Social Sciences, Patna

Prof. P. Radhakrishan
Madras Institute of Development Studies, Chennai

Prof. Ramashray Roy (Rtd)
Centre for Study of Developing Societies, Delhi

Prof. R. P. Singh ( Rtd)
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Indian Agriculture Research Institute, New Delhi

Dr. Nilima Shrivastava
IGNOU, New Delhi

Prof. B. K. Pattanaik
IGNOU, New Delhi

Dr. Nehal A. Farooquee
IGNOU, New Delhi

Dr. P.V.K.Sasidhar
IGNOU, New Delhi


## PROGRAMME DESIGN COMMITTEE (REVISED)


Prof. T.S. Papola
Institute for Studies in Industrial Development, New Delhi

Prof. S. Janakrajan
Madras Institute of Development Studies, Chennai.

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

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Hindu College, University of Delhi, Delhi

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Prof. Rajesh
University of Delhi, New Delhi

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IGNOU, New Delhi

Prof. Nehal A. Farooquee
IGNOU, New Delhi

Prof. P.V.K. Sasidhar
IGNOU, New Delhi

Dr. Pradeep Kumar
IGNOU, New Delhi

Dr. Nisha Varghese
IGNOU, New Delhi

Dr. Grace Don Nemching
IGNOU, New Delhi


## COURSE PREPARATION TEAM


**Unit Writer:**

Dr. Nadeem Mohsin (Rtd)
A.N.Sinha Institute of Social Sciences
(Unit 1 and 2)

Dr. Nisha Varghese
SOEDS, IGNOU (Unit 3)

Prof. Mamata Swain
Revenshaw University, Cuttack (Unit 4)

**Editors:**

Prof. V.K.Jain (Rtd) (Content Editor)
NCERT, New Delhi
Mr. Praveer Shukla (Language Editor), New Delhi
Dr. Nisha Varghese, IGNOU
Prof. B. K. Pattanaik, IGNOU
Prof. Nehal A. Farooquee, IGNOU
Prof. P. V. K. Sasidhar, IGNOU

**Course Coordinator :** Dr. Nisha Varghese, E-mail : nishavarghese@ignou.ac.in

**Programme Coordinators :** Prof. P.V.K. Sasidhar, Prof. B.K. Pattanaik, Prof. Nehal A. Farooquee


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# MDV–106 RESEARCH METHODOLOGY IN DEVELOPMENT STUDIES

Research Methodology in Development Studies is one of the important courses in Master of Arts in Development Studies. To equip the students to undertake any research project, an understanding about the various aspects of research and research methodology is very essential.

**Block 1, Fundamentals of Social Science Research** gives basic backdrop of social sciences research. The block consists of four important units such as Social Science Research: An Overview, Components of Social Science Research, Research Designs and Research Project Formulation.

**Block 2, Development Research** contains three units which are Basics of Development Research; Methods of Development Research; and Development Research Applications.

**Block 3, Measurement and Sampling** comprises of four units. These are Measurement, Scales and Tests, Reliability and Validity, and Sampling.

**Block 4, Data Collection** empowers the student with understanding about the collection of data from various sources. The units included in this block are Quantitative Data Collection Methods and Devices, Qualitative Data Collection Methods and Devices and Data Sources.

**Block 5, Data Analysis** gives an insight into various analytical tools and also guides a student to make meaningful report by properly analysing and interpreting the data. The units included in this block are Overview of Statistical Tools, Use of Computer in Data Analysis, Data Processing and Analysis, and Report Writing.

# BLOCK 1 FUNDAMENTALS OF SOCIAL SCIENCE RESEARCH

Block-1 of Course MDV-106 consists of four units namely Social Science Research: An Overview, Components of Social Science Research, Research Designs and Research Project Formulation

Unit-1 on **'Social Science Research: An Overview'** introduces several concepts and issues related to social science research. It discusses differences and similarities between natural and social science research. The various approaches which can be adopted for conducting social science research – historical, descriptive, case study and experimental are also covered in this unit.

Unit-2 on **'Components of Social Science Research',** discusses the meaning, types and importance of various terms like objectives, concepts, variables, hypothesis, etc. It also gives an account of how a proper research can be done using these components.

Unit-3 on **'Research Designs'** discusses the meaning, purpose and features of research designs. It also gives an account of the functions of research design, the need for research design, features of research design and types of research design.

Unit-4 on **'Research Project Formulation'** discusses the steps in the formulation of a research project proposal, the title of a research project, problem statement, and review of literature. This unit gives an account of objectives of research, methodology, work schedule/time frame budget and dissemination strategy.

# UNIT 1 SOCIAL SCIENCE RESEARCH: AN OVERVIEW

## Structure

1.1 Introduction

1.2 The Meaning and Concept of Social Science Research

1.3 The Differences between Natural and Social Science Research

1.4 Approaches to Social Science Research

1.5 Types of Social Science Research

1.6 Let Us Sum Up

1.7 References and Selected Readings

1.8 Check Your Progress – Possible Answers

## 1.1 INTRODUCTION

In a world which is growing every day, in terms of population and knowledge, it is extremely important to understand how different societies work and influence each other. Social science research is an important tool to understand how society functions, and how human beings in society influence each other. Social science research deals with social phenomena and attitudes of human beings as members of a society under different circumstances and situations. Social science research helps every nation in the formulation of legislations and policies, schemes and programmes on socio-economic issues and has been an extremely essential tool for the government and the people. Let us take an example of a social problem which can be solved through research. The problem is the low level of literacy in the country. If the literacy level is low in the country, the country is not expected to flourish. Low levels of literacy will lead to lower levels of employment and lower incomes. Families with lower incomes have a tendency to send their children to work as child labour. Children who work and earn incomes are not able to go to school, and, hence remain illiterate. Illiteracy results in unemployment and unemployment causes poverty. Social science research will help in finding out causes to problems of illiteracy, unemployment, poverty, etc., thereby, assisting the government to formulate legislations and policies, schemes and programmes for the eradication of illiteracy. Social science research is oriented toward building knowledge. It describes the methods by which results are known; it sets up the inquiry process so that evidence from all sides of a problem can be examined; it generalizes knowledge more broadly beyond the specific instances that are examined. Research is one possible way through which knowledge can be generated.

After studying this unit, you should be able to

- explain the meaning and concept of social science research
- distinguish between natural and social science research
- describe the various types and approaches to social science research
- discuss the recent trends in social science research and understand the basic concepts related to research

## 1.2 THE MEANING AND CONCEPT OF SOCIAL SCIENCE RESEARCH

Social science research can be conducted, for example, in a school setting where absenteeism is a major issue. What are the causes because of which: children remain absent from school; teachers are very strict with students; teaching in the school is not up to the mark; the principal of the school is not able to handle the teachers well; the school is very far off from most of the children's homes; there are no proper toilet facilities for girls in the school? These are some of the issues that could be addressed by research on absenteeism. The solutions for absenteeism can also be found from the findings of the research. Research can, thus, be an important tool in bringing about major policy changes in the school.

What does Social Science research actually mean? This is not a very easy question to answer. At one level, such research deals with social sciences – Sociology, History, Geography, Psychology, Political Science, Economics, etc., and, thus, all research based on these disciplines are social science research. For example, a study of living conditions of tribal communities is research in Sociology. Similarly, a study of the life during the time of Ashoka is research related to History; voting patterns of new eligible voters in a parliamentary election is research in the Political Science; a study on the behaviour of adolescents during parties is Psychological research; and, a study of income and expenditure patterns of middle class urban households during the phase of inflation is research related to Economics. Research, in itself, is designed as a method of enquiry into issues concerning human beings. According to Globusz Publishers, the social science research is a systematic method of exploring, analysing and conceptualising human life in order to extend, correct or verify knowledge of human behaviour and social life. In other words Social Sciences Research "seeks to find explanations to unexplained social phenomena, to clarify the doubtful and correct the misconceived facts of social life". Research is not an arbitrary activity, but follows certain rules and procedures.

Some of the factors of social science research are as follows

a) social science research is a method of enquiry to gain further knowledge or enhance existing knowledge

b) social science research is essential to understand issues of human concerns

c) social science research involves time and money

d) social science research is useful for the formulation of legislations, policies, schemes, and programmes

## 1.3 THE DIFFERENCES BETWEEN NATURAL AND SOCIAL SCIENCE RESEARCH

Let us first try to understand the difference between natural science and social science. Social sciences include the study of Economics, Geography, History, Political Science, Psychology, and Sociology. They are a group of subjects that deal with humans, both as individuals and as interacting groups. Natural Sciences include the study of Astronomy, Biology, Chemistry,

Earth Sciences, Physics, etc. Briefly, social sciences are the study of humans and their interactions, and the natural sciences are the study of the universe and how it works. Perhaps the best way to explain the difference between the two sciences is through the following example. Natural science is when something happens with no help from man whatsoever. It just happens naturally. Social science is when there is some cause to what happens. May be a tree falls down mysteriously and you realize that it was the work of a windstorm; that would be natural science. If you discover that the cause of the tree falling down was that somebody had cut it down, that would be social science.

Within the Social Sciences (Sociology, History, Geography, Psychology, Political Science and Economics) there are differences in research methods. Social Science research has differences as well as some similarities with research in the field of natural sciences (Physics, Chemistry, and Biology). Most of the research pertaining to the natural sciences is completely different from social science research in terms of the entire approach to research, the methodology used for conducting the research, etc. Natural science research is purely experimental in nature, for example, the study of atoms and molecules, the study of the solar system, or the reaction of a particular gas with another gas or solution is research based on experimentation. Many natural science research studies take several years to complete, while many take much less time. The nature of natural science research is mainly scientific and such research often involves huge costs as well. On the contrary, social science research is based on human behaviour and the interrelationship between human beings in a social set up. The methodology of social science research is generally not as complicated as the methodology used in natural science research. Social science research is based on surveys, interviews, focus group discussions, etc., unlike natural science research, which is based on experimentation. The distinction between natural science and social science research is not always very clear and there are areas where both types of researches overlap. For example, when research is carried out on animals, much of the research is biological in nature, where the methods used are those applied in natural science research. However, since such research is also based on animal behaviour, the methodology of research is also those applied in social science research. Nonetheless, it is generally accepted that when it comes to the focus of research, the activities of social researchers differ from those working within the natural sciences. Much of the difference between natural science research and social science research comes to the question of how we actually conduct our research. This is the subject of considerable debate, and some of this revolves around the question of methodology. On one hand, there is a group of social researchers who would argue that when undertaking research projects, we should borrow approaches, designs and methods that are commonly used within the natural sciences, such as experiments. Others would argue that the social world is different from the natural world, and if it is to be investigated effectively, social science research needs to design its own approaches, designs and methods that are more relevant and fit for the purpose.

Let us, now, come to the similarities between natural science research and social science research. Both kinds of research are methods of enquiry to enhance knowledge about something. Both require techniques to conduct

that enquiry. Both enhance knowledge about different aspects of life. Both makes value additions to existing knowledge about particular aspects of life. Both kinds of research are useful and necessary. Both involve time and money. Both are being carried on in different parts of the world, in different ways. Both are useful for the formulation of legislations, policies, schemes, and programmes.

Let us give a tabular representation of the differences between natural science research and social science research.

**Differences**

| **Natural Science Research** | **Social Science Research** |
|---|---|
| Natural science research deals with subjects like Physics, Chemistry, Biology, Astronomy, and the Earth Sciences. | Social science research deals with subjects like Economics, Geography, History, Political Science, Psychology, and Sociology. |
| Natural science research is based on nature. | Social science research is based on the behaviour of individuals in society. |
| Natural science research involves the application of experimentation based on purely scientific tools. | Social science research involves the application of survey methods, interviews, focus group discussions, etc. |
| The nature of natural science research is mainly scientific and such research often involves huge costs not within the control of the researcher. | Social science research is based on human behaviour and the interrelationship between human beings in a social set up. It may involve huge costs but is largely within the control of the researcher. |
| Evolving a methodology for conducting natural science research may often be extremely cumbersome. | Evolving a methodology for conducting social science research may be less cumbersome. |

In this section, you have studied the meaning and concept of social science research and differences between natural science research and social science research, now answer the question given in *Check Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Discuss the term, social science research with your friends, and get an idea of what they mean by it. See if this definition is similar to the one that you have learnt.

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2. Recall the differences between natural science research and social science research and put them point-wise in the space below.

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## 1.4 APPROACHES TO SOCIAL SCIENCE RESEARCH

Various approaches have been adopted for conducting social science research, ranging from the historical approach to the experimental approach. The various approaches to Social Science research can broadly be classified under the following four heads

1. Historical
2. Descriptive
3. Case Study
4. Experimental approach

### 1.4.1 Historical

Most social scientists have treated history differently and have given less importance to the subject from the research perspective. However, the importance of the study of history and its use in social science research is manifold. History depicts social changes and proves that human society was never alike at different points of time. It is rightly accepted that the past affects our present life. It is, therefore, essential to know and understand history in order to understand our present social structures and systems. But, there are social scientists who doubt that history has utility in the study of social systems. Some people even feel that going through old records and documents are a mere waste of time and do not contribute in any way to research.

The historical method of research applies to all fields of social sciences because it includes their origins, growth, etc., over a period of time. For example, if research is to be conducted on the problems of canal irrigation in rural India, one major concern would be the history of origin of the canal from where water is to be made available for irrigation in the area, the government policy in the past on the distribution of canal water, etc. In the collection of historical information, both quantitative and qualitative data can be used. Once the decision is made to conduct historical research, there are steps that should be followed to achieve results. Six steps for conducting historical research have been identified.

i. The need for knowledge about the historical background of the area in which research is to be conducted.

ii. The gathering of as much relevant historical facts about the problem or topic as possible.

iii. If appropriate, the forming of hypothesis that tentatively explains relationships between historical factors.

iv. The rigorous collection and organization of evidence and the verification of the authenticity of information and its sources.

v. The selection, organization and analysis of the most pertinent collected evidence and the drawing of conclusions; and

vi. The recording of conclusions in a meaningful manner.

### 1.4.2 Descriptive

Descriptive research is used to obtain information about the current status of the research issues in question, with respect to the various conditions that are seen to exist. For example, a descriptive approach can be adopted for research looking into the labour issues in a factory within an industrial zone. A descriptive approach would be based on the following steps

statement of the problem – for example, labour disputes in the factory resulting in lower productivity

identification of information needed to solve the problem – for example, grievances of factory workers

selection or development of instruments for gathering the information – interview technique/focus group discussion, etc.

identification of target population and determination of sampling procedure – all members of the population, or only a few members to be selected through a proper sampling technique

design of procedure for information collection – who will collect information and how will the information be collected

analysis of information – how will the information that has been collected be used and analysed

conclusions – what is to be concluded and how the conclusion can be used to solve the problem.

The descriptive approach is also based on survey studies, which assess the characteristics of whole population of people or situations.

School Surveys - used to gather data concerned with internal or external characteristics of a school system

Job Analysis - used to gather information to be used in structuring a training program for a particular job

Documentary Analysis - closely akin to historical research; deals with documenting present situations

Public Opinion Surveys - used to enhance the decision making process by government officials

Community Surveys - used to gather data concerned with internal or external characteristics of a community

The descriptive approach is also based on inter-relationship studies, which trace relationships from the facts obtained to gain a deeper insight into the situation.

Case Studies - probes in depth into an individual situation or personality with the intent of diagnosing a particular condition and recommending corrective measures.

Causal Comparative Studies - compares the likeness and difference among phenomena to determine if certain factors or circumstances tend to accompany certain events, conditions, or processes.

Correlation Studies - determines the extent of the relationship between two or more variables

A descriptive approach is also based on developmental studies which are concerned with the existing status and interrelationships of phenomena and changes that take place as a function of time.

### 1.4.3 Case Study

A case study is one of several ways of doing research whether, it is social science related or even socially related. It is an intensive study of a single group, incident, or community. A case study is a method of exploring and analysing the life of a single social unit – be it a person, a family, an institution, cultural group or even an entire single community. It is a way of organising social data so as to preserve the character of the social unit being studied. Expressed differently, it is an approach which views any social unit as a whole.

The case study method studies a cohesive unit and it may be an individual, a family, an institution, a cultural group, or an entire community, or even an abstract thing; for example, a set of relationships (husband-wife, brother-sister, mother-daughter, and father-son) friendship formation, etc. It can be a person, a single incident of a person's life, a family; a crisis a family has gone through, an incident (for example the tsunami in a particular year), etc. An excellent example of the case study research approach is a study on child abuse where girls from a particular community who have been constantly abused. The information provided by these girls from the same community helps in drawing conclusions about the nature and extent of abuse faced by the girls and on various other dimensions of child abuse. Another example of case study research approach could be a study on drug addicts. The nature of the problem of drug addiction and various other dimensions of drug addiction could be reflected from the case studies.

Some of the salient features of the case study methods or approach are given below.

1. It studies a unit – an individual, a family, a community, a society, a nation, etc.
2. It undertakes an in-depth study of the whole unit.
3. The unit identified for the case study has to be a cohesive and homogenous unit.
4. The method is qualitative in character as it highlights the qualitative aspects of the case by going deep into the issue of concern.
5. The case study method also provides knowledge of the behavioural pattern of the case.

Case studies are used in social sciences research for several reasons. For example, a case study is appropriate when there is one or only a few cases available to study, perhaps because a phenomenon occurs very rarely. An example of something occurring rarely can be the tsunami which affected parts of southern India. A case study of people affected by the tsunami

can be an interesting subject matter of research. Another example could be India's Independence Day, which is celebrated on 15th August. How India achieved independence, and why the British were forced to leave India can be another interesting area for case study research.

### 1.4.4 Experimental Approach

The experimental approach to research involves two sets of units – a control unit and an experimental unit. A control unit is one on which no external intervention has been made. An experimental unit, on the other hand, is one where some intervention has been made. The experimental research is, thus, undertaken to assess the impact of the intervention. Although experimental methods are generally used in natural sciences research, social sciences research is also based on experimental methods. However, experimental methods in social sciences research are mostly used in sociological researches or in multi disciplinary researches, where more than one aspect of the problem is being examined. Thus, research can be multi disciplinary; examining the social, psychological and economic aspects of a problem, or it could be uni-disciplinary, restricting itself only to one aspect of the problem – the social, economic or psychological aspect only.

An experimental research method has its own advantages over other methods.

1. Experimental method allows the determination of cause and effect relationship in very clear terms.
2. The experimental method is comparatively more precise and accurate.
3. A hypothesis can be tested in the best possible manner by the experimental method.
4. The method is universally acclaimed as the most scientific method.

In this section, you have studied the approaches to social science research like historical, descriptive, case study and experimental, now answer the question given in *Check Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are the various approaches of Social Science Research?

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2. What are the steps involved in descriptive research.

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## 1.5 TYPES OF SOCIAL SCIENCE RESEARCH

There are broadly five types of social sciences research that are undertaken, outlined below.

1. Applied Research
2. Fundamental Research
3. Action Research
4. Participatory Research
5. Participatory Action Research
6. Experimental Research

### 1.5.1 Applied Research

Applied research is an empirical research in which the goal is to contribute to apply the research findings to solve a problem. Applied research is designed to solve practical problems of the modern world, rather than to acquire knowledge for knowledge's sake. One might say that the goal of the applied scientist is to improve the human condition. The primary purpose of applied research is discovering, interpreting and developing methods and systems for the advancement of human knowledge on a wide variety of scientific matters of our world and the universe.

For example, applied researchers may be involved in

Research that addresses the effectiveness of a fundraising technique

Research that addresses the effectiveness of a strategy to deal with urban solid waste

Research that studies the effect of minimum tillage on wheat yield.

Some scientists feel that the time has come for a shift in emphasis away from purely basic research and toward applied research. This trend, they feel, is necessitated by the problems resulting from global overpopulation, pollution, and the overuse of the earth's natural resources. Applied research is used in business, education and medical field in order to find solutions to cure diseases solve scientific problems or develop new technologies. As applied research delves into realistic problems, applied researchers are more concerned about external validity of their studies. They attempt to observe behaviours that can be applied to real life situations.

### 1.5.2 Fundamental Research

Fundamental research or basic research (sometimes pure research) is research carried out to increase understanding of fundamental principles. It is carried out with a view to acquire knowledge for knowledge's sake, and not for finding immediate solutions to problems. Many times, the end results have no direct or immediate benefits. Basic research can be thought of as arising out of curiosity. However, in the long term it is the basis for many applied researches. Basic research is mainly carried out by universities. Fundamental research is less oriented towards immediate solutions to problems. It tends to deal with ideas of interest to the researcher. Fundamental research is carried out to understand, for example, how teenagers in a society behave or how a community in a society lives. It does not find answers to how teenagers should actually behave or what causes teenagers to behave in a particular way or how a particular

community in a society should actually live. Any research undertaken to understand how a particular system works falls in the category of fundamental research.

### 1.5.3 Action Research

Action research is a process of progressive problem solving led by individuals working with others in teams or as part of community work to improve the way they address issues and solve their own problems. Action research can also be undertaken by larger organizations or institutions, assisted or guided by professional researchers, with the aim of improving their strategies, practices, and knowledge of the environments within which they work. As designers and stakeholders, researchers work with others to propose a new course of action to help their community improve its work practices. Kurt Lewin, then a professor at MIT, first coined the term 'action research' in about 1944, and it appears in his paper in 1946, *Action Research and Minority Problems*. In that paper, he described action research as "a comparative research on the conditions and effects of various forms of social action and research leading to social action that uses "a spiral of steps, each of which is composed of a circle of planning, action and fact-finding about the result of the action". According to Nunan (1990), a classroom action research does not require the standard formalization of a research project with a literature search, hypothesis testing, treatment conditions, etc. Instead, it consists of seven basic steps to investigate a problem. They are as follows.

1. After determining that there is a potential problem, survey what is happening through observation - via video, audio, hash marks, or whatever relevant means are available.
2. Code the observation based on the problem, and what was seen (i.e., the code is created solely for that problem/session).
3. Based on the coded information, determine one change that could impact the problem in a positive manner.
4. Implement the change in the course/classroom.
5. Observe the class/course (as in Step 1) while implementing the change.
6. Code the new observation(s) as in Step 2.
7. Finally, compare the coded sessions to determine the results of the change.

### 1.5.4 Participatory Research

Participatory research is an action oriented research activity in which ordinary people address common needs arising in their daily lives, and in the process, generate knowledge. Participatory research differs from both basic and applied social science research in terms of people's involvement in the research process, integration of action with research, and the practice-based nature of the knowledge that is entailed. It sets itself apart even from other forms of action-oriented research because of the central role that non-experts play. In contrast to other forms of action-oriented research, in which outsiders have an important role in determining what problems to address, often taking charge of the research process and implementing action, in participatory research people who share problems in common

decide what problems to tackle and directly get involved in research and social change activities. Action minded researchers with technical backgrounds often get involved in this process, but mainly as facilitators. The reason for this emphasis on popular participation is that participatory research is not just a convenient instrument for solving social problems through technically efficacious means, but it is also a practice that helps marginalized people attain a degree of emancipation as autonomous and responsible members of society. It is allied to the ideals of democracy, and in that spirit it is proper to call it research of the people, by the people and for the people.

Participatory research deals with issues that affect classes of people in such wide ranging areas as inner city, rural poverty, health, education, agriculture, environment, housing, community development, mental health, disability, domestic violence, women's oppression, and immigration. The more obvious purpose of participatory research is to bring about changes by improving the material circumstances of affected people. To this end, people engage in three different kinds of activity; inquiring into the nature of the problem to solve by understanding its causes and meaning; getting together by organizing themselves as community units; and mobilizing themselves for action by raising their awareness of what should be done on normal and political grounds. For this reason, gathering and analyzing necessary information, strengthening community ties and sharpening the ability to think and act critically emerge as three main objectives of participatory research, requiring three different kinds of knowledge.

### 1.5.5 Participatory Action Research

Action research or participatory action research has emerged in recent years as a significant methodology for intervention, development and change within communities and groups. It is now promoted and implemented by many international development agencies and university programmes, as well as countless local community organizations around the world. Participatory action research is a recognized form of experimental research that focuses on the effects of the researcher's direct actions of practice within a participatory community with the goal of improving the performance quality of the community or an area of concern. Action research involves utilizing a systematic cyclical method of planning, taking action, observing, evaluating (including self evaluation) and critically reflecting prior to planning the next cycle. The actions have a set goal of addressing an identified problem in the workplace, for example, reducing the illiteracy of students through use of new strategies or improving communication and efficiency in a hospital emergency room. It is a collaborative method to test new ideas and implement action for change. It involves direct participation in a dynamic research process, while monitoring and evaluating the effects of the researcher's actions with the aim of improving practice. At its core, action research is a way to increase understanding of how change in one's actions or practices can mutually benefit a community. Essentially Participatory Action Research (PAR) is research which involves all relevant parties in actively examining together current action (which they experience as problematic) in order to change and improve it. They do this by critically reflecting on the historical, political, cultural, economic, geographic and other contexts which make sense of it. Participatory action research is not just research which is hoped that will be followed by action.

It is action which is researched, changed and re-researched, within the research process by participants. It aims to be active research, by and for those to be helped. It tries to be a genuinely democratic process whereby those to be helped, determine the purposes and outcomes of their own research.

PAR should not be confused with PRA - Participatory Rural Appraisal. PRA is an assessment technique that could form part of a PAR process, but does not encompass the full action-reflection cycle. PAR has evolved through the 1990s and into the 21st century as it has been applied to various fields. Other research approaches that often fall under the label of PAR include participatory research, critical action research, classroom action research, action learning, etc. Additionally, more methods have been developed to add value to the PAR technique, such as Participatory Development Communication (PDC) and Participatory Video (PV). Practitioners have also recently tried to move away from the word "research" because of its abstract meaning to action for change within a community or group. Thus, new names are being used, such as Participatory Action Learning, Participatory Learning Action, and Participatory Action Development. PAR is a popular method used in teaching adult learners in low income communities, and others how to explore, challenge, and react to their own needs. It is gaining popularity among community youth workers, as well as middle and senior high school teachers as a successful methodology for engaging youth voice in the classroom. Youth PAR projects identify mostly issues like educational justice, access to quality healthcare, the criminalization of youth, gang violence, police brutality, etc. PAR is also increasingly used in service learning projects.

### 1.5.6 Experimental Research

Experimental research is commonly used in sciences such as sociology and psychology, physics, chemistry, biology and medicine, etc. In scientific research, an experiment (Latin: *ex- periri*, 'to try out') is a method of investigating causal relationships among variables, or scientific investigation in which an investigator manipulates and controls one or more independent variables to determine their cause and effects on the research. Experimental research is also called randomized controlled research or randomized controlled trials. In experimental research, the researcher manipulates one variable and controls the rest of the variables. The experimental research has an experimental group and a control group. The subjects are randomly assigned between the groups and the researcher tests one effect at a time. For example, suppose a researcher wants to look at the effects of a Computer Assisted Instruction (CAI) programme on children with autism. Suppose the researcher chooses a sample size of 50 children with autism. In the sample, 25 children are taken in the treatment group who will be administered CAI and the remaining 25 will be in the control group. This kind of a research will come under experimental research.

In this section, you have studied types of social sciences research like applied research, fundamental research, action research, participatory research and experimental research, now answer the question given in *Check Your Progress-3.*

**Check Your Progress 3**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Do you remember the seven basic steps of a classroom action research as given by Nunan? If yes, please put them down point-wise.

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2. Write the salient features of a Participatory Action Research.

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## 1.6 LET US SUM UP

We have discussed several concepts and issues related to Social Science research in this unit. We discussed the differences and similarities between Natural and Social Science research. Natural Science research is based on nature. Social Science research is based on the behaviour of individuals in society. Both researches are methods of enquiry to enhance knowledge about something. We all know that various approaches can be adopted for conducting social science research – historical, descriptive, case study and experimental. The experimental approach to research involves two sets of units – a control unit and an experimental unit. The experimental research is thus undertaken to assess the impact of the intervention. Applied research is designed to solve practical problems of the modern world, rather than to acquire knowledge for knowledge's sake. Fundamental research or basic research (sometimes pure research) is research carried out to increase understanding of fundamental principles. While social science research has historically been the domain of government level academic and research institutes, in recent decades many private and non-governmental organisations have also been engaged in such research.

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## 1.8 CHECK YOUR PROGRESS–POSSIBLE ANSWERS

**Check Your Progress 1**

1. Social science research can be conducted, for example, in a school setting where absenteeism is a major issue. What does Social Science research actually mean? At one level, such research deals with social sciences – Sociology, History, Geography, Psychology, Political Science, Economics, etc. and thus all researches based on these disciplines are social science research. Some of the factors of social science research are as follows. Social science research is extremely essential to understand issues of human concerns. Social science researches are useful for the formulation of legislations, policies, schemes and programmes.

2. The difference between Natural Science and Social Science Research are -

| Natural Science Research | Social Science Research |
|---|---|
| It deals with subjects like Physics, Chemistry, Biology, Astronomy and the Earth Sciences. | It deals with subjects like Economics, Geography, History, Political Science, Psychology and Sociology. |
| It is based on nature. | It is based on the behaviour of individuals. |
| It involves the application of experimentation based on purely scientific tools. | It involves the application of survey methods, interviews, focus group discussions, etc. |
| The nature of natural science research is mainly scientific and such researches often involve huge costs not within the control of the researcher. | It is based on human behaviour and inter-relationship between human beings in a social set up. It may involve huge costs but is largely within the control of the researcher. |

| | |
|---|---|
| Evolving a methodology for conducting natural science research may often be extremely cumbersome. | Evolving a methodology for conducting social science research may be less cumbersome. |

**Check Your Progress 2**

1. Various approaches have been adopted for conducting social science research, ranging from historical approach to the experimental approach. The approaches to Social Science research can broadly be classified under four heads: Historical, Descriptive, Case Study, and Experimental approaches.

2. A descriptive research approach would be based on the following steps: a) Statement of the problem; b) Identification of information needed to solve the problem; c) Selection or development of instruments for gathering the information; d) Identification of target population and determination of sampling procedure; e) Design of procedure for information collection; f) Analysis of information; and g) Conclusions.

**Check Your Progress 3**

1. According to Nunan (1990), the seven basic steps of classroom teaching are given below.

   a) After determining that there is a potential problem, survey what is happening through observation - via video, audio, hash marks, or whatever relevant means are available.

   b) Code the observation based on the problem and what was seen (i.e., the code is created solely for that problem/session).

   c) Based on the coded information determine one change that could impact the problem in a positive manner.

   d) Implement the change in the course/classroom.

   e) Observe the class/course (as in Step 1) while implementing the change.

   f) Code the new observation(s) as in Step 2.

   g) Finally, compare the coded sessions to determine the results of the change.

2. Action research involves utilizing a systematic cyclical method of planning, taking action, observation, evaluation and critical reflection of planning the next cycle. Essentially Participatory Action Research (PAR) is research which involves all relevant parties in active examination as well as current action in order to improve it. Participatory action research is not only research, but is also followed by action. These actions are research, its application and follow up research, within the research process by participants.

# UNIT 2 COMPONENTS OF SOCIAL SCIENCE RESEARCH

**Structure**

2.1 Introduction

2.2 Concept

2.3 Objectives

2.4 Definition

2.5 Hypothesis

2.6 Variables

2.7 Let Us Sum Up

2.8 References and Selected Readings

2.9 Check Your Progress – Possible Answers

## 2.1 INTRODUCTION

Social science research is interesting, but requires a clear understanding of its basic components. If the components on which social science research are based are not understood, it will be difficult to undertake research. If concepts like hypothesis, concept, construct, variable, etc., are not understood, a researcher will not be able to understand the basic principles underlying social science research. It is therefore, essential that these concepts are understood. These concepts will be explained here in simple language, through relevant examples wherever required, in order to have a basic understanding of what social science research is all about.

After studying this unit, you should be able to

- explain the meaning of concept, types of concept, difference between concept and construct;
- discuss the meaning of objectives, types of objectives, and the criteria for judging the objectives;
- describe how to develop a theoretical and conceptual framework;
- explain the meaning and characteristics of definition, types, and the role of definition;
- discuss the meaning and importance of hypothesis; and
- describe the meaning, types, and the role of variables.

## 2.2 CONCEPT

A concept is a general idea derived, or, inferred, from specific instances or occurrences. It is something formed in the mind; a thought or notion. A concept is a cognitive unit of meaning - an abstract idea or a mental symbol sometimes defined as a ‘unit of knowledge’, built from other units which act as a concept’s characteristics. A concept is typically associated with a corresponding representation in a language or symbol such as a word.

### 2.2.1 Meaning of Concept

A concept can be defined as a verbal response evoked by objects of the class to which the concept applies, for example, light, temperature, sound, age, sex, accidents, etc., are all class names applied to stimuli, subjects or responses of a specific kind. These are all examples of concepts which cannot be directly observed, but their instances can be located. There are other concepts like mental strength, drive, attitude, motivation, etc., whose instances too cannot be directly observed because they are presumed to be located inside the organism. They are called hypothetical constructs.

A concept is a property, or characteristic of some case, or unit of analysis in which one might be interested. It is essentially an idea about some aspect of some phenomenon, for example, gender, self-esteem, bureaucracy, social classification, etc. A case (unit of analysis) is that defined entity that is sampled and scored, or measured, on variables of interest in a research project. A case is defined in terms of its major characteristics and their location in time and place. In Sociology, a case is often a human individual, a group, an organisation or a society. It can also be social entities such as the father-child role relationship. In research, a sample or population of these cases is targeted for examination. Research involves special concepts such as total family income, self-employment, and economic returns. These are generally technical terms that point to some phenomenon that is an important aspect of a topic to be researched. Such concepts must be defined carefully so that others understand specifically what they mean. The concept of total family income, for example, is defined to have a range of possible values. Thus, it is called a variable in a given piece of research. To be useful to researchers, however, the abstract definition of a concept is not enough. A set of indicators must be developed in order to actually measure or classify families in terms of their total family incomes. Families can be classified, for example, into low, middle and high income groups. They can further be categorised into: less than Rs.5000 per month; between Rs.5,000 and Rs. 10,000, per month; and Rs.10,000 and above, per month.

### 2.2.2 Types of Concepts

Concepts are basically of two types:

1. Concepts which cannot be directly observed, but their instances can be located. Examples of such concepts are: temperature, sound, age, etc.
2. Concepts whose instances cannot be directly observed because they are presumed to be located inside the organism. They are called hypothetical constructs. Examples of such concepts are: mental strength, drive, attitude, motivation, etc.

A concept can have a conceptual definition as well as an operational definition. In the above example of the total family income, the conceptual definition is the total monthly earnings of the family (that is, all earning members in the family) through all sources. In the same example, the operational definition would be the range of categories of income such as less than Rs.5,000 per month, between Rs.5,000 and Rs.10,000 per month and Rs.10,000 and above, per month.

### 2.2.3 Concepts and Constructs

A concept, as already defined, is a property or characteristic of some case or unit of analysis in which one might be interested. It is essentially an idea about some aspect of some phenomenon, for example, gender, self esteem, bureaucracy, social classification, etc.

A construct, too, is a verbal response evoked by objects of the class to which the concept applies. Some concepts such as temperature, sound, age, sex, etc. cannot be directly observed, but their instances can be located. Other concepts such as mental strength, drive, attitude, motivation, etc., can neither be directly observed nor can their instances be located as they are presumed to be located inside the organism, and are called constructs. A construct is a concept. It has the added meaning, however, of having been deliberately and consciously invented or adopted for a special scientific purpose. Constructs play a very important role in theory building. Many theories such as the memory trace theory, the frustration-aggression theory, etc. have emerged out of this. Constructs cannot be observed and, thus, are called non-observables. Constructs are also known as intervening variables. An intervening variable is a term invented to account for internal and directly unobservable psychological processes that, in turn, account for behaviour. In other words, an intervening variable is an in-the-head variable which cannot be seen, heard, or felt. It is inferred from the behaviour of the individual. Hostility is inferred from aggressive acts. When we display aggression, it reflects hostility. Learning is inferred from test scores. We exhibit learning when we perform well in test scores. Similarly, anxiety is inferred from skin response, heart beats, etc. When we are nervous or anxious (maybe at the time of facing an interview, or before the announcement of a result), the hair on our skin rises, or, our hearts start beating faster. In research the name for these terms is ‘invented constructs’, the reality of which is inferred from human behaviour. For example, while studying the effect of motivation, a researcher is aware that motivation is an intervening variable, a construct invented by men to account for persistently motivated behaviour.

### 2.2.4 Role of Concepts in Research

Concepts play an important role in research. In fact, research cannot be conducted without concepts. Every research is based on a concept, as research tries to establish relationship between two concepts, one of which is dependent on the other. Let us explain this through an example. ‘Vitamins supplement the growth in babies’ is a topic of research. This is a hypothesis which needs to be tested (as we are hypothesizing that vitamins supplement the growth in babies). The statement could be true or false. In this topic of research, as in any other research, we are dealing with concepts. One concept that we have identified is ‘vitamins’ and the other concept is ‘growth in babies’. According to the hypothesis, the higher the dose of vitamins (up to a certain level), the more healthy the growth among babies. Here, we are dealing, as already mentioned, with two concepts. One concept, ‘vitamin’, is an independent variable and the other concept, ‘growth in babies’ is a dependent variable. Concepts also help in understanding the cause and effect relationship in research. Let us take an example to understand the cause and effect relationship, as well as the role of dependent and independent variables in research. Concepts are used

in all types of research. We have just given examples of the use of concepts (which are also variables) in experimental research. We can also examine the importance, or role of concept in other types of research. In case study research, for example, the role of concept is equally important. A case study is one of several ways of doing research, whether it is social science related, or even socially related. It is an intensive study of a single group, incident, or community. Case study is a method of exploring and analysing the life of a single social unit – be it a person, a family, an institution, cultural group or even an entire single community – these entities are all concepts.

Similarly, concepts are used in historical as well as descriptive research, as in all types of research we are dealing with individuals, families, institutions, communities, etc., which are all concepts. Thus, research is incomplete without concepts.

## 2.3 OBJECTIVES

Objectives are extremely useful for conducting research. If we take a broader definition of the term, objective, it is something which is useful for conducting any action. Every act that we perform has an intention, or objective. For example, if a mother scolds a child or hits the child, the action is conducted to achieve a certain goal. The immediate objective, or goal, is to make the child avoid doing something that is considered wrong. The long term objective or goal is to discipline the child and make him differentiate between good and bad. The action of the mother is not 'research'; it is simply an 'action'. An example of an objective in social science research could be on 'Good parenting skills' which would be to make children and parents responsible and knowledgeable. Here, the action is to provide inputs on good parenting, and the result of this action is transferring the children from a state of being less responsible and knowledgeable, to a state where they become more responsible and knowledgeable.

### 2.3.1 The Meaning of Objectives

When we talk about an objective or a goal we mean a state which we would like to achieve in the future. The term, state, is however interpreted, here, comprehensively. An example of a state would be, 'to have immigrated within a ten year period to a particular country'. Here, the objective is to reach the state of migrating to a particular country, and the period for achieving that state is ten years. Another example is to have successfully completed a particular educational course in five years. Here, the objective is to reach the state of completing a particular educational course, for which the time period specified is five years. Thus, an objective refers to shifting from one state to another through a certain process, and, within a certain time frame. Thus, we describe an objective as, where we want to be at a particular time. On the other hand, the path to this goal, that is how we wish to achieve this goal as well as the necessary negotiations and decisions, is not a part of the objective itself. Neither is the time period specified for achieving the goal a part of the objective. The dictionary meaning of objective is, 'something that one's efforts or actions are intended to attain or accomplish'.

Let us take an interesting example. You are all interested in studying this unit. Why? Here, 'why' means what is the objective of studying this unit?

The objective of studying this unit is to put in efforts to attain knowledge about the subjects/topics discussed in this unit. When the knowledge is attained, the student shifts from one state to another – that is the state of being less knowledgeable about the topics discussed in this unit to a state of being more knowledgeable about the topics discussed in this unit.

### 2.3.2 Type of Objectives

Objectives are generally of three types:

1. Broad and specific
2. Long term and short term
3. Measurable and non-measurable

**1. Broad and specific objectives**

Broad objectives are those which reflect the goal or purpose, but which do not, in actual terms, specify the goals or purpose or mention in clear terms, the specific goals or purpose. We can take the example of a health project, for example. The project is entitled: 'Improved Systems for Private and Public Health'. Here the broad objective would be to improve the health conditions of people. There are, however, underlying (specific) objectives, whereby, the broad objective, that is, improving the health conditions of people could be achieved.

Specific objectives, on the other hand, refer to specific goals or purpose that are to be attained and are mentioned in specific terms in the statement of objectives. In the example of the health project 'Improved Systems for Private and Public Health', specific objectives would be more than one. It could be a few or it could be many. For example, specific objectives could be reduction of disease; it could be provision of requisite medicines in the Primary Health Centres; it could also be availability of qualified doctors to cater to the needs of people, and so on.

**2. Long term and short term objectives**

The long term objective in the example, above, is improving the health conditions of people. This is a long term objective, since it cannot be achieved overnight, or within a short span of time. In this example, when we refer to people, it could mean the entire population of a country, a state, a district. It could also mean a limited population within the country, state, district, or, a specific community within a block, or, a village. Also, in the same example, when we refer to 'improving health conditions', it could include only provision of timely medicines, or provision of health clinics; it could also mean improvement of sanitation and supply of safe and potable water. Thus, the long term objective can only be achieved over a span of, say, 5-10 years.

The short term objective remains confined to the achievement of certain specific objectives, such as, availability of medicines in a particular Primary Health Centre, or availability of a doctor in a slum community on a particular day in a week. These are short term objectives which can be achieved in a short span of time.

**3. Measurable and non-measurable objectives**

There are certain objectives which can be quantified or measured. In the example, above, the number of patients attending a Primary Health

Centre every week or every month is a measurable objective. One indicator of improving the health conditions of people is more and more patients turning up at the Primary Health Centre every week or every month. The non-measurable objective, in this example could be the improved systems of health in the area. However, even this may be measurable, but only up to a certain extent, since, although it is possible to quantify certain indicators of health, not all of them can be quantified.

### 2.3.3 Criteria for Judging the Objectives

Certain criteria needs to be laid down for judging the objectives – whether the objectives have been thoughtfully identified or not. In social research, it is very important first to understand what are the goals for undertaking the research/study and then to ascertain that the objectives/goals are achievable.

The broad criteria for judging the objectives are:

1. It should lead to action
2. It should be important from the context of the research and should be understood
3. It should be useful and relevant
4. It should be based on logic
5. It should be achievable

**1. It should lead to action**

Any research is undertaken with a single objective or a set of objectives in mind. The first criterion for identifying an objective is that it should lead to action. For example, if the research is on the topic, "Improved quality of education leads to enhancement of knowledge of children", one of the objectives of research is enhancement of knowledge of children. The objective of research, in this example, leads to action, since children's knowledge will increase by the inputs provided through quality education. The provision of quality education is an action which is necessary if the objective of enhancement of knowledge of children is to be achieved.

**2. It should be important from the context of the research and should be understood**

The objective of research in the above example is important from the context of the research that is being undertaken. The most important aspect of improving the quality of education is enhancement of children's knowledge. Improved quality of education may lead to other things as well, but, the most important aspect is knowledge enhancement. The objective in this example is also very clear and direct, and is not presented in a manner which is complex or confusing. As a result, it will be easily understood by anyone who is associated with this research.

**3. It should be useful and relevant**

Let us use the same example to explain our point. In the research cited above, "Improved quality of education leads to enhancement of

knowledge of children", what are the most significant and useful aspects? The most significant and useful aspects are the improvement in quality of education and the enhancement in the knowledge of children. The objective is also relevant in the above research since the relevance of improvement in the quality of education can only be judged through the enhancement of knowledge of children.

**4. It should be based on logic**

Logic is the most important aspect of objective formulation. Any objective can be formulated only if the researcher has a clear understanding of the subject matter of research and why it needs to be conducted. In the above example, once again, the most logical objective is enhancement of children's knowledge. There has to be an application of mind in deciding what could be the best outcome of an action – improvement in the quality of education. There could be another objective of this research – increase in the salary of teachers – but, this would not be the most logical objective of the research.

**5. It should be achievable**

A very important criterion for the formulation of an objective is that it should be achievable. In the example given above, the objective, enhancement in the knowledge of children is achievable. If the quality of education improves - that is, better teachers are provided to children, better facilities are provided to children, interaction between teachers and children are more frequent, parent-teachers meetings are held frequently, special attention is being provided by teachers to weak students, and so on, then children's knowledge is bound to be enhanced. Thus, the objective is achievable if the inputs provided are of good and standard quality.

In this section, you have studied the meaning of concepts, types of concepts, role of concepts, meaning and types of objectives of social science research, now answer the questions given in *Check Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Discuss with your friends and see what they mean by concepts.

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2. Explain to your friends the meaning of different types of objectives.

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## 2.4 DEFINITION

Defining a concept is not very different from defining any word. The objective is to make it very clear to some audience what one is dealing with. Logically, definitions aim to lay bare the principal features or structure of a concept, partly in order to make it definite, to delimit it from other concepts, and, partly, in order to make a systematic exploration of the subject matter with which it deals.

### 2.4.1 Meaning and Characteristics of Definition

The dictionary meaning of definition is the act or process of giving an exact meaning to a concept or word; describing or explaining the scope of the concept or word; describing or explaining a statement of the meaning of a concept, or, word or the nature of a thing. All research deals with concepts which have to be clearly defined. In the absence of a clear cut definition of a concept, the concept becomes ambiguous and vague, creating problems for a researcher in carrying out research.

Definitions have the following characteristics:

1. Definitions provide alternate meaning to concepts.
2. Definitions explain the meaning of concepts in clear and explicit terms.
3. Definitions provide reasonable and logical explanations to concepts.
4. Definitions describe concepts in terms which are easily understandable.
5. Definitions use common sense to describe and explain concepts to make them easily identifiable.

### 2.4.2 Types of Definitions

Definitions are of two types:

1. Conceptual
2. Operational

**1. Conceptual definition**

The first step is to define what we mean by any particular concept. Once that has been done, it will then be possible to develop indicators for that concept as it has been defined. Conceptual definitions are those which define a concept. For example, what is the concept of religiousness – or, how a person can be called more religious or less religious? Similarly, poverty may be conceptualised in economic terms, perhaps using income to assess its existence. Similarly, it can be conceptualised in social terms, using the crime committed in a particular area to assess its magnitude. There are several dimensions to conceptualise poverty.

1. Poor purchasing power – low capacity to purchase because of low income.
2. Powerlessness – inability to influence others.
3. Isolation – being cut off from society.
4. Meaninglessness – no purpose of life as basic needs are not fulfilled.

**2. Operational definition**

Once we are able to specify the different dimensions of a concept, we will be at a point where we can move from the abstract to the concrete.

The operational definition refers to the process through which indicators are developed to measure the concepts – that is, to transform them into observable phenomena. From each of the four dimensions of poverty, a set of questions can be developed to operationalize each dimension. For example, indicators can be developed for the first dimension of poverty, that is, poor purchasing power. In order to get information on this dimension, following questions can be asked:

1. What necessities do you purchase for your family's sustenance?
2. How do you meet the requirements of your child if you are unable to provide mother's milk?
3. What are other items apart from food on which you spend money?

The questions identified above indicate one dimension of poverty. Operational definitions, thus, provide indicators to the conceptual definition of a concept, in this case, poverty.

### 2.4.3 Role of Definitions

Social Science Research revolves around the definition of concepts – both conceptual and operational. If definitions of concepts are not accurate, the researcher may not be able to understand what the concept is and how to ask questions related to the concept from the respondents. It is important for the researcher to understand the concept as it is defined and then conduct the interview. If this is not done, bias may be reflected from the way the questions are addressed to the respondents, and from the response of the respondents, as well.

Concepts like motivation, learning, perception, etc., are research in the Behavioural Sciences (a branch of the Social Sciences) which need to be clearly defined conceptually, and understood by the researcher before the researcher is able to undertake research on these topics. These conceptually defined concepts, then, need to be made operational (operationally defined) by devising indicators that can be used to measure these concepts. If the researcher is unable to understand the conceptual and operational definitions of these concepts, he or she, will not be able to do justice with research. It is, therefore, important that definitions of concepts are clearly understood before they are used by researchers for the purpose of conducting research.

## 2.5 HYPOTHESIS

What is the purpose of formulating research questions like, "do children's performance in school improve on being given special coaching?", or "Does regular use of milk make children healthy?" Well, research questions are formulated with the purpose of seeking answers to these questions. Two approaches to an answer are used in research and both require an examination of facts. The first approach is to gather appropriate factual data and examine them to see whether an answer to the research question can be formulated. The second approach uses prior research and thinking to come up with one or more hypothesized answers to the research question. The answer thus sought is called a hypothesis. Then, research is designed to gather factual data aimed at testing whether the hypothesized answers are false. If they are not falsified by the factual data, then the hypothesized answers are presumed to be reasonable answers to the initial

research question for the time being, as further research may show that the hypotheses are false in some situations.

### 2.5.1 Meaning of Hypothesis

A hypothesis is a proposed answer to a research question. Hypotheses may be derived from theoretical ideas or they may be suggested by exploratory research. For example, if the question is, "does regular use of milk make children healthy?" the hypothesis will be "Regular use of milk makes children healthy".

A hypothesis is defined as a conjectural statement of the relationship between two or more variables. In the above example, the variables are 'regular use of milk' and 'healthy children'. While a problem asks the question, "How is A related to B?" a hypothesis declares, "A is related to B". A hypothesis is, thus, a statement or declaration, about a relationship between two or more variables, which is taken for granted with the purpose of deciding on the basis of research, about the probable existence of the presumed relationship.

A hypothesis is a tentative answer to a research problem, expressed in the form of a clearly stated relation between the independent and the dependent variables. Hypotheses are tentative answers because they can be verified only after they have been tested empirically.

### 2.5.2 Importance of Hypothesis

Hypotheses are important and indispensable tools of scientific research. There are three main reasons to accept this statement:

1. Hypotheses are working instruments of theory. They emerge as a deduction from a theory. Every worthwhile theory permits the formulation of additional hypotheses. These, when tested, are either proved or disproved and, in turn, constitute further tests of the original theory. For example, the theory of aggression may include the hypothesis, "Frustration produces aggression". From this broad hypothesis, a few more specific hypotheses can be deduced. Like, to prevent children from reaching goals they find desirable (frustration) will result in their fighting with each other; children deprived of parental love (frustration) will react with aggressive behaviour.

2. Hypotheses are testable and can prove to be true or false. Facts which do not reflect relationship, for example, "He is smart", are called isolated facts and cannot be tested. Only relations are tested. For example, "Girls from college A are smarter than girls from college B". This is a hypothesis and can be tested.

3. Hypotheses are powerful sources for the advancement of knowledge as they allow the researcher to get outside his own barriers. A hypothesis is so important that it would not be an exaggeration to state that there would be no science in any complete sense without a hypothesis. Hypothesis is considered to be the backbone of all scientific research. Without it, confirmation or rejection of theories would be impossible.

### 2.5.3 Criteria for Judging a Workable Hypothesis

There are several criteria for judging a workable hypothesis.

1. A hypothesis should be stated in conceptually clear terms. In other words, it should not be vague or ambiguous.
2. A hypothesis should be testable. If a hypothesis refers to an idea that is not represented in real life, then it cannot be considered a good hypothesis as it cannot be tested.
3. A hypothesis should be governed by the law of parsimony. In other words, it should be economical in explaining the events to which it relates. It should not be based on too many assumptions.
4. A hypothesis should be formulated in specific terms, to distinguish it from a theory. A hypothesis selects some specific facts and events from a theory.
5. A hypothesis should be related to available techniques of testing it.
6. A hypothesis should be related to the known bodies of facts and theories. Theory building is the ultimate aim of science and a good hypothesis should help in fulfilling this aim.

## 2.6 VARIABLES

Concepts such as 'total family income' are ideas an investigator has about important characteristics of some entity such as a family. The concept must be clarified and defined, preferably explicitly, so that researchers can understand and share the phenomenon that is being studied. The concept of 'total family income' is defined to have a range of possible values. Thus, it is called a variable in a given piece of research.

### 2.6.1 Meaning of Variables

A variable is an indicator of some defined concept or characteristic of a case. For example, a response to the question, "What is your age?" is a variable that can be used as indicator of the concept age. The indicator of the concept age can be: less than one year; between 1 and 5 years; between 5 and 10 years; between 10 and 15 years; and, so on. The indicator of the concept age can be the actual age in numerical terms or the date of birth (date, month, and year). A variable may also be defined as a property that takes on different values, as many measurable attribute of objects, things or beings. Examples of variables could be any concept such as age, income, community, intelligence, motivation, etc. The term variable more directly expresses the quantitative meaning. It means, 'whatever varies'. The most intricate variations can be expressed in terms of numbers which are capable of indefinite divisions. A variable has, accordingly, been defined as 'a symbol to which numerals or values are assigned.

### 2.6.2 Types of Variables

Variables are of different types

1. dependent and independent variables
2. qualitative and quantitative variables

**1. Dependent and independent variables**

Researchers aim at studying the relationship between variables which is described as one of dependence. They are dependent variable and independent variable. The independent variable is the stimulus variable, and the dependent variable is the response variable.

An independent variable is the presumed cause of the dependent variable, which is the presumed effect. In the above two examples, the cause and effect relationship can also be seen. For example, milk is the cause and children's growth is the effect and the kind of school is the cause and mannerism is the effect.

**2. Qualitative and quantitative variable**

Qualitative variables are those which vary in kind and not in degree. An example of a qualitative variable is sex, race, religion, etc. They cannot be described in numbers. A quantitative variable, on the other hand, is one whose values can be ordered in respect of their magnitude, that is, they can be described as being more or less, higher or lower, larger or smaller, etc. Examples of quantitative variables are intelligence, age, time, temperature, etc.

Quantitative variable can further be classified into two: (i) discrete or discontinuous and (ii) continuous. The value of a discrete variable is a fixed quantity. For example, sex and family size are discrete variables. These can be stated in terms of indivisible quantity, and not in terms of fractions like, 2.5 or 15.75, and, so on. Discrete variables consist of two or more classes – dichotomous, those that consist of two categories (for example, sex has two categories-male and female); and, polychromous, those that consist of more than two categories (for example, intelligence can be categorized into high intelligence, average intelligence and low intelligence).

A continuous variable is described as a 'quantitative variable which can be measured with an arbitrary degree of fineness'. For example, time is a continuous variable, since it can be measured in years, months, days, minutes, seconds, one hundred of a second, and so on.

## 2.6.3 Role of Variables

Variables play an important role in research. In fact, research cannot be conducted without variables. Every research is based on variables, as research tries to establish relationship between two variables, one of which is dependent and the other is independent. Variables also help in understanding cause and effect relationship in research. Variables are used in all types of research. We have just given examples of the use of variables in experimental research. We can also examine the importance or role of variables in other types of research. In case study research, for example, the role of variables is equally important. A case study is an intensive study of a single group, incident, or community. A case study is a method of exploring and analyzing the life of a single social unit – be it a person, a family, an institution, cultural group or even an entire single community – these entities are all variables.

In this section, you have studied the meaning and characteristics of definition, types of definition, role of definitions, meaning and importance

of hypothesis, meaning and types of variables, now answer the question given in *Check Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Explain the meaning of definitions and discuss its salient characteristics?

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2. Discuss the meaning and importance of hypothesis in social science research.

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## 2.7 LET US SUM UP

We have discussed several concepts and issues related to social science research in this unit. We have discussed, in this unit, the meaning, types and importance of various terms like objectives, concepts, variables, hypothesis, etc. Objectives are useful for conducting research. Concepts play an important role in research. In fact, research cannot be conducted without concepts. All research is based on concepts, as research tries to establish relationships between two concepts, one of which is dependent on the other. Concepts also help in understanding cause and effect relationship in research, and are used in all research. Behind a good research question is some idea or hunch, or, ideally, a more carefully researched theory. Research questions involve special concepts. A variable is an indicator of some defined concept or characteristic of a case. Variables are of different types: dependent and independent variable; qualitative and quantitative variable. Variables play an important role in research. In fact, research cannot be conducted without variables. Variables also help in understanding cause and effect relationship in research.

Definitions have certain characteristics: they provide alternate meaning to concepts, explain the meaning of concepts in clear and explicit terms; provide reasonable and logical explanations to concepts; describe concepts in terms which are easily understandable; use common sense to describe and explain concepts to make them easily identifiable. Social science research revolves around the definition of concepts – both conceptual and operational. If definitions of concepts are not accurate, the researcher may not be able to understand what the concept is, and how to ask questions related to the concept from the respondents. A hypothesis is a proposed answer to a research question. Hypotheses are working instruments of theory. Hypotheses also deal with linkages between variables.

## 2.8 REFERENCES AND SELECTED READINGS

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## 2.9 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress-1**

1. A concept can be defined as a verbal response evoked by objects of the class to which the concept applies, for example, light, temperature, sound, age, sex, accidents, etc., are all class names applied to stimuli, subjects or responses of a specific kind. A case (unit of analysis) is that defined entity that is sampled and scored or measured on variables of interest in a research project. Research involves concepts such as total family income, self employment and economic returns. The concept of total family income, for example, is defined to have a range of possible values.

2. Objectives are generally of three types: broad and specific objectives, long term and short term objectives, measurable and non-measurable objectives. Broad objectives are those which do reflect the goal or purpose but which do not, in actual terms, specify the goals or purpose or mention in clear terms the specific goals or purpose. Long term objective in the above example is improving the health conditions of people. This is a long term objective, since it cannot be achieved overnight, or within a short span of time. Measurable objectives are quantified or measured and non-measurable objectives are not measured.

**Check Your Progress-2**

1. The dictionary meaning of definition is the act or process of giving an exact meaning to a concept or word; describing or explaining the scope of the concept or word; describing or explaining a statement of the meaning of a concept or word or the nature of a thing. Definitions have the following characteristics.

   Definitions provide alternate meaning to concepts.

   Definitions explain the meaning of concepts in clear and explicit terms.

Definitions provide reasonable and logical explanations to concepts.

Definitions describe concepts in terms which are easily understandable.

Definitions use common sense to describe and explain concepts to make them easily identifiable.

2. A hypothesis is a proposed answer to a research question. For example, if the question is, “does regular use of milk make children healthy?” the hypothesis will be “Regular use of milk makes children healthy”. Hypotheses are important and indispensable tools of scientific research. Hypotheses are working instruments of theory. Every worthwhile theory permits the formulation of additional hypotheses. For example, the theory of aggression may include the hypothesis, “Frustration produces aggression”. From this broad hypothesis, a few more specific hypotheses can be deduced.

# UNIT 3 RESEARCH DESIGNS

## Structure

3.1 Introduction

32. Meaning, Concept and Importance of Research Design

3.3 Functions of Research Design

3.4 Types of Research Design

3.5 Let Us Sum Up

3.6 References and Selected Readings

3.7 Check Your Progress – Possible Answers

## 3.1 INTRODUCTION

This unit focuses on issues involved in designing a study. Any social science study involves several components which need to be integrated in a coherent and unambiguous way so as to ensure that the research problem is addressed effectively. It is the function of the research design to ensure that the research problem is addressed in an effective and unambiguous way. One of the common mistakes made by most of the researchers is that they begin their research without giving proper attention and importance to research design. A proper research design would be a blue print in the hands of the researchers and help in guiding the researcher about the collection, measurement and analysis of data. This unit would cover various aspects and types of a research design. After reading this unit you will be able to:

Describe the meaning and concept of a research design

Discuss the importance of a research design

Elaborate upon the functions of a research design

Explain the different types of research design

## 3.2 MEANING, CONCEPT AND IMPORTANCE OF RESEARCH DESIGN

A research design is a plan and structure of investigation used to obtain answers to research questions (Kerlinger, 1986).

A traditional research design is a blue print or detailed print of how a research study is to be completed – operationalizing variables so that they can be measured, selecting a sample of interest to study, collecting data to be used as a basis for testing hypothesis, and analysing the result. (Thyer, 1993:94).

The first obvious question that arises in one's mind is – why have a research design? A simple analogy will help answer this question better. Say you want to construct a building. You don't right away order materials and set dates for completion of various levels of the building without first knowing what sort of building is to be constructed. You need to first know what the building would be, whether it would be a school, an office or a residential complex. In the same way, social science research also needs

a research design before starting with data collection and analysis. A research design helps the researcher to know what information they require to answer their research questions. A good research design puts before a researcher a blue print of what information needs to be collected, how the respondents would be chosen, how the collected information would be analysed and how the results would be presented in a meaningful manner.

The research design helps in taking decisions on the following:

Nature of the study

Reason for conducting the study

Location of the study

Nature of data needed for the study

The time period for which the data has to be collected

The location from where the data has to be collected

Specifying the sampling design

Techniques of data collection

Analysis of collected data

Style of report writing

A well defined research design is needed for smooth sailing of the research processes from deciding on the topic of research to collection of data, analysis and report writing so as to collect maximum information with minimum money and time. Research designs have a great bearing on the reliability of the research results and hence should be prepared with utmost care.

### 3.2.1 Features of a Good Research Design

A good research design would be one which would maximize the reliability of the results while minimizing the bias. The desirable features of a good research design also depend on the problem being investigated. For some, a design which gives maximum information may be the best while for others it may be the one which gives smallest experimental errors. Thus a design quite suitable for one research problem may be found lacking in others. For example, exploratory research studies require the research design to be flexible enough whereas in case of studies demanding accuracy, the research designs which would minimize bias and maximize reliability will be more suited.

## 3.3 FUNCTIONS OF RESEARCH DESIGN

A research design has two broad functions. The first one relates to identifying and developing logistics and procedures required to undertake a particular study. The second function relates to ensuring quality in these procedures so as to ensure their validity, objectivity and accuracy. The research design should detail all the procedures a researcher plans to use so as to obtain answers to the research question. A good research design should be flexible, appropriate, efficient and economical.

### 3.3.1 A good research design has the following functions:

1. A research design would help identify a research problem and justify its selection.

2. It will provide a proper review of previously conducted research on associated problem and will provide a synthesis of previously published literature.
3. Specifying the hypothesis of the research problem clearly and explicitly is another function of a research design.
4. To identify the variables on which data would be needed in order to test the specified hypothesis and also to clarify the method for collecting the data.
5. To describe the analytical methods that would be used in order to test the hypothesis.

### 3.3.2 Criteria for Choosing a Research Design

The design to be chosen depends on the following factors

The aim of the study and the information required.

The nature of the phenomenon being studied. Whether it is quantifiable and if quantified, whether the results would be reliable and valid.

Is it ethical to conduct the study

The availability of literature on the topic

The cost of the design

Till now you have read about the meaning, concept, importance and functions of a research design. Now try and answer the questions given in *Check Your Progress – 1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is meant by a research design?

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2. Describe the criteria for choosing a research design.

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## 3.4 TYPES OF RESEARCH DESIGN

There are several types of research design which can be used depending on the nature of the research. This section gives you details of the following research designs:

1. Action Research Design

2. Case Study Design
3. Causal Design
4. Cohort Design
5. Cross Sectional Design
6. Descriptive Research Design
7. Experimental Design
8. Exploratory Research Design
9. Historical Research Design
10. Longitudinal Research Design
11. Metal-Analysis Design
12. Observational Design
13. Philosophical Design
14. Sequential Design

Let us study each of these designs in detail.

**1. Action Research Design**

Action research consists of a family of research methodologies which pursue action and research outcomes at the same time. Action research design tends to be cyclic in nature wherein, initially an understanding of the problem is developed and plans are made for some intervention. This is followed by acting upon the interventions and then the related observations or information is collected. This is followed by critical reflection in which the researchers reflect upon and critique what has happened. This reflection leads to next stage of planning and the cycle continues.

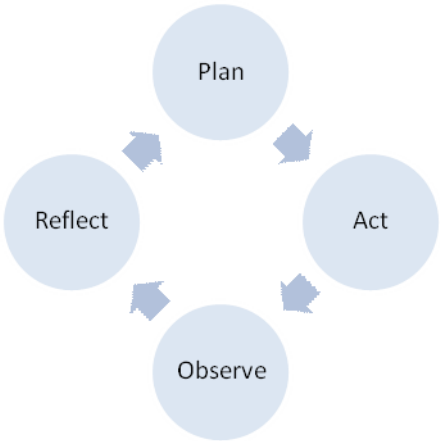


**Fig. 1: Cyclical Nature of Action Research Design**

This research design is thus cyclical in nature and helps in deeper understanding of a given situation starting with conceptualizing the problem followed by several interventions and their evaluations.

Advantages:

Action research designs are used in community situations. They aim at solution driven research outcomes instead of testing theories. Apart from being cyclic, action research is also participative in nature. Its cyclic nature gives more chance to learn from experience provided that there is real

reflection on the process and on the outcomes of each cycle. Action research also provides flexibility to allow fuzzy beginnings while progressing towards appropriate endings.

Disadvantages:

One of the most important features of action research is that the researcher is responsible for both change (action) as well as for research. Hence action research is more time consuming than conventional research. You may also not be able to use the conventional format of documentation in case of action research.

**2. Case Study Design**

Case study design is a useful tool for in depth analysis of a particular research problem rather than a statistical survey. It helps in narrowing the research problem to a few examples. Unlike surveys, a case study will not provide complete answers to a question but it can help in elaboration and hypothesis formation. This design can also be used to test the applicability of a theory or a model in the real world.

Advantages:

Case study designs help in understanding complex issues by a detailed study of limited number of cases. Examining of contemporary life situations through case studies helps in application of concepts and theories and extension of methodologies. Case studies also help in detailed descriptions of rare cases.

Cautions:

Case studies cannot be used to generalise the findings over wider population. This type of design may lead to researcher's bias while interpreting the results due to intense exposure of the researcher to the case being studied. A case being studied may not be a representative of the larger problem being studied and hence may not be a good design to assess the cause and effect relationship.

**3. Causal Design**

Causal designs are used to study phenomena in which a variation in one phenomenon (the independent variable) leads to a variation in other phenomena (the dependent variable). Causal researches are conducted in order to understand the nature and extent of cause and effect relationships. One of the examples where causal research design can be used in development studies is when one needs to study the impact of a livelihood programme on the income levels of the people. For a researcher to choose a causal research design there should be an empirical association between the independent variable and the dependent variable and the relation between the two variables is not spurious. Another important aspect to be kept in mind is that the variation in the independent variable should precede any variation in the dependent variable to establish the causality.

Advantages:

Causal studies help in identifying the reasons behind some processes. They are also useful in impact assessment studies. Replication is possible in causal studies. These studies offer high levels if internal validity due to systematic selection of subjects.

Cautions:

Coincidences in events or spurious relations may be perceived as cause and effect relations. Due to the existence of a wide range of extraneous variables in the social environment, the causality can only be inferred but not proven with high levels of certainty. There exists possibility of existence of causal relationship between two variables but it may be difficult to establish which variable is the cause and which the effect is.

**4. Cohort Design**

Cohort design is a design in which a group having similar characteristics is closely monitored over time simultaneously with another group. It is generally used in medical research where a population is selected and information is collected on the statistical occurrence of a particular phenomenon (say heart disease) among subjects which have a particular characteristic (diabetics). The entire population is then followed up in time and the incidence of occurrence of heart disease in diabetic individuals is compared with incidence of heart disease in those who are not diabetic. This design can also be used in applied social science research, specially the researches that measure risk factors.

Advantages:

This research design is specially used in studies where a randomised control study may be unethical and hence researches that measure risk factors usually use cohort design. Cohort studies measure the potential causes before the outcome, thereby avoiding the problem of having to clearly state which the cause is and which is the effect.

Caution

While using the cohort design to compare two cohorts, the researcher cannot control for all other factors that might differ between the two groups. Sometimes cohort studies may take long time to complete especially if researcher has to wait for the incidence of interest to occur within the group. Sometimes the time may be long enough for the key variables to change, thereby impacting the validity of the study. Since cohort design lacks randomization, it has lower validity than those designs in which the sample is chosen randomly.

**5. Cross Sectional Design**

Cross sectional design lacks the dimension of time. In cross sectional researches, observations are taken for different groups at one point of time. A cross sectional design can only measure differences among the subjects. A cross sectional study can be used to describe the characteristics of a group. However, the process of change cannot be traced in a cross sectional study. It focuses on finding relationship among variables at one point of time.

Advantages:

Cross sectional studies are based in drawing inferences from the existing differences than measuring change. The selection of groups is purposive and based upon existing differences in the sample and not random. This design uses survey technique to collect data and hence can be done at a relatively lower cost.

Caution

Finding subjects for study with similar characteristics can be difficult. The results being static cannot be explained in temporal context. These studies cannot be used to establish cause and affect relationships. There is no follow up to the findings.

**6. Descriptive Research Design**

Descriptive research designs are the best methods for collecting information that will demonstrate relationships or describe the current status of the phenomenon as it exists. Descriptive studies involve surveys or interviews to collect the necessary information. Descriptive studies typically provide answers to questions related to who, what, when, where and how, however, they cannot provide answers to why.

Advantages:

Descriptive studies observe the subjects in their natural environment as they exist and are generally precursors to qualitative research designs. They are useful tools in more focused studies.

Caution:

The results from descriptive studies cannot be used to prove or disprove a hypothesis. The results of descriptive studies cannot be replicated as they are based on observational methods.

**7. Experimental Design**

In the simplest forms of experimental designs, two groups are created which are equivalent to each other. Then one of the groups, also called the treatment group gets a programme and the other group, also called the control group does not get the programme. These two groups are similar in all other aspects. Then the differences are observed in both the groups. Since both the groups are supposed to be equivalent in all the aspects, the difference arising between the two is considered to be due to the only difference between the two groups which is that one of the groups get the programme.

Advantages:

If people are assigned to the two groups on a random basis from a common pool and if the sample size is large enough to achieve probabilistic equivalence between the two groups, the experimental research designs are capable of achieving strong internal validity. Since the experimental designs allow researchers to control a situation, it also allows researchers to establish a cause and effect relationship.

Caution:

Since the experimental designs are artificially established, the results may not generalize well to the real world. Also, the artificial setting of the experiments may alter the response of the participants. Experimental designs requiring special equipments may be a costly affair. There may also be ethical considerations to be addressed in experimental research designs.

**8. Exploratory Research Design:**

Exploratory research designs are used when the researcher has an understanding or observation about something and seeks to learn more about

it. It is used in research problems in which there are few or no earlier studies to refer to or rely upon to predict an outcome. Exploratory designs are undertaken with one or more of the following goals:

To develop familiarity with basic details, settings, and concerns.

To develop a well grounded picture of the existing situation

Generation of new ideas and assumptions.

Development of tentative theories or hypotheses.

To determine the feasibility of the study in future.

To lay the groundwork which will lead to future studies.

Direction for future research and techniques get developed.

Advantages:

It helps in gaining background information on a particular topic. Exploratory research designs are undertaken with one of the two basic purposes to define new topics or a new angle or to clarify the existing concepts. These research designs help in generating a formal hypothesis or in developing a more precise research problem. Exploratory designs are useful in research prioritization or resource allocation.

Caution:

As the sample size used in exploratory designs are small, they cannot be used to make generalizations about the population. They do not provide a definitive conclusion for a research problem. The outcome of exploratory researchers may not be of much value to the decision makers. As compared to other designs, this design lacks the rigorous standards of data collection and analysis.

**9. Historical Research Design**

Historical research typically involves studying and interpreting past events to predict the future ones. Historical research typically involves Collection, verification and synthesis of evidences from the past so as to establish or refute a hypothesis. It uses both primary and secondary data sources including documentary evidences such as diaries, reports, archives, official records etc.

Advantages:

Historical researches are unobtrusive and do not affect the result of the study. Historical approach is typically suited for trend analysis. There is no possibility of interaction between the researcher and the subject which could affect the findings of the research.

Caution:

The fulfilment of the objectives of such researches is based upon the availability and quality of documents related to the research problem. Interpreting historical researches can be very time consuming. Historical researches are weak in terms of the demands of internal validity. Since the availability of entire documents needed to fully address a historical research is rare, such gaps need to be acknowledged in the report.

**10. Longitudinal Research Design**

In a longitudinal study, the sample is followed over time to make repeated observations. In longitudinal studies, the same group or sample is tracked

over time and the changes observed. The researcher then relates them to variables that might have caused the changes. They are useful in studies required to establish causal relationship and help in showing both the magnitude and direction of causal relationships.

Advantages:

Longitudinal studies help in identifying the duration of the particular phenomenon being studied. These studies help in measuring and analysing the pattern of change on different variables over time. They also facilitate predictions to be made on the basis of earlier factors.

Caution:

Large sample size is needed to be able to accurately explain the causal relationships. It may also be difficult to maintain the integrity of original sample over time. The data collection method may change over time and it may also be difficult to show more than one variable at a time. Longitudinal research is based on the assumption that the present trend will continue which may not hold true all the time.

### 11. Meta-analysis Design

Meta analysis is a technique designed for combining results from independent studies. It involves evaluation and summarizing of results from a number of individual studies thus increasing the overall sample size and also increasing the ability of researcher to study the effects of interest. This type of study uses synoptic reasoning to develop a new understanding of the research problem. Meta-analysis includes analysing differences in the results among studies and increasing the precision by giving due weight to the size of different studies included. The validity of meta-analysis depends on the quality of systematic review on which it is based. A well designed meta-analysis depends upon strict adherence to the criteria used for selecting studies and the availability of information in those studies to be able to properly analyse their findings. Larger the heterogeneity in the results of the individual studies, the more difficult it becomes to establish validity of the synopsis of the results.

Advantages:

Meta-analysis can be used as a strategy to determine gaps in already existing literature. Such studies help in review if researches on a particular topic over a long period of time and published in various sources. They also help in overcoming the problem of small sample in individual studies. They are generally used to generate new hypothesis or suggest problems for future studies.

Caution:

Large sample may yield reliable but not necessarily valid results. Synthesis of a heterogeneous collection of studies in terms of literature reviewed, methods applied or measurements of findings may be difficult. The whole process can be quite time consuming and small violations in criteria used for analysing the studies may lead to meaningless findings.

### 12. Observational Design

This type of research design draws a conclusion by comparing subjects against a control group; however, the allocation of treatment is not fully

under the control of the researcher. The main difference between experimental and observational research is the lack of manipulation of independent or causal variable in case of observational research design. The researcher simply observes the naturally occurring values of the independent and dependent variables and then uses techniques to find out if they co-vary. This design helps ensure that there are no false responses that might be introduced by manipulative research procedures. An observational study allows a useful insight into a phenomenon and avoids the ethical and practical difficulties of setting up a large and cumbersome research project. Observational designs are of two types: direct observations in which subjects know that the researcher is watching them and Unobtrusive observations in which the individuals do not know that they are being observed.

Advantages:

Observational designs are flexible and do not necessarily need to be structured around a hypothesis. The researcher is able to do an in depth investigation about a particular behaviour and hence helps in understanding the interrelation among various dimensions of the study. As the variables being studied are allowed to operate without any intervention in case of observational designs, the external validity is often very high. The results of observational research can be generalised in real life situations.

Caution:

The internal validity of observational research designs is low. Reliability of the data is low as they are difficult to replicate. The findings may pertain to a unique sample population and cannot be generalised. The study may have an element of the researcher's bias. Since nothing is manipulated, a cause and effect relationship cannot be established. The presence of a researcher in case of direct observations may lead to skewed data.

**13. Philosophical design**

The philosophical researches challenge the assumptions underlying a particular study. Arguments derived from philosophical theories, models, concepts or traditions form the tools for this type of studies. Such studies can basically be of three types:

Ontology — the study that describes the nature of reality; for example, what is real and what is not, what is fundamental and what is derivative?

Epistemology — the study that explores the nature of knowledge; for example, by what means does knowledge and understanding depend upon and how can we be certain of what we know?

Axiology — the study of values; for example, what values does an individual or group hold and why? How are values related to interest, desire, will, experience, and means-to-end? And, what is the difference between a matter of fact and a matter of value?

Advantages:

This type of research helps the researcher in gaining greater self understanding about the purpose of research. Philosophical studies help to refine concepts and theories that are invoked in relatively unreflective modes of thought and discourse thus offering clarity to the terms, concepts and ideas.

Caution:

Its application is limited to specific problems and has limited applicability in real life issues. There can be analytical difficulties in moving from philosophy to advocacy and between abstract thought and application to the phenomenal world.

### 14. Sequential Research Design

A sequential design may be defined as a combination of longitudinal and cross sectional design in which several cohorts are followed at a time. In longitudinal designs, we look at one group over a long period of time and in cross sectional design we look at several groups at a particular period of time. In sequential design, we look at different groups over a period of time.

Advantages:

Sequential design is a useful design for exploratory studies. As the study is repetitive in nature, minor changes or correction warranted in the research methods can be done at the initial stages. The study being conducted serially, the results of one sample are known before next sample is drawn and analysed providing enough opportunities for improvement of sampling methods and analysis.

Caution:

The sampling method used does not allow choosing a representative sample of the population unless the researcher goes for a very large sample. Also as the sampling technique is not randomised, the results cannot be generalised for the entire population. It is also difficult to interpret variation from one sample to another over time.

In this section you have read about the various types of research design. Now try and answer the questions given in *Check Your Progress – 2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is Cohort Research Design? What are its advantages?

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2. What is longitudinal Research Design? What are its advantages?

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## 3.5 LET US SUM UP

In this unit, we discussed the meaning, purpose and features of research designs and found that a good research design is possible through different phases. Research design, however, depends on research purpose, and is bound to be different in the case of exploratory or formulative studies from other studies, such as descriptive or diagnostic ones. Each type of research design, however, does not suit all categories of designs and for each category of research, separate types of designs will be needed. The researcher must decide in advance of collection and analysis of data as to which design would prove to be more appropriate for his/her research project. The researcher must give due weight to various points such as the type of universe and its nature, the objective of the study, the resource list or the sampling frame, desired standard of accuracy, and the like, when taking a decision with respect of the design for the research project.

## 3.6 REFERENCES AND SELECTED READINGS

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## 3.7 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress 1**

1. A traditional research design is a blue print or detailed print of how a research study is to be completed – operationalizing variables so that they can be measured, selecting a sample of interest to study,

collecting data to be used as a basis for testing hypothesis, and analysing the result. (Thyer, 1993:94).

2. The design to be chosen depends on the following factors

   The aim of the study and the information required.

   The nature of the phenomenon being studied. Whether it is quantifiable and if quantified, whether the results would be reliable and valid.

   Is it ethical to conduct the study

   The availability of literature on the topic

   The cost of the design

**Check Your Progress 2**

1. Cohort design is a design in which a group having similar characteristics is closely monitored over time simultaneously with another group. It is generally used in medical research where a population is selected and information is collected on the statistical occurrence of a particular phenomenon. The entire population is then followed up in time and the incidence of occurrence of heart disease in diabetic individuals is compared with incidence of heart disease in those who are not diabetic. This design can also be used in applied social science research, specially the researches that measure risk factors.

Advantages:

This research design is specially used in studies where a randomised control study may be unethical and hence researches that measure risk factors usually use cohort design. Cohort studies measure the potential causes before the outcome, thereby avoiding the problem of having to clearly state which the cause is and which is the effect.

2. In a longitudinal study, the sample is followed over time to make repeated observations. In longitudinal studies, the same group or sample is tracked over time and the changes observed. The researcher then relates them to variables that might have caused the changes. They are useful in studies required to establish causal relationship and help in showing both the magnitude and direction of causal relationships.

Advantages:

Longitudinal studies help in identifying the duration of the particular phenomenon being studied. These studies help in measuring and analysing the pattern of change on different variables over time. They also facilitate predictions to be made on the basis of earlier factors.

# UNIT 4 RESEARCH PROJECT FORMULATION

## Structure

4.1 Introduction

4.2 Steps in the Formulation of a Research Project Proposal

4.3 Title of Research Project

4.4 Problem Statement

4.5 Review of Literature

4.6 Objectives of Research

4.7 Methodology

4.8 Work Schedule/Time Frame

4.9 Budget

4.10 Dissemination Strategy

4.11 References

4.12 Let Us Sum Up

4.13 References and Selected Readings

4.14 Check Your Progress – Possible Answers

## 4.1 INTRODUCTION

Research project formulation is one of the important tasks of the students pursuing various programmes in Development Studies. The research project formulation comprises many steps starting from the choosing of a research topic up till the budget and time line fixation. This unit deals with the details of the various steps involved in the research project formulation.

After reading this unit, you should be able to formulate a research project proposal by completing the following steps

- identification, analysis and description of a research problem
- review of relevant literature and other available information
- formulation of research objectives
- development of an appropriate research methodology
- preparation of a work plan for the study
- identification of resources required and preparation of a budget
- development of a strategy for distribution and utilisation of research results

## 4.2 STEPS IN THE FORMULATION OF A RESEARCH PROJECT PROPOSAL

The first step in any research project is to write a research proposal. The research proposal indicates the research problem that you will study, and shows the road map to undertaking the research project. A research proposal is intended to convince others that you have a worthwhile research project and that you have the competence and the work plan to complete it. Generally, a research proposal should contain all the key elements involved in the research process, and include sufficient information for the readers

to evaluate the proposed study. First, the researcher has to identify a problem that he aims to study. The logical next step is to find an answer or solution to the problem through a systematic step by step approach. A good proposal increases the chances of getting funding, and is also necessary for efficient research and valid results. A good proposal contains a clear statement of the problem to be studied, a review of relevant literature, objectives of the study, methodology, time frame, budget, and references.

An outline of the proposal format is provided below.

1. Title of research project
2. General introduction/ Background/ Importance of Study/Statement of Problem
3. Review of relevant literature
4. Objectives
5. Methodology
6. Time Frame
7. Budget
8. References

A schematic diagram of steps in the formulation of a research project proposal is given below.

**Table 4.1 Steps in the Formulation of a Research Project Proposal**

| Questions you must ask | Steps you will take | Important elements of each step |
|---|---|---|
| What is the problem and why should it be studied? | Selection, analysis and statement of the research problem | - problem identification<br>- prioritising problems<br>- analysis<br>- justification |
| What information is available? | Literature review | - literature and other available information |
| Why do we want to carry out the research? What do we hope to achieve? | Formulation of research objectives | - general and specific objectives<br>- hypotheses |
| What additional data do we need to meet our research objectives? How are we going to collect this information? | Research methodology | - variables<br>- types of study<br>- data collection techniques<br>- sampling<br>- plan for data collection<br>- plan for data processing and analysis<br>- ethical considerations<br>- pre-test or pilot study |
| Who will do what, and when? | Work plan | - human resources<br>- timetable |
| What resources do we need to carry out the study? What resources do we have? | Budget | - material support and equipment<br>- money |
| How will the project be administered? How will utilisation of results be ensured? | Plan for project administration and utilisation of results | - administration<br>- monitoring<br>- identification of potential users |
| How will we present our proposal to relevant authorities, community and the funding agencies? | Proposal summary | - briefing sessions and lobbying |

**Source:** *http://www.Module 6 FORMULATION OF RESEARCH OBJECTIVES International Development Research Centre.htm*

## 4.3 TITLE OF RESEARCH PROJECT

The title of the research project gives the first impression of a proposal and, hence, it needs to be carefully framed. It has to be catchy, small and informative. It should be a shorter version of the objective. It should indicate, broadly, what is being attempted. It should be precise and accurate. No jargon or abbreviations should be used. Use of ambiguous and confusing words should be avoided. The title should not be too long. It should contain the key words to reflect the research objectives. It should not usually contain more than 8-10 words. If there are too many words, the title may be broken into main title and sub title. An effective title not only arouses the reader's interest, but, also, steers the researcher towards the proposal in an organized way.

A few examples of good titles are given below.

1. Cost of Cultivation of Paddy in Punjab
2. Changes in Land Holding Pattern in Orissa
3. Participatory Irrigation Management in India
4. Groundwater Management for Agriculture in Uttar Pradesh
5. Economic Impact of Flood in Andhra Pradesh
6. Functioning of Public Distribution System in Bihar
7. Effectiveness of Extension Services in Agriculture in Tamil Nadu

## 4.4 PROBLEM STATEMENT

The introductory section in a research proposal highlights the importance of the study and describes the context in which the study is required. It typically begins with a general statement of the problem area, a focus on a specific research problem, to be followed by the rationale or justification for the proposed study. The introduction generally contains the following components.

1. A statement of the research problem, which is often referred to as the importance of the study.
2. A discussion of the context and definition of your research question in such a way as to show its necessity and importance.
3. The rationale of your proposed study and a clear indication of why it is worth doing.
4. A brief description of the major issues and sub-problems to be addressed by your research.
5. An outline of the boundaries of your proposed research in order to provide a clear focus.

However, try to place your research question in the context of either a current "hot" area, or an older area that remains viable and interesting. Second, provide a brief, but appropriate historical backdrop. Third, provide the contemporary context in which your proposed research question occupies the central stage. Finally, identify key players and refer to the most relevant and representative publications. In short, try to paint your research question in broad brushes, and, at the same time, bring out its

significance. It is pertinent to mention here, that during the line of formulation of a "Problem Statement", you have to take into consideration two vital factors:

(i) criteria for choosing a research topic

(ii) formulating research questions.

### 4.4.1 Criteria for Choosing a Research Topic

Development research is intended to provide information for decision making to promote development, the selection and analysis of the research topic should involve those who are responsible for the development of the community. This would include managers in service delivery, workers in different development sectors and community leaders, as well as researchers. Each topic that is proposed for research has to be judged according to certain guidelines or criteria. There may be several ideas to choose from. The guidelines or criteria for selecting a research topic are as follows

1. Relevance
2. Avoidance of duplication
3. Urgency or timeliness
4. Political acceptability of study
5. Feasibility of study
6. Applicability of results
7. Ethical acceptability

**1. Relevance**

The topic you choose should be a priority problem. Questions to be asked include

How large or widespread is the problem?

Who is affected?

How severe is the problem?

Try to think of serious socio-economic problems that affect a great number of people, or, of the most serious problems that are faced by the managers in the area of your work.

**2. Avoidance of duplication**

Before you decide to carry out a study, it is important that you find out whether the suggested topic has been investigated before, either within the proposed study area or in another area with similar conditions. If the topic has been researched, the results should be reviewed to explore whether major questions that deserve further investigation remain unanswered. If not, another topic should be chosen.

**3. Urgency of data needed (timeliness)**

How urgently are the results needed for making a decision or developing interventions at various levels (from community to policy)? Consider which research should be done first and which can be done later.

**4. Political acceptability**

In general it is advisable to research a topic that has the interest and support of the local/national authorities. This will increase the chance that the results of the study will be implemented. Under certain circumstances, however, you may feel that a study is required to show that the government's policy needs adjustment. If so, you should make an extra effort to involve the policy makers concerned at an early stage, in order to limit the chances of confrontation later.

**5. Feasibility**

Look at the project you are proposing and consider the complexity of the problem and the resources you will require while carrying out your study. Thought should be given first to manpower, time, equipment, and money that are locally available. In situations where the local resources necessary to carry out the project are not sufficient, you might consider resources available at the national level; for example, in research units, research councils or local universities. Finally, explore the possibility of obtaining technical and financial assistance from external sources.

**6. Applicability of possible results/recommendations**

Is it likely that the recommendations from the study will be applied? This will depend not only on the management capability within the team and the readiness of the authorities but also on the availability of resources for implementing the recommendations. Likewise, the opinion of the potential clients and of responsible staff will influence the implementation of recommendations.

**7. Ethical acceptability**

We should always consider the possibility that we may inflict harm on others while carrying out research. Therefore, review the study you are proposing and consider important ethical issues such as:

How acceptable is the research to those who will be studied? (Cultural sensitivity must be given careful consideration). Is the problem shared by the target group and management staff and researchers?

Can informed consent be obtained from the research subjects?

Will the results be shared with those who are being studied? Will the results be helpful in improving the living standard of those being studied?

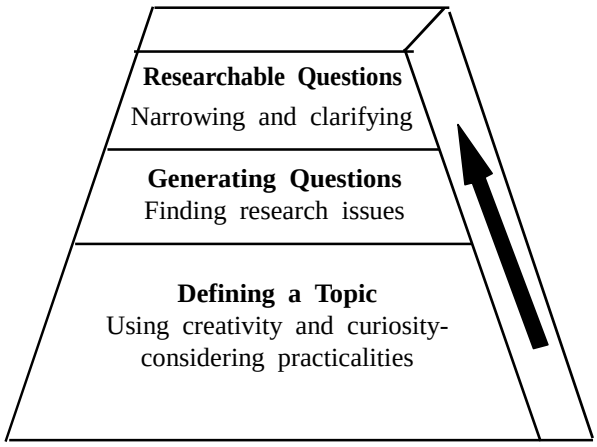


**Fig. 4.1 : From Topics to Researchable Questions**

**Source :** *O'Leary, 2004*

### 4.4.2 Formulating Research Question

Developing a well articulated research question is an important part of the process because it defines the project, sets boundaries, and gives direction. Moving from ideas to researchable question can be daunting. Using insights derived from personal experience, theory, observations, contemporary issues, and engagement with the literature can give you direction for your research. Narrowing, clarifying and even redefining your questions is essential to the research process. Forming the right questions should be seen as an iterative process that is informed by reading and doing, at all stages. Hypotheses are designed to express relationships between variables. If this is the nature of your question, a hypothesis can add to your research. If your question is more descriptive or explorative, generating a hypothesis may not be appropriate. Good research questions need to be: right for you; right for the field; well articulated; doable. Good research questions get approval from experts in the field. A check list for framing a good research question is shown in Table 4.2.

**Table 4.2 Check List for Good Research Question**

| |
|---|
| **IS THE QUESTION RIGHT FOR ME?** |
| Will the question hold my interest? |
| Can I manage any potential biases/subjectivities I may have? |
| **IS THE QUESTION RIGHT FOR THE FIELD?** |
| Will the findings be considered significant? |
| Will it make a contribution? |
| **IS THE QUESTION WELL ARTICULATED?** |
| Are the terms well defined? |
| Are there any unchecked assumptions? |
| **IS THE QUESTION DOABLE?** |
| Can information be collected in an attempt to answer the question? |
| Do I have the skills and expertise necessary to access this information? If not, can the skills be developed? |
| Will I be able to get it all done within my time constraints? |
| Are costs likely to exceed my budget? |
| Are there any potential ethics problems? |
| **DOES THE QUESTION GET APPROVAL FROM EXPERTS?** |
| Do experts in the field think my question is relevant/important/doable? |

**Source :** *O'Leary, 2004*

In this section, you have studied the various steps adopted for the formulation of research project, the title of a research project and problem statement, now answer the questions given in *Check Your Progress-I* .

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Define research and write the different components of a research project proposal.

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2. What criteria should a researcher take into account while choosing a research topic?

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## 4.5 REVIEW OF LITERATURE

Most application forms for research grants include a section called a literature review. The production of new knowledge is fundamentally dependent on past knowledge. If the researcher is not conversant with the existing literature, it is virtually impossible to add to it. Reviewing the literature is an essential part of the research process. It informs, educates, inspires, and enlightens the researcher. It helps in generating ideas, raising questions, and is instrumental in the process of research design. In fact, it is very important to ascertain what information already exists on the research topic, in order to make the best possible use of existing data; avoid duplication; and get a clear idea of what resources are needed for new data collection.

### 4.5.1 Need of Review of Literature

Informing your audience of what is happening in the field.

Establishing your credibility as a knowledgeable and capable researcher.

Arguing the relevance and the significance of your research question(s).

Providing the context for your own methodological approach.

Arguing the relevance and appropriateness of your approach.

### 4.5.2 What are the possible sources of information?

Individuals, groups, and organisations

Published information (books, articles, indexes, abstract journals)

Unpublished information (other research proposals in related fields, reports, records, computer data bases)

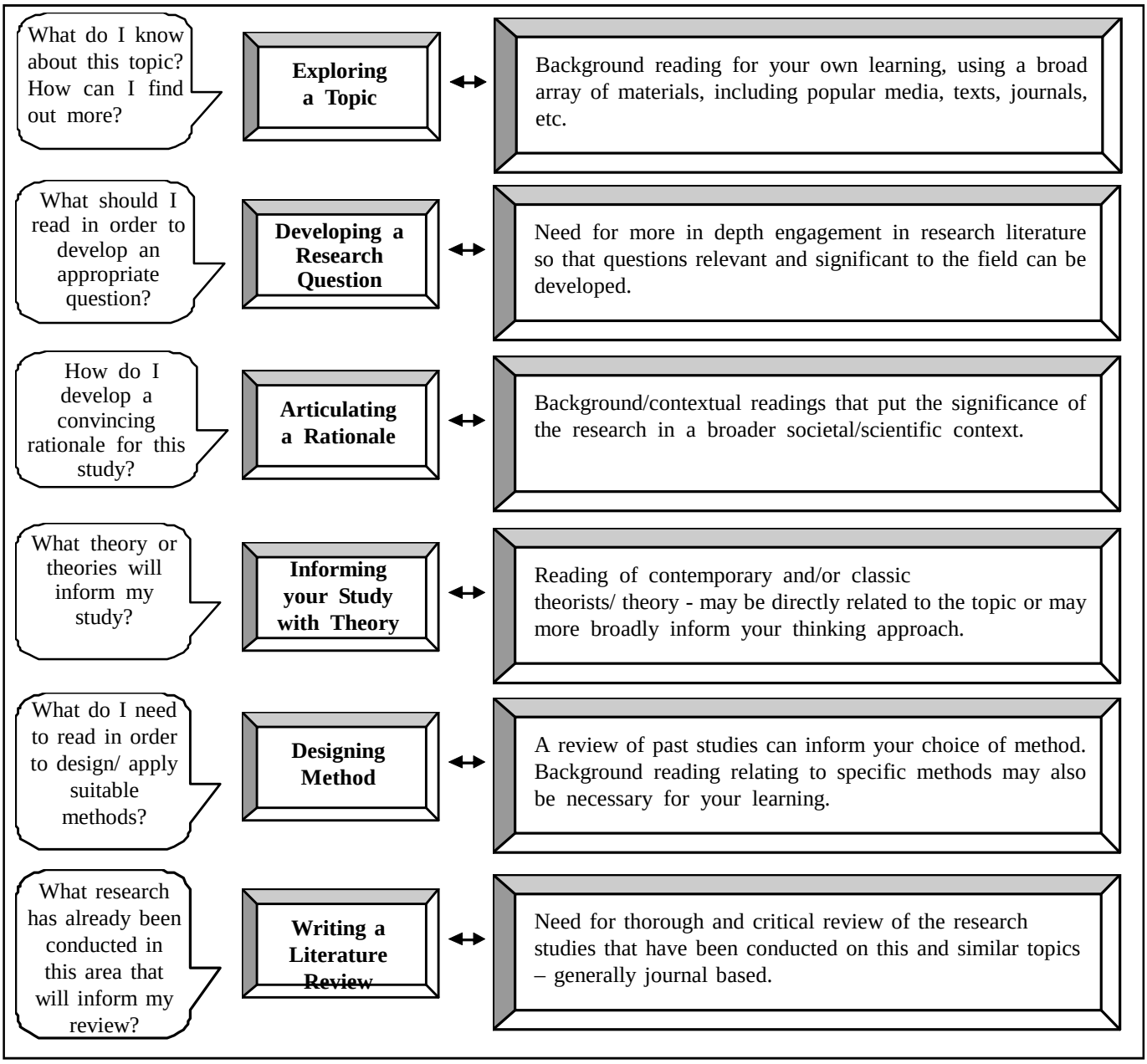
### 4.5.3 Functions of Literature Review

1. Ensures that you are not duplicating work that has been done before.

2. Gives credits to those who have laid the groundwork for your research.
3. Demonstrates your knowledge of the research problem.
4. Demonstrates your understanding of the theoretical and research issues related to your research question.
5. Shows your ability to critically evaluate relevant literature information.
6. Indicates your ability to integrate and synthesize the existing literature.
7. Provides new theoretical insights or develops a new model as the conceptual framework for your research.
8. Convinces your reader that your proposed research will make a significant and substantial contribution to the literature (i.e., resolving an important theoretical issue or filling a major gap in the literature).

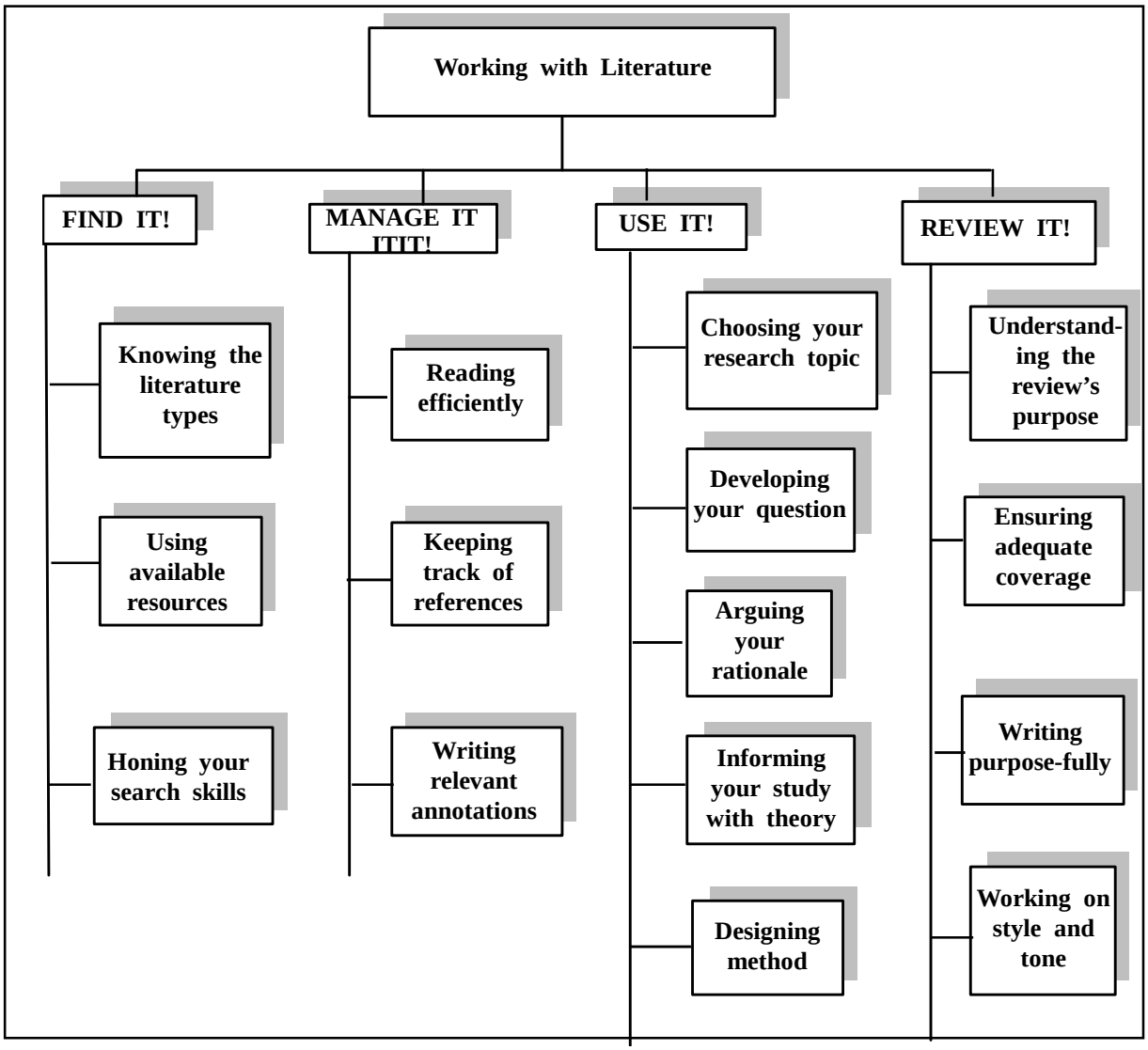
The functions of the literature review in the research process are shown with more clarity in the following schematic diagrams.

**Fig 4.2 Literature and the Research Process**




**Source :** *O'Leary, 2004*

**Fig 4.3 How to work with literature is indicated in the following flow chart**




**Source :** *O'Leary, 2004*

### 4.5.4 Problems in Reviewing Literature

In most cases, the literature reviews suffer from the following problems.

Lack of organization and structure

Lack of focus, unity and coherence

Being repetitive and verbose

Failing to cite influential papers

Failing to keep up with recent developments

Failing to critically evaluate cited papers

Citing irrelevant or trivial references

Depending too much on secondary sources

Your scholarship and research competence will be questioned if any of the above applies to your proposal.

There are different ways to organize your literature. Once you have read a number of different sources and thought about them, the next step is to bring these together under different themes. Writing up a literature review is not about summarizing and describing the points made by each author you have read. Instead, your review should be a coherent argument where you analyse the arguments of others. You have an important role in synthesizing different people's work on a particular theme and by doing this you are adding value to this work by presenting it in a new light. Writing a good review is therefore quite a specific skill.

## 4.6 OBJECTIVES OF RESEARCH

Having identified a real world problem and framed it in terms of its relevance to a policy maker, the researcher must, then, pose an answerable research question or hypothesis. This essentially defines the objective of the project.

The objective of a certain research summarizes what is to be achieved by the study. It should clearly define the question for which a solution is being sought. You should consider the following points on stating research objectives in order to

be clearly related to the statement of the problem

cover the different aspects of the problem

be clearly phrased in operational terms specifying exactly what you are going to do, where and for what purpose.

be realistic considering local conditions and available resources.

use specific action verbs i.e. to determine, to identify, to verify, to describe, to calculate.

avoid vague non-action verbs i.e. to study, to appreciate, to understand.

The research objectives are classified into two types, general and specific.

### 4.6.1 General Objectives

These will define what is expected to be achieved by the study in general terms. For example, if the research problem chosen is "Atrocities against tribals in the Area X", the general objective could be "to identify the reasons for atrocities against tribals in the Area X, so as to suggest remedial measures".

### 4.6.2 Specific Objectives

Here, the general objective is broken down into smaller and logically connected units to address the various aspects of the problem and the key factors that are assumed to cause or influence the problem. The specific objectives of a research work should focus on the following points:

To identify the distribution and patterns of a problem.

To examine the possible factors that may influence the problem.

To indicate how the research results will be used.

Returning to our example on atrocities against tribals, the specific objectives for a research work in this problem could be set in the following manner:

To determine the prevalence of atrocities against tribals in the Area X.

To‘ identify the socio-economic characteristics of the exploited tribals and the exploiters.

To examine the mode of exploitation and oppression of the tribals in the Area X.

To identify the socioeconomic and cultural factors that may influence atrocities against tribals in the Area X.

In addition to objectives, a set of hypotheses can be formulated in some studies. An hypothesis can be defined as, a ‘Logical conjecture (hunch or educated guess) about the nature of relationships between two or more variables expressed in the form of a testable statement’. A hypothesis is a suggested or assumed explanation for the research problem that can be tested. It is a prediction for a relationship between one or more factor and the problem under study. In our example above about atrocities against tribals we can formulate and test the following hypotheses:

The higher caste, landowning, non-tribals attack and exploit the tribals from poor socioeconomic backgrounds.

Women, children, and elderly tribals are more vulnerable to such violence.

Police inaction/leniency is the root cause of persistence of atrocities against tribals.

Now that you are familiar with the various steps of research project proposal like review of literature and objectives of research, answer the questions given in *Check Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Explain the functions of a literature review in formulating a research proposal.

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2. Do you remember some important points which help to formulate a research objective?

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## 4.7 METHODOLOGY

This is one of the most important steps in designing a research project. The reviewers of the project proposal usually pay utmost attention to the methodology aspect to examine whether the project is doable or not given the time and budget limit. The guiding principle for writing the methodology section is that it should contain sufficient information for the reader to determine whether the methodology is sound. Some even argue that a good proposal should contain sufficient details for another qualified researcher to implement the study. The methodology should be as explicit as possible, identifying the research sites; sample size for surveys; method for stratification of samples; frequency of surveys (e.g., one-shot or repeated); and so on. Pre-tests of questionnaires are highly recommended. You need to demonstrate your knowledge of alternative methods and make the case that your approach is the most appropriate and most valid way to address your research question.

There are mainly two types of research with regard to methodology: qualitative and quantitative. There are no well-established or widely accepted canons in qualitative analysis. If you are doing qualitative research, your method section needs to be more elaborate than what is required for traditional quantitative research. More importantly, the data collection process in qualitative research has a far greater impact on the results as compared to quantitative research. That is another reason for greater care in describing how you will collect and analyze your data.

For quantitative studies, the method section is typically outlined by the following sections.

1. **Design** - Is it a questionnaire study or a participant observation? What kind of design do you choose?
2. **Respondents or participants** - Who will take part in your study? What kind of sampling procedure do you use? Census or sample survey?
3. **Tools-** What kind of tools or questionnaires do you use? Why do you choose them? Are they valid and reliable?
4. **Procedure** -How do you plan to carry out your study? What activities are involved? How long does it take?

In light of the questions raised or the hypotheses proposed to be tested, sampling becomes necessary, and full information on the following points should be provided:

(1) Universe of study

(2) Sampling frame

(3) Sampling procedure

(4) Units of observation and sampling size

If the study requires any control groups, these should be specifically mentioned. An explanation of the determination of size and type of sample will also be necessary. Proposals that do not require a sample selection should specify their strategy appropriately, and describe the rationale.

### 4.7.1 Data Collection

The different types of data that are proposed to be collected should be specifically mentioned. The sources for each type of data and the tools and techniques that will be used for collecting different types of data should be specified.

a) For the questionnaire or schedule to be used, the following points should be covered.

   (1) Distribution of questionnaire or schedule in different sections, e.g. identification data, socio-economic data, questions on various sub-themes.

   (2) The approximate number of questions to be asked from each respondent.

   (3) The scaling techniques to be included in the instrument.

   (4) The approximate time needed for the interview.

   (5) Plans, if any, for index construction.

   (6) A coding plan (whether the questions and responses will be pre-coded or not; whether the coding is done for computer, or for hand tabulation).

b) For interviews, provide the following details.

   (1) How they are to be conducted (free associational, non-directive, focused, direct or on telephone)?

   (2) Particular characteristics that interviews must have.

c) Describe how the observation technique will be used.

   (1) Provide the type of observation: participant, quasi-participant, non-participant.

   (2) Provide the units of observation.

   (3) Will this be the only technique or will other techniques also be employed?

### 4.7.2 Editing

During editing, look for

completeness of responses. (Note that a blank space may mean ‘no response’ or ‘don’t know’, unless you’ve made a category for each of these responses)

logical inconsistencies, correcting them whenever possible

the possibility of combining responses, if that is more suitable for analysis.

Editing should be done by the research team, or under its direction. If several persons are involved in editing, as in the case of large surveys, an editing manual should be compiled beforehand.

### 4.7.3 Training of Research Team Members

The research team including, in particular, research assistants who join just before the pre-test, must be given explicit training. They should not only

be able to collect data properly but also understand other procedures such as the selection of sampling units, map reading and data handling. They may also be involved in the pre-test and in the adjustment of instruction sheets and data collection tools after the pre-test.

The training programme usually consists of

discussion on the objectives and methodology of the study

reading of manuals or instruction sheets prepared for the study

interview training

field experience (this should include participation in the pre-test described below)

discussion on data-collection tools and instruction sheets and how they need to be adjusted (based on field-testing).

The research assistants should be trained together with the whole team, including possible additional supervisors.

### 4.7.4 Pre-test or Pilot study of the Methodology

A pre-test usually refers to a small-scale trial of particular research components. The pre-test should assess the validity of the data-collection instruments and procedures, as well as the sampling procedures. A pilot study is the process of carrying out a preliminary study, going through the entire research procedure with a small sample. A pre-test or a pilot study serves as a trial run that allows us to identify potential problems in the proposed study. Although this means extra effort at the beginning of a research project, the pre-test and/or pilot study enables us, if necessary, to revise the methods and logistics of data collection before starting the actual fieldwork. As a result, a good deal of time, effort and money can be saved in the long run. Pre-testing is simpler and less time consuming and costly than conducting an entire pilot study.

**What aspects of your research methodology can be evaluated during pre-testing?**

1. Reactions of the respondents to the research procedures can be observed in the pre-test to determine

   availability of the study population and how respondents' daily work schedules can best be respected

   acceptability of the methods used to establish contact with the study population

   acceptability of the questions asked

   willingness of the respondents to answer the questions and collaborate with the study.

2. Data collection tools can be pre-tested to determine the following points

   Pre-tests show you whether the tools you use allow you to collect the information you need, and whether those tools are reliable. You may find that some of the data collected is not relevant to the problem, or, is not in a form suitable for analysis. This is

the time to decide not to collect this data, or, to consider using alternative techniques that will produce data in a more usable form.

How much time is needed to administer the interview guide or questionnaire, to conduct observations, or group interviews, and/ or to make measurements?

3. Whether there is any need to revise the format or presentation of interview guides/ questionnaires, including whether:

   the sequence of questions is logical

   the wording of the questions is clear

   translations are accurate

   space for answers is sufficient

   there is a need to pre-categorise some answers or to change closed questions into open- ended questions.

   there is a need to adjust the coding system

   There is a need for additional instructions for interviewers (e.g., guidelines for 'probing' certain open questions).

4. Sampling procedures can be checked to determine

   whether the instructions concerning how to select the sample are followed in the same way by all staff involved

   how much time is needed to locate individuals to be included in the study.

5. Staffing and activities of the research team can be checked, while all are participating in the pre-test, to determine

   how successful the training of the research team has been

   what the work output of each member of the staff is

   how well the research team works together

   whether logistical support is adequate

   the reliability of the results when instruments or tests are administered by different members of the research team

   whether staff supervision is adequate

### 4.7.5 Data Processing and Analysis

You need to mention how different types of collected data will be processed. How will data be entered in the computer by using a master sheet? Which computer software will be used to enter and analyse the data? Usually, in most social science research, MS-Excel is used for data entry, and SPSS (Statistical Package for Social Science) is used for analysis. Which type of statistical analysis will be applied to test the hypotheses? You may use simple average, standard deviation, or regression analysis. For interpreting the data more accurately, sometimes more advanced econometric techniques may also be used.

## 4.8 WORK SCHEDULE/ TIME FRAME

The project should be broken up in suitable stages and the time required for the completion of each stage of work should be specified. Such stages may cover

- preparatory work, including selection and appointment of staff and their training
- literature review
- data collection from secondary sources
- preparation of questionnaire and pre testing
- pilot study, if any
- drawing of sample
- data collection from primary sources
- data processing (which should include coding, editing, verification, sorting, and computer analysis)
- data analysis
- report writing

The timetable should allow adequate time for each stage to carry the project through to completion. A work schedule is a table that summarises the tasks to be performed in a research project, the duration of each activity, and who is responsible for the different tasks.

The work schedule includes

- the tasks to be performed
- the dates each task should begin and be completed
- research team, research assistants and support staff ( typists) assigned to the tasks
- person-days required by research team members, research assistants and support staff.

## 4.9 BUDGET

The budget should specify the resources needed to carry out all the tasks specified above. The budget for research work is essentially a document of its expenses. While constructing a budget, one should adopt a bottom up approach. For example, if fieldwork is involved, the budget for that item should be calculated by estimating the number of trips required, their duration and mileage, and so on.

The research proposal is required to outline the capital and running costs together with the hidden costs such as the use of already existing laboratories, libraries and computer facilities and technical and secretarial help, in addition to the costs of travel of researchers and subjects. A portion of the proposed budget should be reserved for the unforeseen costs. A fully itemized budget is necessary as granting bodies require a detailed breakdown of the costs of the projects. The golden rule is not to ask for too much or too little. It is wise to find out in advance the likely figure a particular granting authority will allow for a work of the type proposed (which

provides a ceiling for the budget). A narrative portion of the budget is used to explain any unusual items in the budget. If the costs are straightforward no explanation is needed. If the narrative is needed it can be structured in two ways.

1. Create "notes to the budget" with footnote style numbers on the line items in the budget, keyed to the numbered explanations.
2. Or, if extensive or more general explanation is required, the budget narrative can be structured as straight text.

The cost of the project is to be estimated in terms of total man-month and the facilities needed. Calculate it under the headings that follow.

(1) Personnel

(2) Travel

(3) Data Processing

(4) Stationery and printing

(5) Equipment

(6) Books and journals etc.

(7) Contingency expenses including postage

(8) Any other (specify)

(9) Overhead charges

(10) Grand total

While suggesting budget estimates for your research proposal, the project director should take into account the time budget, as well as various steps involved in the conduct of the research proposal. The rationale for the allocation of time and money for the various items of budget estimates must be furnished.

### 4.9.1 How Should a Budget be Prepared?

It is necessary to use the work plan as a starting point. Specify, for each activity in the work plan, what resources are required. Determine these for each resources needed, as well as the unit cost and the total cost. Example, in the work plan of a study to determine factors affecting farmers' suicides in Andhra Pradesh, it is specified that 5 field investigators will each visit 20 households, one per working day, as 100 households of deceased farmers will need to be visited. With two vehicles this amounts to 20 working days. Each research team member will be accompanied by one of the research assistants. The budget for the fieldwork component of the work plan will include funds for personnel salary, transport expenses, accommodation and daily allowances as outlined below.

(a) Remuneration

  (i) Two Field Investigators for 20 days

  (ii) Two Field Assistants for 20 days

(b) Expenses for hiring two vehicles for 20 days

  (i) Daily Allowance for the two field investigators for 20 days and two field assistants for 20 days

(c) Hotel accommodation expenses

(i) Two Field Investigators for 20 days

(ii) Two Field Assistants for 20 days

## 4.10 DISSEMINATION STRATEGY

The research findings should be disseminated to policy makers, planners, practitioners and other researchers for their consideration and reaction. There are various ways to publicise your research output as indicated below.

Through seminars and workshops, organized to provide a forum for sharing experiences and research findings among academicians, administrators, executives, scientists, policy makers.

Conducting awareness meetings in the study areas and to receive the feedback from the community.

Presenting the research findings in national and international seminars and workshops and publish research papers in research journals.

Publishing popular articles in daily news papers and magazines, preferably in regional languages.

Holding issue-based group discussion and talks on project findings in radio and television.

Entering the findings into worldwide website network for wider dissemination of findings.

Translating the findings into regional language and publish brochures and pamphlets and circulate among interested readers.

## 4.11 REFERENCES

You always need to reference all the literature that you refer to in your proposal. When you use the Vancouver system, you will use consecutive numbers in the text to indicate your references. At the end of your proposal you will then list your references in that order, using the format described above. If your research proposal has annexure, the references will come before the annexure.

⇒ **Activity 1:** Prepare a research proposal for assessing the impact of air pollution on the health of inhabitants in Delhi.

Alternatively, you can use the Harvard system and refer to the references more fully in the text, putting the surname of the author, year of publication and number(s) of page(s) referred to between brackets, e.g., (Basu 1998:15-17). If this system of citation is used, the references at the end of the proposal should be listed in alphabetical order. The Harvard author/date system of referencing seems easier, as you can change the order of paragraphs without consequences for your referral system. However at present, computers have programmes that change the numbers of your references automatically if you reshuffle the text while using the Vancouver system.

In this section, you studied methodology, work schedule/time frame, budget and dissemination strategy, now answer the questions given in *Check Your Progress-3*.

**Check Your Progress 3**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Write short notes on the following: a) pilot study and b) pre-testing.

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2. Write the names of some data collection tools and techniques in social science research?

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## 4.12 LET US SUM UP

The first step in any research project is to write a research proposal. The research proposal details the research problem that you are interested to study, and shows the road map to undertaking the research project. At the outset the researcher has to choose a topic after doing the extensive review of literature and rationale behind choosing the topic. Then, the researcher has to give a detail of methodology of how to conduct the study including spelling the area, sample, tools for data collection and analysis technique. Next, the researcher has to clearly indicate the time frame on the budget required for undertaking the research work. Nowadays, the bilateral of organizations and government funded projects require the dissemination strategies to be used for the wider circulation of research findings.

## 4.13 REFERENCES AND SELECTED READINGS

Jay P. M. and WallerD. S. (2005), Designing and Managing a Research Project: A Business Student's Guide, Response Books, New Delhi.

O'Leary Zina (2004), *The Essential Guide to Doing Research*, Vistaar Publications, New Delhi.

Vandana D. and Potter R. B. (eds.), (2006), Doing Development Research, Sage and Vistaar Publications, New Delhi.

Varkevisser C. M., Pathmanathan I. and Brownlee A. (1991), Designing and conducting Health Systems Research projects. Part I: Proposal development and fieldwork; Part II: Data analysis and report writing. Ottawa: Health Sciences Division of the International Development Research Centre (IDRC) and Geneva: Programme on Health Systems Research and Development of the World Health Organisation.

## 4.14 CHECK YOUR PROGRESS - POSSIBLE ANSWERS

**Check Your Progress 1**

1. Research is the systematic collection, analysis, and interpretation of data to answer a certain question or solve a problem. The different components of a research project proposal are (i) general introduction/ background/ importance of study problem; (ii) review of relevant literature; (iii) objectives; (iv) methodology; (v) time frame; (vi) budget, and (vii) references

2. Each topic that is proposed for research has to be judged according to certain guidelines or criteria. There may be several ideas to choose from. The guidelines or criteria for selecting a research topic are: relevance, avoidance of duplication, urgency of data needed, political acceptability of the study, applicability of results, and ethical acceptability.

**Check Your Progress 2**

1. The functions of the literature review in the research process are

   a. Ensures that work is not duplicated

   b. Give credit to those who have laid the groundwork for your research

   c. Demonstrate knowledge of the research problem

   d. Demonstrates your understanding of the theoretical and research issues

   e. Show an ability to critically evaluate relevant literature information

   f. Indicates the ability to integrate and synthesize the existing literature

2. The following are some of the important points to formulate research objectives:

   To be clearly related to the statement of the problem.

   To be clearly phrased in operational terms, specifying exactly what you are going to do, where, and for what purpose.

   To be realistic considering local conditions and available resources.

   To use specific action verbs (i.e., to determine, to identify, etc.) and to avoid vague non-action verbs (i.e., to study, to appreciate, to understand, etc.).

**Check Your Progress 3**

1. a) Pre-test refers to a small-scale trial of specific research components. The pre-test should assess the validity of the data collection instruments and procedures, as well as the sampling procedures. b) A Pilot Study is the process of carrying out a preliminary study, going through the entire research procedure with a small sample.

2. In social science research, various types of techniques and tools are used for data collection. But most the important tools and techniques for data collection are: a) questionnaire and schedule b) interviews c) observation techniques, etc.

# MDV-106: RESEARCH METHODOLOGY IN DEVELOPMENT STUDIES

(6 CREDITS)

| BLOCK | UNIT NOS | UNIT TITLES |
|---|---|---|
| **1** | | **Fundamentals of Social Science Research** |
| | **1** | **Social Science Research: An Overview** |
| | **2** | **Components of Social Science Research** |
| | **3** | **Research Designs** |
| | **4** | **Research Project Formulation** |
| 2 | | **Development Research** |
| | 1 | Basics of Development Research |
| | 2 | Methods of Development Research |
| | 3 | Development Research Applications |
| **3** | | **Measurement and Sampling** |
| | 1 | Measurement |
| | 2 | Scales and Tests |
| | 3 | Reliability and Validity |
| | 4 | Sampling |
| 4 | | **Data Collection** |
| | 1 | Quantitative Data Collection Methods and Devises |
| | 2 | Qualitative Data Collection Methods and Devises |
| | 3 | Data Sources |
| 5 | | **Data Analysis** |
| | 1 | Overview of Statistical Tools |
| | 2 | Use of Computer in Data Analysis |
| | 3 | Data Processing and Analysis |
| | 4 | Report Writing |

Indira Gandhi National Open University
School of Extension and Development Studies

# MDV-106
# Research Methodology in Development Studies

Block

# 2

## DEVELOPMENT RESEARCH

**UNIT 1**
**Basics of Development Research** **5**

**UNIT 2**
**Methods of Development Research** **22**

**UNIT 3**
**Development Research Applications** **38**

## PROGRAMME DESIGN COMMITTEE


Prof. Amita Shah
Gujarat Institute of Development Research, Ahmedabad

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

Prof. J. S. Gandhi (Rtd)
Jawaharlal Nehru University, New Delhi

Prof. Gopal Krishnan (Rtd)
Punjab University, Chandigarh

Prof. S. Janakrajan
Madras Institute of Development Studies, Chennai

Prof. Kumar B. Das
Utkal University, Bhubaneswar

Prof. Nadeem Mohsin (Rtd)
A.N.Sinha Institute of Social Sciences, Patna

Prof. P. Radhakrishan
Madras Institute of Development Studies, Chennai

Prof. Ramashray Roy (Rtd)
Centre for Study of Developing Societies, Delhi

Prof. R. P. Singh ( Rtd)
Ex-Vice-Chancellor, MPUAT, Udaipur

Prof. K. Vijayaraghavan
Indian Agriculture Research Institute, New Delhi

Dr. Nilima Shrivastava
IGNOU, New Delhi

Prof. B. K. Pattanaik
IGNOU, New Delhi

Dr. Nehal A. Farooquee
IGNOU, New Delhi

Dr. P.V.K.Sasidhar
IGNOU, New Delhi


## PROGRAMME DESIGN COMMITTEE (REVISED)


Prof. T.S. Papola
Institute for Studies in Industrial Development, New Delhi

Prof. S. Janakrajan
Madras Institute of Development Studies, Chennai.

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

Prof. Preet Rustagi
Institute for Human Development, Delhi

Prof. Gopal Iyer (Rtd)
Panjab University, Chandigarh

Dr. S. Srinivasa Rao
Jawaharlal Nehru University, New Delhi

Dr. S. Rubina Naqvi
Hindu College, University of Delhi, Delhi

Prof. Nadeem Mohsin (Rtd)
A.N.Sinha Institute of Social Sciences, Patna

Prof. Rajesh
University of Delhi, New Delhi

Prof. B. K. Pattanaik
IGNOU, New Delhi

Prof. Nehal A. Farooquee
IGNOU, New Delhi

Prof. P.V.K. Sasidhar
IGNOU, New Delhi

Dr. Pradeep Kumar
IGNOU, New Delhi

Dr. Nisha Varghese
IGNOU, New Delhi

Dr. Grace Don Nemching
IGNOU, New Delhi


## COURSE PREPARATION TEAM


**Unit Writer:**

Prof. .N. Narayanasamy
Gandhigram Rural Institute - Deemed University
Gandhigram (Units 1, 2 and 3).

**Editors:**

Prof. V.K.Jain (Rtd) (Content Editor)
NCERT, New Delhi

Mr. Praveer Shukla (Language Editor) New Delhi
Dr. Nisha Varghese, IGNOU

Prof. B. K. Pattanaick, IGNOU

Prof. Nehal A. Farooquee, IGNOU

Prof. P.V.K. Sasidhar, IGNOU

**Course Coordinator :** Dr. Nisha Varghese, E-mail : nishavarghese@ignou.ac.in

**Programme Coordinators :** Prof. P.V.K. Sasidhar, Prof. B.K. Pattanaik, Prof. Nehal A. Farooquee,


## PRINT PRODUCTION


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# BLOCK 2 DEVELOPMENT RESEARCH

Block-2 of Course MDV-106 consists of three units namely Basics of Development Research, Methods of Development Research and Development Research Applications.

Unit-1 on **'Basics of Development Research'**, introduces meaning and concept of development research, purpose of development research, types of development research, approaches to research in development work, conditions for development research, key principles of development research, community consultation and development research. This unit also discusses conventional research vs development research, the roles required of a development researcher, outcome of development research and limitations of development research.

Unit-2 on **'Methods of Development Research',** gives an account of various methods of development research namely, direct observation, interviewing, focus group discussion, case study method and processes of development research.

Unit-3 on **'Development Research Applications',** discusses application of development research, appraisal of existing situation, need assessment, stakeholders' analysis, formulation of development project, monitoring of development projects and participatory evaluation.

# UNIT 1 BASICS OF DEVELOPMENT RESEARCH

## Structure

1.1 Introduction

1.2 Concept and Purpose of Development Research

1.3 Approaches to Development Research

1.4 Types of Research in Development Work

1.5 Conditions and Key Principles of Development Research

1.6 Community Consultation and Development Research

1.7 Conventional Research and Development Research

1.8 The Roles Required of a Development Researcher

1.9 The Outcomes of Development Research

1.10 The Limitations of Development Research

1.11 Let Us Sum Up

1.12 Key Words

1.13 References and Selected Readings

1.14 Check Your Progress - Possible Answers

## 1.1 INTRODUCTION

We have seen in the previous block that research is an 'organized inquiry'. It is a systematic and logical study of an issue, a problem, or a phenomenon through scientific methods. We have also seen that social sciences research uses various methods, such as surveys, case studies, experiments, observations, and so on. They are all time-tested methods and are widely used. They have inherent merits and strengths. Yet, they do have certain limitations and shortcomings, especially when they are applied in development-related issues and initiatives especially at the micro level. The limitations include: i) top-down orientation and approach with limited scope for the participation of the respondents or subjects of research; ii) the use of one or two methods of enquiry (mono-method bias) which invariably fails to capture the complexities of various issues at the grassroots level; iii) rigidity, or a blueprint approach adopted in the research process restricting the researcher to see beyond what is in the design; iv) research that take a long time to complete, making the data and information out of date; and v) absence of avenues to share the findings of the research with the subjects of research resulting in the denial of opportunities for the respondents to know the outcome of research. These limitations act as barriers and impediments in taking the benefits of development initiatives and interventions to the people, especially at the grassroots level. Experience has shown that the people, especially the deprived, underprivileged, and marginalized sections of society are excluded from the process of development. Hence, the development facilitators, in order to enable the people to be part and parcel of development process, have come out with alternative ways of doing research which include improvisation of the existing methods and innovation

of new methods. These methods are employed in different stages/phases of development such as the appraisal of existing situation, identifying and prioritizing the problems and needs, finding solutions, preparing development proposal, implementing, monitoring and evaluating projects, and learning lessons from the process, and reflecting on them for future guidance. The outcome of all these efforts is the emergence of the concept of development research.

After studying this unit you should be able to

- explain the meaning, concept and purpose of development research
- differentiate the types and approaches to development research
- describe the key principles of development research
- list the differences between conventional research and development research
- identify the roles required of a development researcher
- explain the outcome and limitations of development research.

## 1.2 CONCEPT AND PURPOSE OF DEVELOPMENT RESEARCH

You will be able to understand the meaning and concept of development research only when you understand the concept of development. Hence, a brief introduction to the concept of development is presented which would be followed by the concept of development research.

Development means a desirable change. The goal of development is wellbeing for all. Wellbeing denotes the experience of good quality life which includes better living standards, access to basic services such as basic education and health care, good relation with others, friendship, love, peace of mind, choice, creativity, fulfilment and fun, and freedom from fear. The means of wellbeing are livelihood security and capability. Livelihood can be defined as adequate stocks and flow of goods and cash to meet basic needs and to support wellbeing. Security refers to reliable access to five types of capital or assets viz., natural, human, physical, financial and social, which in turn, provide secured rights and reliable access to food, income, and basic services. Capability refers to what people are capable of doing and being. Capabilities can be enhanced through learning, practice and training. They help in achieving livelihood security. Principles underlying the objective of wellbeing are equality and sustainability. Equity refers to human rights and gender equity. Sustainability refers to development that meets the needs of the present without compromising the ability of the future to meet their own needs. Development research largely deals with the issues related to livelihood security, capability, resources associated with livelihood security, and the principles that govern the ends and means of development.

Development research is utility oriented. It must be noted that it is not pure or basic research. It is applied, application-oriented, and action-oriented research. It is not aimed at contributing to, or extending the knowledge in a given field. Yet, it has a tendency to contribute to the knowledge in a given field or sector towards better practice. It is the knowledge that

enhances the way development practice takes place. It expands avenues for better comprehension of issues and intricacies which results in enhancing the effectiveness of development practice.

### 1.2.1 Concept of Development Research

Development research aims at providing knowledge on which the best decisions can be made. The target may be to solve specific policy related problems, or to help practitioners accomplish tasks. It means to say that research is used in development work for a variety of purposes. It may set out to explore an issue in order to plan a programme; it may, more broadly, ask people in an area about their own needs; or, it may aim to collect in-depth information about a specific issue, to find out a case for change. It may also aid in monitoring, evaluating, reviewing, and reflecting the outcome of a development programme. It can range from comparing a small piece of existing data to major international projects.

Development practitioners, in their ordinary work, do some things that are similar to researchers. They are very likely to undertake situation analysis and need assessment. They investigate people's opinions and probe their explanations for problems in their lives. They work with people to help them to analyse their situations – to make sense of things beyond the individual. Development researchers do some of the same methods as researchers, but the way in which things are done will be somewhat different. Both may conduct interviews, undertake observation, hold group discussions, and ask groups what is most important to them. However, development researchers do differ from conventional researchers as they generally specialise in being with people in an informal way. They treat people as partners and collaborators in their research. They consider themselves as learners and actively listen to the voice of the people. They respect the knowledge and wisdom of the people. They strongly believe in the culture of sharing. They have unshakable conviction that any development research can be done only when the subjects of research play a predominant role in different phases of research and action. All these are based on mutual trust which is being gradually developed at different stages of the development research. The skills and knowledge of the development worker have a great deal to contribute towards research processes. One key role is identifying issues on which research is required.

Development workers are in the business of creating social change, and need to take a pragmatic approach to the use of research in their work. Policy makers rarely commission such research, at least, compared to investments for development itself. Its characteristics and added value demand better theoretical articulation, more empirical evidence, wider application in development practices, and a more prominent place in professional and scientific publications. There is a broad variety of activities, with different emphasis in their primary aims, under the main umbrella of development research. Also, on a rather abstract level, one can distil a very general aim of all approaches: reducing uncertainty of decision making in developing interventions. The term 'intervention' then serves as common denominator for programs, procedures, scenarios, processes, and the like. That general aim can be specified in two more specific goals that apply to those approaches in various degrees: (a) providing ideas (suggestions, directions) for optimizing the quality of the intervention to be developed;

and (b) generating, articulating, and testing principles. These principles can be of a substantive nature, referring to characteristics of the intervention (what it should look like), or, of a procedural nature (how it should be developed).

### 1.2.2 Purpose of Development Research

There can be various purposes for conducting development research. A basic motive stems from the experience that traditional research approaches (e.g., experiments, surveys, correlation analyses) with their focus on descriptive knowledge, hardly provide prescriptions with useful solutions for a variety of development problems. Probably the greatest challenge for a development worker is how to cope with the manifold uncertainties in their complex tasks in very dynamic contexts. If they do seek support from research to reduce those uncertainties, several frustrations often arise: answers are too narrow to be meaningful, too superficial to be instrumental, too artificial to be relevant, and, on top of that, they usually come too late to be of any use.

Optimization of intervention is especially oriented towards practical ends in a given situation. An additional objective is also visible in various approaches stimulating professional development of participants. This motive even appears to be in the forefront of many 'action research' activities.

## 1.3 APPROACHES TO DEVELOPMENT RESEARCH

Development research is a rather volatile term that has known changing connotations over the last decades, in various contexts. In practice, it often refers to activities that almost exclusively convey the 'action' component and lack an explicit, scholarly orientation on contributions to knowledge that is accessible to others. An approach which is to be subsumed under the heading of development research must possess more balance between development and research.

Another way to differentiate between various types of development research is to focus on the temporal relation between development activities on one hand, and the research activities on the other: is the research concentrated in the stages before, during, or after the bulk of development activities?

In their overview of developmental research, Richey and Nelson (1996) distinguish between type I and type II approaches. Type I refers to an approach in which the roles of researcher (partly) coincide within a specific development context. Such research usually occurs throughout the complete development cycle. In type II, however, that relationship is more loose; the researchers are not involved in the development process themselves, but they study those processes (including tools and models applied) as practiced by others, in order to come to conclusions concerning principles of generalizable nature.

Some of the approaches to development research are discussed below:

**(i) Explorative Design Studies:** the first type worth mentioning is explorative design studies. The activities undertaken under this type precede the actual development work and aim at clarifying the design

problem-in-context, and at generating tentative design ideas. Such explorations can be very valuable in directing the development work. However, we may not include these studies under the heading of scientific research, because they do not aim at statements of a more or less generalizable nature.

**(ii) Formative studies:** the research activities performed during the entire development process of a specific intervention, from exploratory studies through (formative and summative) evaluation studies are known as formative research. It aims at optimization of the quality of the intervention, as well as testing development strategies and principles.

**(iii) Reconstructive Studies:** the research activities conducted sometimes during, but often, after the development process of several interventions are known as reconstructive studies. They focus on the articulation and specification of strategies, and principles of development.

Obviously, this typology does not pay justice to many possible differences and linkages between various sorts of development research. The boundaries and labels are not very strict (for example, exploratory design studies often convert to formative research) but they do make a distinction between approaches with relatively different emphasis.

In this section, you studied the concept and purpose of development research, and approaches to development research. Now, answer the questions given in *Check Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is developmental research? Explain briefly.

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2. What are the different approaches to developmental research?

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## 1.4 TYPES OF RESEARCH IN DEVELOPMENT WORK

In development work, research is undertaken for two main reasons. They are: informing about the programme (either as needs assessment before starting, or, as monitoring and evaluation as the programme develops); or,

to learn more about issues with a view to influencing policy. Based on focussed development, research can be broadly classified as under: (i) policy focused research; and (ii) programme focused research.

**(i) Policy Focused Research**

Raising a new issue in the public domain

Putting forward a new perspective on a live issue

Producing strong evidence of the benefit or harm of a particular policy

Drawing together and learning from different studies to support a policy position

**(ii) Programme Focused Research**

Investigating the needs of a community, or specific group of people

Investigating the need for a particular programme

Demonstrating convincingly the effectiveness of a particular programme (evaluation)

## 1.5 CONDITIONS AND KEY PRINCIPLES OF DEVELOPMENT RESEARCH

### 1.5.1 Conditions of Development Research

The conditions required for development research can be categorised into two. These are:

**(i) When research may be an effective approach**

When no one has much information on a situation

When there is only anecdotal evidence of a hidden problem

When the group you are working with feels that their point of view has not been heard

When-policy makers, e.g., in government, are considering a policy change and want to investigate its possible impact

When it is important to show that you have accurately represented people's views

When you know that past attempts to address this issue through programmes have not produced proper results.

**(ii) When research is not likely to be helpful**

When it is clear what needs to be done, but no one is getting on with it

When you are trying to decide where to start the programme, in a known environment

When political conflict or state repression is particularly intense

When communities have already been the subject of many research projects

When the primary concern is to increase people's participation, and build their personal development, rather than to act upon research findings

Where there are no resources to follow up research with any action

To avoid making a decision

### 1.5.2 Key Principles of Development Research

Development research is often initiated for complex, innovative tasks for which only very few validated principles are available to structure and support the development activities. Since, in those situations, the image and impact of the intervention to be developed is often still unclear, the research focuses on realizing limited but promising examples of those interventions. The aim is not to elaborate and implement complete interventions, but to come to (successive) prototypes that increasingly meet the innovative aspirations and requirements. The process is often cyclic or spiral: analysis, design, evaluation, and revision activities are iterated until a satisfying balance between ideals and realization has been achieved. Important principles of development research are

i) preliminary investigation

ii) theoretical embedding

iii) empirical testing

iv) documentation, analysis and reflection on process and outcome

v) seeking complexity and diversity

vi) methodological pluralism

vii) multidisciplinary approach

viii) self-critical awareness

ix) empowerment

**(i) Preliminary investigation**

An intensive and systematic preliminary investigation of tasks, problems, and context is made in development research. It also includes searching for more accurate and explicit connections of that analysis with latest knowledge from literature. Some typical activities include: literature review; consultation of experts; analysis of available promising examples for related purposes; case studies of current practices and better understanding of needs and problems in intended user contexts.

**(ii) Theoretical embedding privilege**

More systematic efforts are made to apply state-of-the-art knowledge in articulating the theoretical rationale for design choices. Moreover, explicit feedback to assertions in the rationale about essential characteristics of the intervention is made after empirical testing of its quality. This theoretical articulation can increase the transparency and plausibility of the rationale. Because of their specific focus, these theoretical notions are usually referred to as mini- or local theories, although sometimes connections can also be made to middle-range theories with a somewhat broader scope.

**(iii) Empirical testing**

Clear empirical evidence is delivered about the practicality and effectiveness of the intervention for the intended target group in real

user settings. In view of the wide variation of possible interventions and contexts, a broad range of (direct/indirect; intermediate/ultimate) indicators for success should be considered.

**(iv) Documentation, analysis and reflection on process and outcomes**

Much attention is paid to systematic documentation, analysis and reflection on the entire design, development, and evaluation and implementation process and on its outcomes in order to contribute to the expansion and specification of the methodology of design and development.

**(v) Seeking complexity and diversity**

Development research takes into account complex and diverse nature of society. It recognizes the differences between community and within communities and their significance. Hence, it seeks and enables the expression and analysis of complex and diverse information and judgment. This has been expressed in terms of seeking variability rather than averages. It has been described as the principle of maximum diversity, or maximizing the diversity and richness of information. This includes looking for, learning from exceptions, oddities, dissenters, and outliners in any distribution. It deliberately looks for, notices and investigates contradictions, anomalies, and differences. Development research, thus, recognizes and supports diversity, complexity, and multiple realities.

**(vi) Methodological pluralism**

A development problem or issue has several dimensions. Each dimension of a problem or an issue has to be carefully examined. It may be difficult and, at times, it may not be possible to capture the different dimensions of a problem / issue which may be mainly attributed to mono-method bias in the conventional research. Hence, in order to have a deeper understanding of the problem / issue, development research adopts the principle of methodological pluralism in its investigation. In other words, it always adopts a mix of methods depending upon the nature, type, and context of a problem / issue. Further, it strikes a balance between quantitative and qualitative methods of investigation – using mixed methodology. It greatly helps in the diagnosis of a problem in the right perspective, and provides correct solution to any problem.

**(vii) Multidisciplinary approach**

Development is multidisciplinary, with many dimensions. Recognizing and positioning the problem and solution, therefore, require deployment of a multidisciplinary team. The team is also a mix of outsiders and insiders. Depending on the problem to be studied or issue to be solved, the nature and blend of the team from outside can be decided; and, similarly, the team from inside can be identified and deployed. It should be noted that the community has specialists in varied fields. They are experience based specialists. The team from the outside needs to identify such specialists, include them in their research pursuit, and make use of their services for better outcome. The team should treat such specialists as their partners and collaborators. This kind of multidisciplinary team not only enriches the knowledge base, it also

facilitates effective implementation of various phases of the programme in a development cycle.

**(viii) Self-critical awareness**

This means that the development researchers ought to examine their own behaviour continuously and critically. They must develop a spirit of self-criticism. Self-criticism or self awareness is the ability of each person to accurately analyse his, or her own work, or his, or her own behaviour, or attitude in undertaking work to distinguish good from bad practice. Such an analysis would help in acknowledging one's own behaviour and to discuss the causes and effects of these errors. Self critical awareness is an act of frankness, courage, comradeship and an awareness of one's responsibility. It is a proof of will to accomplish and to accomplish properly. To criticize oneself is to reconstruct one's self from within, in order to serve better.

Self-critical awareness includes embracing the error. The development researcher needs to welcome the error as an opportunity to learn. They have to face failure positively. Such an attitude helps the development researcher to pursue development research with a sense of honesty and devotion. It also helps them to go nearer to the people and ultimately helps them to serve them better.

**(ix) Empowerment**

Development research seeks to empower the subjects of research. It strongly believes in the voice of the people, and puts the people first in all its endeavours. It adopts the philosophy of 'Let them do', 'Let them decide', and 'Let them own'. Thus, it consciously allows the voiceless, the powerless, and the marginalized and deprived sections of the community to take control over their lives. The researchers in course of time need to hand over the stick to the people. This process enables the people to make a choice and take action on their own behalf with self-confidence, from a position of economic, political and social strength.

## 1.6 COMMUNITY CONSULTATION AND DEVELOPMENT RESEARCH

One important activity of any development worker who believes in the bottom up approach or the participatory process is that they have to consult the community even on a day-to-day basis. The local people need to be involved in decision making of various kinds. Consultation is about taking advice from people, asking their opinions, and not just about recording their experiences or collecting information. One important thing to keep in mind is that, in some cases, the intention is to consult people because they have had a particular experience, and in others simply as members of the public. However, there is some common ground between the two kinds of process, including the necessity of

(a) being fair about who is involved

(b) asking questions in a way which is seen to be unbiased

(c) ensuring that people are consulted in a way which enables them to participate properly - clear communication

(d) reporting findings accurately and honestly

Research tradition may have many useful things to teach those involved in consultation, but consultation exercises should not be turned into research projects. This is because terming a simple consultation process research can create problems rather than help people.

In this section, you studied about types of research in development work, conditions for development research and key principles of development research, community consultation and development research. Now answer the questions given in *Check Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are the different types of research in development work? Briefly explain any one.

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2. What are the key principles of developmental research?

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## 1.7 CONVENTIONAL RESEARCH AND DEVELOPMENT RESEARCH

Development research often turns out to be participatory research, as it entails dealing with primary sources of data collection involving a community in face to face situations. The development researcher builds trust, enables and engages in close dialogue. She/he engages in joint analysis and negotiation trying to build understanding through engagement. This element of closeness, or building understanding between the researcher and respondents, is not required in conventional research. The interaction between the investigator and the objects of research is intense unlike in a conventional research where responses are generally sought in an insensitive cold-blooded way.

**Table 1.1: Distinctions between Development research and Conventional research**

| Point of Reference | Conventional Reference | Development Research |
|---|---|---|
| Assumptions about reality | Assumptions about reality Assumption of singular, tangible reality. | Assumption of multiple realities that are socially constructed. |
| Scientific method | Scientific method is reductionist and positivist; complex world split into independent variables and cause-effect relationships; researchers' perceptions are central. | Scientific method of holistic and post-positivist; local categories and perceptions are central; subject and method-data distinctions are blurred. |
| Strategy and context of inquiry | Investigators know what they want; pre-specified research plan or design. Information is extracted from respondents or derived from controlled experiments; context is independent and controlled. | Investigators do not know where the research will lead; it is an open-ended learning process. Understanding and focus emerges through interaction; context of inquiry is fundamental. |
| Who sets priorities? | Professionals set priorities together | Local people and professionals |
| Relationship between all actors in the process | Professionals control and motivate clients from a distance; they tend not to trust people (farmers, rural people etc.) who are simply the object of inquiry. | Professionals enable and engage in close dialogue; they attempt to build trust through joint analysis and negotiation; understanding arises through this engagement, resulting in inevitable interactions between the investigator and the 'objects' of research. |
| Mode of working | Single disciplinary – working alone. | Multi-disciplinary - working in groups. |
| Technology or services | Rejected technology or service assumed to be fault of local people or local conditions. | Rejected technology or service is a failed technology. |
| Career development | Careers are inwards and upwards – as practitioners get better, they become promoted and take on more administration. | Careers include outward and downward movement; professionals stay in touch with action at all levels. |

**Source:** *Adapted from Jules N Pretty and Chambers, 1993*

## 1.8 THE ROLES REQUIRED OF A DEVELOPMENT RESEARCHER

A development researcher, unlike a conventional academic researcher, will have to play different roles as a professional development practitioner. She/he has to deal with multiple realities most of which are socially constructed. Therefore, apart from being a person with an unbiased research bent, she/he has to rise to the occasion to wear the cap that a given situation may warrant in the field. Primarily, she/he has to be a team player open to ideas, and giving shape to ideas. The following could be stated as some of the roles that a development researcher generally assumes.

**The Coordinator:** listens well; able to elicit contribution from all members of the team; promotes decision making; need not be a brilliant intellect.

**The Spark:** the chief source of ideas: creative, unorthodox, imaginative.

· **The Implementer:** the workhorse; turns ideas into practical actions and gets on with them logically and loyally; disciplined, reliable, and conservative.

**The Shaper:** usually the self-elected leader: dynamic, positive, outgoing, argumentative, a pressurizer; seeks ways around research obstacles.

**The Monitor Evaluator:** the team's rock, strategic, analytical, introvert; capable of deep analysis of huge quantities of data; rarely wrong.

**The Team worker:** a counsellor and conciliator; social, perceptive, accommodating, aware of undercurrents and other's problems; promotes harmony; most valuable at times of crisis.

**The completer/finisher:** the team's stickler for detail, deadlines and schedules; has relentless follow-through; chief catcher of errors and omissions.

**The Specialist:** the team's chief source of rare knowledge and skill; a single-minded loner; self-starting, dedicated and makes the occasional dazzling breakthrough.

## 1.9 THE OUTCOMES OF DEVELOPMENT RESEARCH

Development research aims at making both practical and scientific contribution Therefore the search for innovative 'solutions' for social problems, interaction with practitioners (in various professional roles: policy makers, developers, and the like) is essential. The ultimate aim is not to test whether theory, when applied to practice, is a good predictor of events. The interrelation between theory and practice is more complex and dynamic: is it possible to create a practical and effective intervention for an existing problem or intended change in the real world? The innovative challenge is usually quite substantial; otherwise the research would not be initiated at all. Interaction with practitioners is needed to gradually clarify both the problem at stake and the characteristics of its potential solution. An iterative process of successive approximation or evolutionary prototyping of the ideal intervention is desirable. Direct application of theory is not sufficient to solve those complicated problems. One might state that a more constructivist

development approach is preferable: researchers and practitioners cooperatively construct workable interventions and articulate principles that underpin the effects of those interventions.

The prime reason for cooperation is that without the involvement of practitioners, it is impossible to gain clear insight in potential implementation problems and to generate measures to reduce those problems. New interventions, however imaginative, their design require continuous anticipation at implementation issues, not only for social reasons but also for technical benefits. Therefore, rigorous testing of practicality is a *sine qua non* in development research.

It is not uncommon in formative research that such knowledge, especially the substantive knowledge about essential characteristics of an intervention, can partly be extracted from a resulting prototype itself. That is one of the reasons that make it so profitable to search for, and carefully analyze already available interventions to generate ideas for new tasks. However, the value of that knowledge will strongly increase when justified by theoretical arguments, well articulated in providing directions, and convincingly backed up with empirical evidence about the impact of those principles. Moreover, those heuristic principles will be additionally powerful, if they have been validated in successful design of more interventions in more contexts. The chances for such knowledge growth will increase when development research is conducted in the framework of research programs, because projects can then build upon one another.

## 1.10 THE LIMITATIONS OF DEVELOPMENT RESEARCH

One major constraint with development research is the effort to generalize findings that cannot be based on statistical techniques, focusing on generalizations from sample to population. Instead, one has to invest in analytical forms of generalization. Readers need to be supported to make their own attempts to explore the potential transfer of the research findings to theoretical propositions in relation to their own context. Reports on formative research can facilitate that task of analogy reasoning by a clear theoretical articulation of the design principles applied and by a careful description of both the evaluation procedures as well as the implementation context. Especially a thick description of the process-in-context may increase the ecological validity of the findings, so that others can estimate in what respects, and to what extent, transfer from the reported situation to their own is possible. Another option that may stimulate exploration of possibilities for (virtual) generalization is to organize interactive meetings with experts from related contexts to discuss the plausibility of the research findings and recommendations for related tasks and contexts.

Research based progress to expand and sharpen our knowledge on development is greatly enhanced through interdisciplinary approaches with purposive cross-fertilization between many specialized sub-domains. Moreover, it is our own experience that joint development research efforts of professionals in various roles offer fine opportunities for professional learning and capacity building.

In this section, you studied about conventional research *vs*. development research, the roles required of a development researcher, outcome of development research, and limitations of development research. Now answer the questions given in *Check Your Progress-3.*

**Check Your Progress 3**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are the roles required of a development researcher?

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2. What are the limitations of development research?

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## 1.11 LET US SUM UP

The goal of development is 'wellbeing for all' which means having the experience of a good quality of life. Development research largely deals with issues, problems, strategies related to means, ends and principles needed for the achievement of this goal.

Development research is not research for knowledge sake. It is action oriented. The purpose of development research is to enable the development workers to cope with the manifold uncertainties in their complex tasks. It also stimulates professional development of participants.

Development research is a valuable term with changing connotations. The major types of development research are explorative design studies, formative research and reconstructive studies. However, the boundaries are not clearly demarcated. Development research is based on two approaches

i) policy focused research

ii) programme focused research.

The key principles of development research are: i) preliminary investigation ii) theoretical embedding iii) empirical testing iv) documentation, analysis and reflection of process and outcome v) seeking complexity and diversity vi) methodological pluralism vii) multidisciplinary approach viii) self-critical awareness and ix) empowerment.

Though development research adopts various conventional methods of research, it is distinctly different from conventional research such as methods adopted, strategy and context of enquiry, relationship among various factors of research, mode of working, etc. The outcome of development research is creating a pragmatic intervention for an existing problem and for an intended change in the real world through a process of successive approximation or prototyping of the ideal intervention. An important constraint of development research is that findings cannot be generalized based on statistical techniques.

## 1.12 KEY WORDS

**Appraisal** : assessment, or taking consideration of a given situation, or context, or phenomenon. When you appraise a situation, you are trying to understand a situation systematically, using methods that are scientifically accepted in social sciences research.

**Conventional research** : this is also known as a traditional approach to research that is conservative, unadventurous, and conformist to the accepted methods, tools and techniques. It does not seek diversity or anomaly. It employs mostly quantitative methods that measure, or takes into account things that are measurable.

**Development cycle** : is the path a development intervention towards wellbeing takes. The path usually consists of several phases.

**Empirical** : this is pragmatic and observable, and not imaginative or rhetoric.

**Evolutionary prototyping** : an intervention model (design) that evolves or gets shape over a period of time out of experimentation.

**Generalization** : providing generality or an overview of a phenomenon. An occurrence that is argued as very commonly present. Often, it may even be easily observable too.

**Mixed methodology** : making use of both quantitative and qualitative methods of research in social sciences.

**Mono-method** : making use of a single method, and this might sometimes turn out to be biased.

**Scientific methods** : unbiased, objective and provable with evidences.

**Successive approximation** : rough estimation found consecutively, or repeatedly.

**Validation** : a way of ensuring that the evidence collected in support of empirical presence of a phenomenon is scientifically correct.

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## 1.14 CHECK YOUR PROGRESS-POSSIBLE ANSWERS

**Check Your Progress 1**

1. Development research aims at providing knowledge on which the best decisions can be made. The target may be to solve specific policy related problems or to help practitioners accomplish tasks. It means to say that research is used in development work for a variety of purposes.
2. Type I refers to an approach in which the roles of researcher (partly) coincide within a specific development context. In type II, however, that relationship is more loose: the researchers are not involved in the development process themselves, but they study those processes (including tools and models applied) as practiced by others.

   Some approaches to development research include explorative, formative and reconstructive studies.

**Check Your Progress 2**

1. The different types of research in development work are: i) Policy focussed research and ii) Programme focussed research. The Policy focused research, which includes raising a new issue in the public domain, putting forward a new perspective on a live issue, producing strong evidence of the benefit or harm of a particular policy and drawing together and learning from different studies to support a policy position.
2. The key principles of development research are: preliminary investigation, theoretical embedding, empirical testing, documentation, analysis and reflection on process and outcome, seeking complexity and diversity, methodological pluralism, multidisciplinary approach, self-critical awareness, and empowerment.

**Check Your Progress 3**

1. The roles of a development researcher are: (i) The Coordinator: listens well; able to elicit contribution from all members of the team; promotes decision making; need not be a brilliant intellect. (ii) The Spark: the chief source of ideas; creative, unorthodox, imaginative. (iii) The Implementer: the workhorse; turns ideas into practical actions and gets on with them logically and loyally; disciplined, reliable, and conservative.

2. One major constraint in development research is the efforts to generalize findings that cannot be based on statistical techniques, focusing on generalizations from sample to population. Instead, one has to invest in analytical forms of generalization. Readers needed to be supported to make their own attempts to explore the potential transfer of the research findings to theoretical propositions in relation to their own context.

# UNIT 2 METHODS OF DEVELOPMENT RESEARCH

**Structure**

2.1 Introduction

2.2 Methods Of Development Research

2.3 Direct Observation

2.4 Interviewing

2.5 Focus Group Discussion

2.6 Case Study

2.7 Process of Development Research

2.8 Let Us Sum Up

2.9 Key Words

2.10 References and Selected Readings

2.11 Check Your Progress - Possible Answers

## 2.1 INTRODUCTION

You have studied in the previous unit that research has become established in recent years as a powerful tool for development workers. Development workers widely differ (from conventional researchers) in their orientation towards the use of research, as they intend it to be mostly participatory and utility-oriented in approach, rather than research merely for the sake of adding to the existing body of knowledge in a given field. Therefore, research for development is utility-oriented. It is not pure, or basic research as it is technically known. It is applied or application-oriented in approach.

Development research aims at providing better understanding of a given context or phenomenon, so as to devise appropriate interventions. The knowledge generated through development research usually enhances the way development practice takes place. It expands avenues for better comprehension of issues and intricacies, which results in enhancing the effectiveness of development practice or social action.

After studying this unit, you should be able to:

- analyse the various methods of development research
- describe in detail the meaning, features, merits and limitations of development research methods
- explain the process of development research

## 2.2 METHODS OF DEVELOPMENT RESEARCH

The methods of development research serve as systems of inquiry or interaction. Assemblages of methods to suit the requirements that the context or research problem warrants is what is in the ingenuity of the development researcher – no matter whether the type of development research taken up is programme focused or issue focused. Development researchers use a wide range of methods which are mostly borrowed from

various sources such as conventional methods of research and participatory research methods. The methods that are used by development researchers include: review of secondary sources, direct observation, semi-structured interviews, ranking and scoring, diagrams of different types, case studies, games and role plays, workshops, informal and formal survey, and so on. The methods borrowed and used largely depend on the felt needs of the development researcher. We will present, here, the four most popular and widely used methods of development research. They are

Direct Observation

Interviewing

Focus Group Discussion

Case Study

## 2.3 DIRECT OBSERVATION

Observation is viewing. Observation as a method of data collection is different from casual viewing. Observation is a method that employs vision and alert mind as main means of data collection. Observation is defined as 'a systematic viewing of specific phenomenon in its proper setting for the specific purpose of gathering data for a particular study'. It is planned methodical viewing. Scientific observation differs from other methods of data collection specifically in four ways: (i) observation is always direct while other methods could be direct or indirect (ii) field observation takes place in a natural setting (iii) Observations tend to be less structured (iv) it makes only the qualitative (and not quantitative) study which aims at discovering subjects experiences, and how subjects make sense of them, or how subjects understand their life.

Behavioural scientists observe interaction in small groups, anthropologists observe simple societies and small communities, political scientists observe the behaviour of political leaders and political institutions. In a sense, all branches of social sciences including development research begin with and end with observation. The major purpose of observation is to capture human conduct as it actually happens. In other methods, we get only a static comprehension of people's activities.

### 2.3.1 Characteristics of Observation

Researchers consider that this method is more appropriate for studying lifestyles or subcultures, practices, episodes, encounters, relationships, groups, organisations, settlements and roles, etc. The following could be stated as important characteristics of observation.

First, it entails both physical and mental activity. Second, it is selective. A researcher does not observe anything and everything, but selects the range of things to be observed on the basis of the nature, scope and objectives of his/her study. Third, it is purposive and not casual. Fourth, it captures the natural social context in which a person's behaviour occurs. Fifth, it grasps the significant events and occurrences that affect social relations of the participants. Other characteristics are given below.

It enables understanding significant events affecting social relations of the participants.

It determines reality from the perspective of observed person himself /herself.

It identifies regularities and recurrences in social life by comparing data in one study with those in other studies.

### 2.3.2 Types of Observation

Observation may be classified in different ways. With reference to the investigator's role, it may be classified into: (i) participant observation and (ii) non-participant observation. In terms of mode of observation, it may be classified into (i) direct observation and (ii) indirect observation. With reference to the rigour of the system adopted, observation is classified into: (i) controlled observation, and (ii) uncontrolled observation.

Participant observation is a method where the observer is a part of the phenomenon or group which is observed and he/she acts as both the observer and a participant. As a non-participant, the observer stands apart and does not participate in the phenomenon observed. Direct observation means observation of an event done personally by the observer when it takes place. Indirect observation does not involve the physical presence of the observer, and it is recorded by mechanical, photographic, or electronic devices. Controlled observation involves standardisation of observational techniques and exercise of maximum control over extrinsic and intrinsic variables by adopting experimental design and systematically recording observation. Uncontrolled observation does not involve control over extrinsic and intrinsic variables.

### 2.3.3 Application

Observation or direct observation is generally used in combination with other methods. This method is flexible and allows the observer to see and record subtle aspects of events and behaviour as they occur. The observer is also free to shift places and change the focus of observation. Direct observation is useful when the information we want is about observable things and when we need to cross-check people's account of what happens.

### 2.3.4 Observation in Practice

The quality of direct observation can be ensured through the adoption of step-by-step procedure. The steps that can be adopted are briefly stated here.

Determine the focus of the observation. Direct observation has to be selective due to time and resource constraints.

Establish the objective of direct observation and information required.

The timing of the observation has to be decided in consultation with the people. Timing is a critical factor in direct observation. Wrong timings can distort findings.

Establishing rapport with the people; community or organisation to be observed is important before embarking on direct observation.

Make sure that those being observed are aware of the reasons for your study and they do not see you in negative terms.

Allow sufficient time for observation. Brief visits can be deceptive, partly because people tend to behave differently in the presence of observers.

Note down any events that you do not understand and try to clarify them with the participants from the community.

Write down your first impression about your observation before the analysis stage later on.

Analyse, summarise and report in relation to the objectives set out at the start of the exercise.

Check for reliability and validity. Direct observation techniques are susceptible to errors and bias that can affect reliability and validity. These can be minimised by recording observation promptly, seeking clarification on the spot, using a multidisciplinary team.

### 2.3.5 Dangers or Limitations of Observation

Although observation or direct observation is widely used as methods of development research in combination with other methods, one has to be careful in employing this method. Care is needed because of the possibility of the following limitations associated with this method.

It is susceptible to observer bias.

It has the danger of leading to over simplification.

It is not possible to understand the motives of the people.

People can be alert to when they are being observed, and their behaviour during observation may differ from how they behave in normal situations.

## 2.4 INTERVIEWING

Interviewing and dialogue skills are quite essential in development research. This is all the more important in rural development work where the outside professionals' level of information and understanding about the rural situation are limited. Interview, in true sense, means dialogue. Dialogue is based on people sharing their own perceptions of a problem, offering their opinions and ideas on the issues or research questions in hand. A series of interviews or a chain of interview with key informants help us gain more accurate insights into rural situations, problems, customs, practices, systems, values, and the way the rural people think, act, and perceive things. Good interviewing and dialogue facilitate an information flow that is true, authentic and relevant.

While interviewing is basically about asking questions and receiving answers, there is much more to it than that, especially in a development research context. The most common type of interviewing is individual, face-to-face verbal interchange, but it can also take the form of face-to-face group interviewing and telephone surveys. Interviewing can be structured, semi structured, or unstructured. It can be used for the purpose of measurement or its scope can be the understanding of an individual or a group perspective. An interview can be a one-time brief exchange, say five minutes over the telephone, or it can take place over multiple, lengthy sessions, sometimes spanning days, as in life history interviewing.

Interviewing can be used in focus group discussions (FGDs) and during direct observations (DO) as well. It can be fully structured or semi structured. Semi structured interviewing in itself has emerged as a skill

among development professionals involved in development research. Direct observation always involves dialogue or interviewing. No observation can take place in a dump-found situation. Passive watching cannot be construed as observation. Observation involves an inquisitive and alert mind. It involves a questioning mind. Direct observation is not passive watching, it involves questioning in an attempt to understand the phenomenon or subject being observed. Therefore, direct observation is also considered as a technique in interviewing.

Similarly, FGD as the method itself suggests, involves dialogue/interview. Often during DO and FGD, checklists are used for interviewing. When the checklist contains only the possible lines of questions (focused to the core of the research), the method is known as semi structured, and not fully structured. Interviewing progresses based on subsequent responses.

Interviewing is one of the major methods of data collection in development research. It is defined as 'a two-way systematic conversation between an investigator and an informant, initiated for obtaining information relevant to a specific study'. It involves conversation as well as learning from the respondent's gestures, facial expressions, pauses, and body language, etc. It is useful for collecting a wide range of data from factual demographic data to highly personal and intimate information relating to a person's opinions, attitudes, beliefs, past experiences and future intensions. Interviewing is often superior to other data-gathering methods, because people are more willing to talk rather than write. It permits probing into the context and reasons for answers to questions.

### 2.4.1 Types of Interviews

Interviews may be broadly classified into the following categories.

(i) Structured or Directive Interview

(ii) Unstructured or Non-Directive Interview

(iii) Semi-Structured Interview (SSI)

**(i)** **Structured Interview** is an interview made with a detailed standardised schedule. The same questions are put to all the respondents and in the same order. Each question is asked in the same way in each interview, promoting measurement reliability. This type of interview is used for large scale formalised surveys.

**(ii)** **Unstructured Interview** is the least structured one. The interviewer encourages the respondent to talk freely about a given topic with minimum prompting or guidance. Under this type, a detailed pre-planned schedule is not used. The interviewer avoids channelling the direction of the interview. Instead, he develops a very permissive atmosphere. The questions are not standardised and not framed in a particular way.

**(iii)** **Semi-structured Interviewing (SSI)** is a focused interview. Here, the interviewer attempts to focus the discussion on the actual effects of a given experience to which the respondents have been exposed. This type of interview is free from the inflexibility of formal methods, yet gives the interview a set form and ensures adequate coverage of all topics.

What type of interviewing method is used when as far as development research is concerned depends on the demands of the contexts. As participatory methods are in the forefront of working of several development organisations, most of them prefer to use SSI for development related research. It is more conversational while still controlled and structured. This is referred to as a semi-structured interview or SSI for short. In SSI, only some of the questions and topics are predetermined. Most often it is only a checklist of topics and subtopics that are used for conducting SSI, and not the structured questions as such. Questions are framed, drawing points from the checklist, based on how the interview progresses. It often becomes a progressive learning process for the interviewer, who has to record all the conversations using shorthand, scribbling, or by recording on a digital voice recorder.

SSI, in short, is a conversation where only some of the questions are predetermined, and new questions or insights arise as a result of discussion and visualised analysis.

### 2.4.2 Guidelines for Asking Questions

Always start the interview with simple questions. Difficult and sensitive questions may be put near the end of the interview so that if the respondents decide not to answer these, you do not lose his/her willingness to answer other questions. While conducting SSI, questions should be properly worded and asked. Questions should be simple and to the point. The following should be avoided.

**Leading Questions:** A leading question is one that is worded in a way as to influence the respondents to give a certain answer. It does not elicit an accurate answer or correct view point of the respondent. For example, “Education must have high priority in government spending. What do you think?”

**Loaded Questions:** A loaded questions is one that contains words, which are emotionally coloured, and suggests an automatic feeling of approval or disapproval. Using words like ‘terrorism’, ‘bureaucracy’, ‘greedy’ ‘vested interest’, and oppressed may seem to imply a judgement. Such words can cause a bias in the answers. Respondents may be reluctant or nervous to give answers, e.g. “Do you think something can be done to repair the vested interests of the state actors and the bureaucracy which is the main reason for child-trafficking in India?”

**Ambiguous or Vague Questions:** Ambiguous question is a question with no clear meaning. It may mean different things to different people, e.g. “What do you think about the education you have received?”

**Multiple Questions:** They contain two or three ideas or questions in one, e.g. “Do you favour or oppose the idea of increased job security and productivity-linked wage system for women?”

**Hypothetical Questions:** These are questions based on a nonexistent situation, e.g. “If you had been able to complete your schooling, what would you be doing today?”

**Offensive or Insensitive Questions:** These are questions that are rude and insulting in nature. They are most likely to upset the people / respondents, e.g. "Why do you not think it is important to pay for noon-meals at school?"

### 2.4.3 How to do Semi-structured Interviewing.

Be sure to start from known to unknown; and from familiar to unfamiliar.

Ask questions in a logical order.

Do not ask difficult questions first.

Mix questions with discussion, and conduct it in an informal way.

Make sure that the responses you get contain the information you need.

Listen carefully. Note down and make sure that your recording or noting down does not disturb further responses.

Look for apparent inconsistencies in what people are saying and probe further to unearth the thinking behind them.

The responses from the participants may be in the form of a fact, opinion, rumour, or lie. The interviewers need to be careful in judging the responses through probing and liberally trying to get clarity through further questions.

Avoid leading questions, vague questions, and questions that are loaded.

Resist the temptation to help the respondents with responses when they are temporarily at loss for words.

Remember to cross check and triangulate information.

In this section, we have discussed two widely used methods of development research, direct observation and interviewing. Now, answer the questions in *Check Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What do you mean by observation?

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2. What is interview? What are the different types of interview?

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## 2.5 FOCUS GROUP DISCUSSION

Focus groups are basically group interviews. A moderator guides the interview while a small group discusses the topics that the interviewer raises. What the participants in the group say during their discussions is the essential data in focus groups. Typically, there are six to eight participants who come from similar backgrounds, and the moderator is a well trained development professional who raises his questions from a predetermined set of discussion topics, otherwise known as focus group discussion (FGD) checklist.

The hallmark of focus group discussion is the explicit use of group interaction to produce information and insights. The basic tenet of focus group discussion is listening and learning. There is progressive recognition of the use of focus groups in development research. Focus group interviews are used where qualitative data is highly usable. FGDs usually generate a lot of qualitative data. The data, information and insights developed are useful to explain and understand certain empirical phenomenon. The information generated through FGD is often used to supplement, complement, or strengthen the arguments made using quantitative data.

David L Morgan (1998) points out a three part process of communication in FGDs. (i) The research team members decide what they need to hear about from the participants.

(ii) The focus groups create a conversation among the participants around these chosen topics.

(iii) Members of the research team summarise what they have learnt from the discussion.

When it comes to the use of FGD based data: first, they are used as a ‘self-contained’ method in studies in which they serve as the principal source of data. Second, they are used as a supplementary source of data in studies that rely on some other method such as survey. Last, they are used in multi-method studies that combine two or more means of gathering data, in which no one primary method determines the use of the others. One important use of FGD is that a poorly understood survey’s results can be explained clearly. In multi-method studies FGDs are used so as not to miss some qualitative dimension that might not get covered in other methods. However, as in any other research, it is the rigour of enquiry, credibility of the results, and relevance of the findings to the requirements that usually determine the quality of the focus group research.

### 2.5.1 Where to use and where not to use Focus Group Discussions (FGDs)?

**a. Appropriate Uses**

When investigating complex behaviour and motivations.

When the research problem requires to be understood and demand diversity of analysis.

When there is a gap between providers of service and recipients of service.

When gathering data is not sufficient and getting closer to people is required.

When quantitative data is not sufficient to draw conclusions and arrive at findings.

**b. Inappropriate Uses**

If the FGD carried out would not lead to useful developmental action, avoid using it.

Avoid FGDs if the participants who will provide information are not comfortable sitting together or talking to one another.

Where the topic of discussion or the problem to be discussed is not relevant to the group, the FGD result may not be insightful.

Where the requirement is more statistical or quantitative data, and the method of analysis to be used is mostly quantitative, FGD may not help.

### 2.5.2 Steps in Conducting Focus Group Discussion

The following steps are usually used for the conduct of FDGs.

**(a) Planning:** Focus groups are usually semi-structured, allowing discussions to develop while being moderated. Therefore, careful planning is very important. The complexity that might arise due to being optimally prepared could be faced without much difficulty if we have our focus group plan properly prepared. During the planning stage, care needs to be taken on the points that follow

conceptualising the study

developing discussion topics

determining the time required

the composition of the interviewers' team

the type of informants we need to form as focus groups

the venue for the FGD

logistical arrangements

Writing down the checklist and selecting the participants and key informants are vital, and the ability comes with experience.

**(b) Enlisting or selection of the group itself:** A typical focus group has seven or eight participants. Having the right kind of informants in the focus group will determine the quality of discussion and the results of the research. You need to have enough of the right informants to conduct the focus group discussion. If the informants recruited are people who experience or have experienced the phenomenon to be discussed, the results would be enriching, realistic, and practical.

**(c) Moderating the focus group:** This is a skill that can be developed with every successive focus group. Talented or experienced focus group moderators know how to clarify the problem, word the questions, sequence questions, categorise questions, probe answers for validity. A skilled moderator can trace the entire route of questioning and response. The moderator must have a good idea of how to open the

discussion, the introduction, the transition from easy to difficult questions, simple to key questions, and the ending questions for the conversation. As a principle, good moderators use mostly open ended questions, and avoid close-ended questions.

**(d) Analysing and Reporting:** This is a challenge for many researchers and even for talented practitioners. This requires objectivity, and one need to make sure personal biases and subjectivity do not find place in the report. The descriptive nature of information collected poses a challenge in analysing, and conceptualising the results. The data and information may be in the form of field notes, charts, recorded cassettes or digitally recorded, photographs, video graphs, etc.

One needs to plan how they are going to be reported. It is good to have them all typed out in a computer first with crude segmentation and category systems. Identifying themes, sub-themes, patterns and semantic relations can take place gradually in the subsequent stages. If the data is amenable, construction of charts, graphs, bar and pie-diagrams may be attempted. We can corroborate and validate the results by presenting the results to the same or similar group, from where the data sets were collected. They may confirm it, or would want revision of some of the ideas that the researchers' team did not understand properly or misunderstood. Then, it becomes the report of the focus group.

Analysing and reporting require objectivity and skills of high order. The process of analysis requires several skills. These include: the use of words, the context, internal consistency, frequency of comments made, extensiveness of the comments, specificity of responses, and what was not said and why. These could be some of the items to consider while analysing and reporting FGDs. Finally, the report may be prepared taking into consideration the purpose of the report and the type of readers it is meant for.

## 2.6 CASE STUDY

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context, when the boundaries between phenomena and context are not clearly evident, and in which multiple sources of evidences are used. A dictionary of sociological terms defines a case study as: a method of studying social phenomena through the analysis of an individual case. The case may be a person, a group, an episode, a process, a community, a society, or any other unit of social life. All data relevant to the case are gathered, and all available data are organised in terms of the case. The case study method gives a unitary character to the data being studied by interrelating a variety of facts to a single case. It also provides an opportunity for the intensive analysis of many specific details that are often overlooked with other methods.

We need to understand that the case is a bounded system – it has boundaries. We need to identify and describe the boundaries of the case as clearly as possible. Therefore, specific focus is required even within a case. Research questions help to define this focus. Multiple sources of data and multiple data collection methods are likely to be used, typically in a natural setting. We may use observations, interviews, and narratives reports and so on.

In keeping with other approaches in development research, the case study aims at understanding the case in depth, and in its natural setting,

recognising its complexity and its context. It also has a holistic focus, aims to preserve and understand the wholeness and unity of the case. Case study is a way of organising social data to preserve the unitary character of the social object being studied. This strategy for understanding provides an interesting comparison with the reductionist approach of some quantitative research.

The basic idea is that one case (or perhaps, a small number of cases) will be studied in detail. While there may be a variety of specific purposes and research questions, the general objective is to develop as full an understanding of that case as possible.

### 2.6.1 Type of Cases

We must understand that almost anything can serve as a case, and the case may be simple or complex. A case is a phenomenon of some sort occurring in a bounded context. Thus, the case may be an individual, or a role, or a small group, or an organisation, or a community, or a nation. It could also be a decision, or a policy, or a process, or an incident or event of some sort, and there are other possibilities as well. Generally, there are six different type of units referred to in social science research. They are

(a) Individuals

(b) Attributes of individuals

(c) Actions and interactions

(d) Residues and artefacts of behaviour, settings

(e) Incidents and events

(f) Collectives

Any of these may be the focus of case study research. Case studies usually confine the attention to those aspects that are relevant to the research problem at the time.

### 2.6.2 Type of Case Studies

There are also different types of case studies. The three main types follow.

**The Intrinsic Case Study**, where the study is undertaken because the researcher wants a better understanding of a particular case.

**The Instrumental Case Study**, where a particular case is examined to give insight into an issue, or to refine a theory.

· **The Collective Case Study,** where the instrumental case study is extended to cover several cases, to learn more about the phenomenon, population or general condition.

The first two are single case studies, where the focus is within the case. The third involves multiple cases, where the focus is both within and across cases. It is also called a multiple case study, or a comparative case study.

### 2.6.3 Preparing a Case Study

A case study would need to

be clear on what the case is, including identification of its boundaries

be clear on the need for the study of this case, and on the general purpose(s) of this case study

translate that general purpose into specific purposes and research questions (these may emerge during the early empirical work)

identify the overall strategy of the case study, especially whether it is one case or multiple cases

show what data will be collected, from whom, and how

how the data will be analysed

Case studies can make an important contribution in combination with other research approaches. Discovering the important features, developing an understanding of them, and conceptualising them for further study, is often best achieved through the case study method.

### 2.6.4 Criticism and Response

A very common criticism of the study concerns generalization of results: The first point is to ask if we would want to generalise from a particular case study. There are two types of case study situations where generalization would not be the objective. First, the case may be so important, interesting, current, or misunderstood that it deserves study in its own right or it may be unique in some very important respects, and therefore worthy of study. These are actually examples of intrinsic case study. It is not the intention of such a study to generalise, but rather, to understand this case in its complexity and its entirety, as well as in its context. Therefore, whether a case study should even seek to generalise, and claim to be representative, depends on the context and purposes of the particular development project in question.

Whether the study takes a conceptual approach or descriptive approach is another question. If it has takes conceptual approach, most probably it could be generalised. If it merely takes a descriptive approach it may not offer possibilities for generalisation. Generalization should not necessarily be the objective of all research projects, whether case studies or not. The first is what we can learn from the study of a particular case, in its own right. As noted, the case being studied might be unusual, unique or not yet understood, so that beautiful and in-depth understanding of the case is valuable. This might cover all three types of case studies described above.

In this section, we discussed another two widely used methods of development research, which are the focus group discussion and the case study. Now, answer the questions in *Check Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is a focus group discussion?

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2. What is a case study?

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## 2.7 PROCESS OF DEVELOPMENT RESEARCH

Research process is vital in any kind of research. It is all the more important when it comes to development research because it relies greatly on qualitative methods of data generation in field situations. A well done process builds the confidence of the community and takes the researcher closer to the community; whereas, a poorly executed process, provides the researcher with data and information that are of inferior quality, rendering the results of the study either false or as figments of imagination. Most often a well-done research process leads to better knowledge and awareness of the conditions in which the community lives, and what needs to be done to ameliorate the conditions. How best the community is prepared to put their best step forward, if they get the support of the researcher or development organisation involved in researching the conditions of life of the community.

This change does not occur immediately. It occurs as the groups pass through different stages of development. The development process researcher must have special skills to note the changes in the knowledge and behaviour of the community towards themselves and the outsiders in successive visits and interactions. There are five stages through which a well-facilitated group passes, namely

(i) rapport building

(ii) confidence gaining

(iii) self appreciation

(iv) capacity building

(v) empowerment and action.

A development researcher needs to note and record the changes in the participants in each of the stages. The guiding questions to note changes in each stage are presented here.

**(i) Rapport building**

Is there transparency in the relationship between the participants from inside and the outside team?

**(ii) Confidence gaining**

Has the participating group gained adequate confidence on the motives and purposes expressed by the outside team?

**(iii) Self appreciation**

Has the process of research paved the way for self appreciation by the participating group of their own analysis and interpretation of situation and events?

**(iv) Capacity building**

Does the process enable capacity building and empowerment?

Is it superficial?

Has the power centre changed place from outsiders to insiders, because of the reversal of learning process?

**(v) Empowerment and Action**

Does the research process tend to initiate action?

Has the outside team raised the expectations and exceed the scope of development research, or have they empowered the people to facilitate their own change?

The process cited above would largely help us wherever we have failed to adhere to the basic tenets of development research. A continuous and critical reflection on the process would enable us to handle various methods of development research appropriately, as required by the research questions in hand, or the problem required to be studied.

## 2.8 LET US SUM UP

Development researchers may use a wide range of methods which are normally borrowed from conventional as well as participatory methods of research. We have described four most popular and widely used methods of development research such as direct observation, interviewing, focus group discussion, and case study. Observation is a planned, systematic and methodical viewing with a definite purpose. Observation is of different types. Based on the investigator's role, it may be subsumed into participant observation and non-participant observation. With reference to the mode of observation it can be classified into direct observation and indirect observation. We need to adopt a step-by-step procedure to improve the quality of observation. Observation as a method of development research has certain limitations. Prominent among them is its susceptibility to observer bias.

Interviewing is yet another method of development research. It is a sort of dialogue. It is a two way systematic conversation between an investigator and an informant to obtain information. Interviews can be structured, unstructured, or semi-structured. Whatever might be the type of interview, one should cultivate the art of interviewing for better output. An interviewer should avoid leading questions, loaded questions, vague questions, multiple questions and insensitive questions.

Focus group discussion is basically a group interview. It is a qualitative research method. The groups which conduct the focus group discussion should be familiar with where to use and where not to use it. FGD involves a process which includes four main phases, viz., planning, selection of the group, moderating the focus group, and analysing and reporting.

A case study is an empirical inquiry. It is everything about something. It is an in depth and a comprehensive study about something - a person, a group, an episode, a phenomenon, a process, etc. A case study is of three types, viz., intrinsic case study, instrumental case study, and collective case study. The researcher has to prepare well for a case study for better results.

The development researcher has to adopt a definite process in employing methods of research which include rapport building, confidence gaining, self appreciation, capacity building, empowerment and action.

## 2.9 KEY WORDS

**Qualitative Research** : a flexible approach of building up an in depth picture of a situation, community, etc., often combining a variety of methods, observation, discussion, open ended and semi structured interviews, mapping, and other participatory approaches and tools.

**Quantitative Research** : used to collect data which can be analysed in numerical form. Often makes use of survey questionnaire.

**Monitoring** : a continuous function that uses systematic collection and analysis of data on specified indicators, to provide information on the management of an ongoing development intervention so as to indicate the extent of progress and achievements of objectives.

**Evaluation** : a systematic examination of an ongoing or completed project, programme or policy, its design, implementation, and results.

## 2.10 REFERENCES AND SELECTED READINGS

Morgan, D. (1998), *The Focus Group Guidebook*, Sage Publications.

Narayanasamy, N. (2009), *Participatory Rural Appraisal: Principles, Methods and Applications"*, Sage Publications, New Delhi.

Laws, S., Harper, C. and Marcus, R. (2003), *Research for Development: A Practical Guide*, Vistaar Publications New Delhi.

## 2.11 CHECK YOUR PROGRESS - POSSIBLE ANSWERS

**Check Your Progress 1**

1. Observation is a method of data collection. Observation is a method that employs vision and an alert mind as the main means of data collection. Observation is defined as 'a systematic viewing of specific phenomenon in its proper setting for the specific purpose of gathering data for a particular study'. It is 'planned methodical viewing'.

2. Interview, in a true sense, means dialogue. Dialogue is based on people sharing their own perceptions of a problem, offering their opinions and ideas on the issues or research questions in hand. A series of interviews, or a chain of interview with key informants help us gain more accurate insights into rural situations, problems, customs, practices, systems, values and the way rural people think, act, and perceive things. The types of interviews are

   (a) structured or directive interview

(b) unstructured or non directive interview

(c) semi-structured interview (SSI).

**Check Your Progress 2**

1. Focus groups are basically group interviews. A moderator guides the interview while a small group discusses the topics that the interviewer raises. What the participants in the group say during their discussions is the essential data in focus groups. Typically, there are six to eight participants who come from similar backgrounds, and the moderator is a well trained development professional who raises his questions from a predetermined set of discussion topics, otherwise known as focus group discussion (FGD) checklist.

2. A case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context, when the boundaries between phenomena and context are not clearly evident, and in which multiple sources of evidences are used. There are also different types of case studies : (i) The Intrinsic Case Study (ii) The Instrumental Case Study (iii) The Collective Case Study.

# UNIT 3 DEVELOPMENT RESEARCH APPLICATIONS

## Structure

3.1 Introduction

3.2 Application of Development Research

3.3 Appraisal of Existing Situation

3.4 Formulation and Implementation of Development Research Project

3.5 Monitoring and Evaluation of Development Research Project

3.6 Let Us Sum Up

3.7 References and Selected Readings

3.8 Check Your Progress - Possible Answers

## 3.1 INTRODUCTION

The most common application of research that many development professionals put to use in their work is to know about the planning and implementation of their programme. They may want to get to grips with issues that are perceived to be important by local people or to understand in-depth about why things are the way they are. Sometimes this will mean a broad look at a wide range of issues affecting a community, and sometimes research will be targeted at a particular issue.

Increasingly, development professionals engage communities directly in the research process of deciding priorities for their work, rather than regarding it as primarily a technical exercise. Research for development has kept spreading, from rural development projects to a wide set of other issues. The applications include analysis, planning, implementation, and evaluation in many areas of development.

The current application of participatory development approaches goes beyond projects to application of participation in connection with programme strategies and policies, national policy reforms like poverty reduction plans, and strategies for decentralization. Development research methods can be practised with a cross section of a wide variety of audience as they are flexible, interactive, semi-structured, visual and user-friendly. The strength of development research lies in its methodological pluralism. It is the combination of flexible and innovative use of these methods that enrich both the process and the outcome of the research process.

After studying this unit, you should be able to

- examine the areas of application of development research
- define project proposal and discuss the process of project formulation
- describe the contents of the project proposal
- develop a system for monitoring and evaluating a development project
- distinguish between process monitoring and progress monitoring

## 3.2 APPLICATION OF DEVELOPMENT RESEARCH

Among many development issues that students and development researchers address, there are five areas where this research can be particularly interesting, relevant, and rewarding. These include

(i) research on development policy

(ii) working with civil society or Non Governmental Organisations (NGOs)

(iii) interpreting the imagery of development

(iv) understanding the historical construction of development

(v) using the potential of information and communication technologies (ICTs) to contribute to development practices.

The three key components of development research application which are discussed in this unit are

(i) Appraisal of Existing Situation

(ii) Research Project Formulation and Implementation

(iii) Monitoring and Evaluation

## 3.3 APPRAISAL OF EXISTING SITUATION

The first step to development research application is appraisal of existing situation. We present below, a few popular ways or methods used for the appraisal of existing situation that development researchers generally consider handy.

Needs Assessment

Stakeholder Analysis

Social Assessment

Beneficiary Assessment

Social Audit

Participatory Poverty Assessment

Sustainable Livelihood Analysis

Analysis of Hunger

Vulnerability Analysis

Institutional Analysis

Participatory Evaluation

### 3.3.1 Needs Assessment

It is not actually possible to read off from a broad assessment of people's situation what interventions are needed and possible. There are a number of reasons for this. One is about the nature of need. It may be useful to distinguish felt or expressed need (which people themselves put forward) from normative need (based on standard, which is socially and culturally accepted as necessary for a decent life).

It is important for needs assessment work to take account of these differences in choosing appropriate methods to use. The question to ask is – whose view of needs is important here? In an ideal world, perhaps, the potential beneficiary's view would be paramount, but in real life it may not be so central to the argument of a case. Participatory research methods will naturally produce an account of needs which depends largely on people's own perceptions. This will, therefore, be limited by people's experience, knowledge, and expectations. A conventional survey may not provide us with knowledge of how to go about addressing the identified needs. Questions will only be asked in the area of life that the researchers have identified as important, and may completely miss key issues as perceived by the community. Group processes, where people grapple together with analysing their problems and looking at potential solutions, are likely to generate more helpful responses.

All communities have strengths and resources as well as needs, opportunities and problems. It is important to take these into consideration in the needs assessment processes.

Different organisations have different traditions and expectations in terms of needs assessment requirements. Obviously some systematic assessment of need is important to justify the direction of resources to one purpose rather than another. But, the fact is that we all know that there is plenty of 'need' out there – it can be as important to identify opportunities and to assess ideas about ways of meeting needs, as to identify needs themselves. Needs assessment must include work on the organisation's own strategy, and those of surrounding agencies, as well as on collecting information about the potential beneficiaries of any programme.

### 3.3.2 Stakeholder Analysis

Stakeholder analysis is part of any programme planning. Stakeholders are people, groups, or institutions with interests in a programme. It is helpful to distinguish between primary stakeholders, who are those directly affected (either positively or negatively), and secondary stakeholders, who are intermediaries in the process / or those not directly affected. The uses of stakeholder analysis in development research are to

- identify various groups that have an interest in a project or proposed project
- better understand client or beneficiary interest, needs, and capabilities
- understand the interests, needs, and capabilities of other groups and identify opportunities and threats to implementation
- assess which groups should be consulted or directly involved in programme planning and implementation.

The process that is followed is essentially one of analysing information about the various stakeholders to assess their likely responses to the project, and, thus, to plan a strategy to win people over or, at least, to reduce their resistance to an innovation. The information you need to base this on could be collected through all the usual methods – interviews, survey data wherever available, institutional appraisals, and observation. Carrying out an analysis like this could at least prove a useful way for a team to share its knowledge of the different groups involved. The analysis can lead into

an inclusive planning process. The process followed can be summarised as follows

identify and list all stakeholders (divide primary stakeholders into relevant sub-groups; consider the poorest; consider gender issues)

draw out the stakeholders' interests (what benefits may they gain? What resources may they commit? Do they have other interests which may produce conflict?)

assess stakeholders' power and influence

assess which stakeholders are important for the success of the project

identify the assumptions which must be made about what role each stakeholder group will play for your project to succeed – and consider the risks if there is a negative response

Check your information carefully, if possible drawing on more than one source.

### 3.3.3 Social Assessment

Social Assessment provides a framework for beneficiaries to have equitable access to development opportunities. It helps in lending a helping hand to the vulnerable and the poor to voice their concerns during project formulation. Technically, social assessment is done in terms of the following five entry points

i) social diversity and gender analysis

ii) institutional rules and behaviour

iii) stakeholders

iv) participation

v) social risk and vulnerability

Of all these, the most important as emphasised by organisations like the World Bank is, institutional rules and behaviour, and participation. Institution's rules and behaviour analyses the role an institution plays in affecting change and ensuring community participation through techniques presented below.

Social assessment, as a process, starts by analysing the institution's rules and behaviour. It helps in appraising the institutional capacity of the project implementing agency. Social analysis focuses on institutional rules and behaviours, both formal and informal, which is likely to affect the project's development objectives. It analyses groups characteristics, relationships (intra group and inter group) with institutions and the community.

### 3.3.4 Beneficiary Assessment

Beneficiary assessment is defined as a qualitative research tool that is used for improving the impact of development operations by analysing the views of the intended beneficiaries regarding an ongoing reform/process. This process starts as a consultation with project beneficiaries and other stakeholders to help them in designing development activities, and to list down any potential constraints and in obtaining feedback on reactions to intervention during the implementation process.

Beneficiary assessment, like social assessment provides the target population with the opportunity to voice their opinions, needs and concerns regarding

the development process. Thus, it is also a process of (i) listening to the issues and concerns of the poor and disadvantaged beneficiaries, and (ii) obtaining feedback on project interventions. Beneficiary assessment is a qualitative method of investigation that relies primarily on the following three data collection techniques

i) In-depth Interviews

ii) Structured and Unstructured Focus Group Discussion

iii) Direct Observation and Participant Observation

Beneficiary Assessment is usually carried out with individual beneficiaries or with groups with a smaller sample size.

### 3.3.5 Social Audit

Social Audits are concerned with the social consequences of a particular action. Social audit process enables you to assess and demonstrate the social benefits of a given programme or project. This is also a kind of social reach and effectiveness analysis of a given programme / intervention. Initially, it was considered informal and so it had no structures. But, later on, some sort of commonality has been established across various audits. As part of good governance, and as elements of transparency and accountability, social audit these days come with specific structures also which are generic and can be customised to suite the context. The social audit element of National Rural Employment Guarantee Scheme (NREGS) can be one of the best examples to put it across.

In 1981, an organisation known as TSO (Third System Organisation) developed the concept of social audit. TSO has also developed some toolkits for social audit across programmes. Social audit is based on three key elements: social targets, internal view, and external view as a process of auditing, though social audit in its various forms and adaptations are used in developing countries.

The social audit process is defined as the way in which a social audit is planned and carried out. It encompasses various steps related to preparation for managing the social audit, that is, setting the criteria and target, monitoring progress, and finally evaluating the flow of benefits. At the end of each of the elements, audit teams use internal verifiable indicators to monitor the project's activities and actions. Social audit teams use social target sheets as a series of planning tools to set targets, which ultimately helps in promoting good practice. These social targets together provide the planned and actual framework for measurement.

### 3.3.6 Baseline Studies

Baseline studies should take place before a programme starts. It is aimed at understanding the nature and extent of a problem so as to have a well informed planning. Baseline would also be very helpful to compare the changes that have taken place from the conditions with which things started at square one. A baseline study aims at providing a reference point against which changes can be measured so that the impact of the programme or of external factors can be measured.

The collection of data pertaining to an existing situation, a systematic look at what is at present being done to address the problem, and some minor

field work to get basic information about how the issue is experienced in the community, should be undertaken. For large scale programmes, which are seen as demonstration projects, a more rigorous study will be needed. Points that need to be considered include: which key factors should be the planned intervention impact? What can be used as observable, quantifiable indicators? Evidence of effectiveness is important, therefore, baseline research is very important as well.

### 3.3.7 Community Consultation

These are deliberative processes, meaning that the people involved discuss and deliberate over an issue, and reach a decision. This is, obviously, different from individual-focused research methods such as questionnaires as it involves group discussion. But, it is also very different from a focus group, for example, where people are asked to draw on their specific experience and put forward their views, but are specifically briefed that they need not reach agreement with the other members in the group. This might look almost like a public hearing taking place in several places of a region.

### 3.3.8 Participatory Poverty Assessment

In 1999, the World Bank undertook a global research study called 'Consultations with the Poor'. The purpose of the study was to enable a wide range of poor people in diverse countries and conditions to share their views in such a way that they can inform and contribute to the concept and content of the World Development Report, 2000-01. It was also expected to provide a micro level perspective of the poor people's own experience of poverty and responses to it, illuminating the nature of risk and vulnerability. The following were the four main themes for the analysis of the study

- exploring wellbeing
- priorities of the poor
- institutional analysis
- gender relations.

This requires a checklist of issues and the methods of development research (or participatory research) employed in the study. The checklist along with a research plan should include: themes, data requirements, and methods. The researcher must constantly bear in mind if the method employed would produce the data he or she is looking for, under each theme.

### 3.3.9 Sustainable Livelihood Analysis

The Department for International Development UK has developed a framework known as the sustainable livelihood framework, which presents a comprehensive analysis of the main factors that affect people's livelihoods, and typical relationship between these. The framework can be meaningfully used to assess the contribution of the existing activities for livelihood sustainability and to plan new development activities for sustainable livelihood. The core issues presented in the framework are

- livelihood assets, which include human capital, social capital, physical capital, natural capital and financial capital, having a strong influence on the livelihood of the people

structures and processes which represent organisations, institutions, policies and legislation that shape livelihood

livelihood strategies which denote the range and combination of activities and choices that people make in order to achieve their livelihood goals

vulnerability context which speaks about shocks (drought, flood, storm, civil conflicts and epidemics), trends, seasonal shifts in prices, employment opportunities, food availability which affect peoples' livelihoods

livelihood outcomes which are the achievement or outputs of livelihood strategies.

The framework is quite comprehensive and provides a vivid picture of appraising various issues. The framework does suggest various participatory research methods and other conventional methods that are to be judiciously used to appraise and analyse various issues connected with sustainable livelihood.

### 3.3.10 Analysis of Hunger

Hunger is the starkest form of human deprivation. It is the inability to secure food needed to support a healthy life. More pervasive in impact are malnutrition and undernourishment. Although acute hunger or famine receives more attention, it should be remembered that the great majority of hunger deaths comes not from starvation but from nutrition related sickness and diseases.

Availability of food is a necessary condition to end hunger. But it is not a sufficient condition to ensure security of food for all. Nutrition security requires physical and economic access to a balanced diet and a conducive environment for its effective biological utilization. Freedom from hunger is the first step in the alteration of poverty and is a prerequisite for active participation of the people in the economic activity. Hunger depletes strength and reduces the immune competence of the people and makes them vulnerable to infectious diseases, aggravating further the problems of hunger. Non food factors play an important role in determining both access and effective biological utilization. This is why food security involves attention to sustainable livelihoods, safe drinking water, environmental sanitation, primary health care and basic education. Any analysis on hunger should take care of all these factors. Development research methods, along with conventional methods of research can be meaningfully employed to assess hunger and hunger related issues.

The themes generally included are

identification of hunger prone families

targeting the poor

livelihood sources and opportunities of the needy families

local factors responsible for well-being and ill-being

the cyclical and seasonal nature of hunger

availability of facilities and services

effectiveness of institutions

allocation and reach of various schemes

assessment and prioritization of possible option for development activities

nutritional status assessment.

### 3.3.11 Vulnerability Analysis

Vulnerability is defined as an exposure to risks, which the people are not able to cope up with. In other words, the people especially the poor, the marginalised, the deprived, and the powerless, do not have the wherewithal to effectively face risks to which they are exposed. Vulnerability analysis assumes importance in the context of sustainable livelihood analysis and poverty assessment. Rapid assessment of vulnerability can be attempted using participatory research methods. The focus of research pertaining to vulnerability can have the following standpoints

identification of vulnerable groups

focusing

identification of causes

trends in vulnerability

institutional analysis (including governmental and non-governmental)

resource analysis (including common and private property resources)

gender analysis

future vision.

### 3.3.12 Institutional Analysis

Institutional analysis studies how institutions behave and function according to both empirical rules and theoretical rules. Participatory research methods can be effectively used to assess the functioning of any formal or informal grassroot level organisation. There was a study undertaken by the Rural Extension Wing of the Gandhigram Rural University in Tamil Nadu using participatory research methods. The idea was to find out the causes for the dormancy of a milk producers' cooperative society and to ascertain the feasibility of reviving the society. After reviewing the secondary sources of data, a battery of participatory research methods was used to analyse the various issues related to the dormancy of the society. The issues that were analysed include

milk production and productivity

historical profile of the dairy cooperative society

change in the production and marketing of milk

season-wise problems and prospects

persons behind the rise and fall of the society

circumstances that led to the closure

the consequences of closure

revival possibilities of the society

decision on the sources of marketing

community/milk producers options / and decisions on the options.

Thus institutional analysis can be used to assess the capacity and behaviour of organizations that carry out reforms.

### 3.3.13 Action Research

Action research recognises explicitly that it is concerned about change, and that the people who need to implement the change should be directly involved in investigating the issues surrounding it. Action research views data collection, analysis, and reflection on it as part of a cycle, of which action is a key element. It is recognised that research questions arise originally from the experience of people working in the field and reflecting on their work. Action research usually involves introducing new practice, and then testing how well it goes. It is seen as a kind of experiment, in a real life setting, and, in action research, implementation is the real test. Action research is about finding local solutions to local problems – solutions which are fully owned by the key participants. The people most directly concerned with the issue have been seen as the people most important to involve in action research process.

In many ways development work could be seen as action research. There is, perhaps, more concern for systematic recording in action research. Analysing problem from the perspective of those who experience the problem and, trying to find a solution from among them for joint implementation is what action research is all about. This is being widely used. Any research commencing from baseline to designing an intervention, and implementing the same could be viewed as action research.

In this section, you studied the application of development research and appraisal of existing situation. Now, answer the questions given in C*heck Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are the methods used for the appraisal of existing situation?

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2. How is application of development research useful?

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## 3.4 FORMULATION AND IMPLEMENTATION OF DEVELOPMENT RESEARCH PROJECT

The concepts involved in the research project proposal formulation and implementation are as follows

### 3.4.1 Meaning of a Project Proposal

A proposal is 'a statement of purpose and plan' that is presented for someone's acceptance. It intends to persuade that person or agency to fund your project.

It states the problem, or analyses the situation.

It offers a plan with clearly stated goals, objectives, and strategies for solving the problem.

It makes a request for the resources needed to accomplish the plan.

It demonstrates probable success, that is, it shows that you are capable of doing what you say you will.

It offers a commitment that you will show by certain specified measures that you have accomplished what you said you would.

### 3.4.2 Types of Project Proposals

Types can be explained at two levels, based on time and nature. Projects based on time are at the pilot or experimental level, and at full length project level. Pilot projects are usually meant for experimentation. It can be for understanding a specific situation or for testing the validity of a solution at the micro level before it is scaled up at full length project level. Projects based on nature are

(i) research project proposals

(ii) action project proposals

(iii) business project proposals.

**(i) Research Project Proposals**: these are usually research studies that aim at understanding a situation. These studies try to understand certain problems or to record the social realities, and to try to find ways to go about solving a problem, or to come out with certain policy recommendations, or to develop a specific conceptual package for implementation. Universities and research departments of the government usually undertake research studies. These require sound academic knowledge about research methodology and its application.

**(ii) Action Project Proposals**: these are project ideas that give description of a problem, and a plan for solving that problem. The ideas contained in this type of projects are meant for action, meaning that these ideas translate into action for the benefit of a target population who are experiencing the stated problem.

**(iii) Business Project Proposals**: There are proposals meant for identifying business prospects in terms of raw materials availability, capacity for converting raw materials into finished products, the financial viability and market prospects of the project idea. The small business and micro entrepreneurial ventures of SHGs can be stated as examples of this type of proposal.

### 3.4.3 The Process of Project Formulation

This is also known as the 'Phases of Project Planning' or 'Phases of Project Formulation', or 'Project Planning Cycle'.

Project planning can be presented in the following five distinct phases

**(i) Situational Appraisal (Base line Study):** a good initial situation analysis is necessary for good project planning and implementation. Goals, activities, and resource mobilization as inputs are all meaningless without understanding the context of the target group, the environment, local institutions, social values, and the relationships. All planning must, therefore, be based on knowledge of the real situation, and of the various factors which have formed it. On the basis of these data a community profile can be developed.

**(ii) Needs Assessment*:*** needs assessment deals with the question: who needs what, as defined by whom? This is an essential consultation process which lets the project writer identify all the needs, then develop a community prioritization of needs, and levelling of needs. No one project can address all the identified needs, hence, the need for prioritization. The negotiating process should bring consensus on which priorities should be first addressed.

**(iii) Project Designing*:*** determining goals, objectives, activities, strategies based on prioritized needs are essential for successful project planning. This is called project designing. They set the direction of the project and are the terms of reference for monitoring progress. While designing the project, it is important to consider the actual needs, practical constraints, and likely possibilities. This means that we need to reconsider the needs, and how to go about fulfilling the needs despite the external conditions which are beyond the control of the project.

**(iv) Developing Detailed Implementation Plan*:*** based on the project design usually a detailed implementation plan is prepared with a time frame. This is identifying individual activities and sequencing them with a timeframe. This is done either as a Gantt chart or simply as a Quarterly Forward Plan (broken down from the Annual Operating Plan). This process also determines the allocation of human, financial, and material resources on various activities. This serves as an indicator to measure progress fortnightly through an internal project review.

**(v) Developing Indicators for Evaluation:** this is done especially to understand periodical project outcome or long term project impact on the target population. This can also serve as monitoring indicators later on for external evaluators. This is formulated, taking cues from the project goal, objectives, activities, and the desired outcome of the project.

### 3.4.4 Project Implementation

In this step**,** a detailed implementation plan should be presented. Basically, this is the section of the project where you will describe how you are going to carry out the project to achieve your outputs and project objectives. It can be presented in a step-by-step presentation of activities. Some points to consider are

(a) how you intend to involve the local people and their contribution to the project

(b) the number and kind of personnel needed

(c) administrative and supervisory responsibilities

(d) the method of implementation

(e) quantified resources would be required at each step

In this section, we discussed the formulation and implementation of a development project. Now answer the questions given in C*heck Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What do you mean by project proposal? What are its components?

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2. What are the types of project proposals?

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## 3.5 MONITORING AND EVALUATION OF DEVELOPMENT RESEARCH PROJECT

Monitoring is a management tool for tracking progress of ongoing projects. The basic idea is to compare actual performance with plans and to measure actual results against expected results. It means, checking the progress, watching, tracking, finding relative position of a project as to where the project stands, compared to where it should be as per plan.

### 3.5.1 Monitoring

**Monitoring comprises**

measuring the ongoing project activities (where we are)

monitoring the project variables (cost, effort, scope, etc.) against the project management plan and the project performance baseline (where we should be)

identifying corrective actions to address issues and risks properly (How can we get on track again)

influencing the factors that could circumvent integrated change control so only approved changes are implemented

**(i) Answers questions such as**

What progress have we made?

What are the problems?

How far have we gone?

How much more to go, do we need to change our strategies and approaches?

**When done:** ongoing, at regular intervals (once in three months/ six months)

**For whom:** it is usually internal, especially meant for the project director and project staff. It is needed for the donor who funded the project as well.

**(ii) What to monitor and evaluate?**

**Inputs:** money, materials, human resources.

**Activities:** what has been done, when, how much.

**Processes:** how activities are being implemented; how milestones are reached.

**Outputs:** direct results of activities, what results have been achieved immediately.

**Outcomes / effects (Impact):** what is achieved in the short to medium term?

### 3.5.2 Issues Surrounding Monitoring and Evaluation

Input monitoring

Activity monitoring

Process monitoring

Output evaluation

Impact evaluation

**Illustration from Monitoring and Evaluation of a Watershed Project is given below.** These are

**Inputs monitoring:** money, materials, human resources

**Activities monitoring:** a set of tasks performed (e.g. area survey, transect walk plus mapping, SHG group formation, SHG meeting, plan for watershed development)

**Process monitoring:** a set of activities, towards a common purpose (group formation, watershed committee, engineering survey)

**Outcomes evaluation:** series of effects of some action and activities (e.g., reduced run off, increased recharging, increased water table).

**Impact evaluation:** changes in people's lives and livelihoods (e.g., increased income, reduced morbidity, increased capacity to negotiate, and remunerative cropping pattern)

**Outputs evaluation:** the number of groups formed, number of check dams constructed, number of percolation ponds desilted or created, trees planted, soil moisture increased)

| Type of Indicator | Recommended frequency of measurement |
|---|---|
| Input | Continuously |
| Process | Quarterly, Semi-annually, or annually |
| Output | Quarterly, Semi-annually, or annually |
| Outcome | 1 to 3 years |
| Impact | 2 to 5 years |

The steps involved in participatory monitoring and evaluation are

review objectives and activities

review reasons for evaluation

why are we doing evaluation

what do we want to know

develop evaluation questions

decide who will do the evaluation

identify the direct indicators and indirect indicators

identify the information sources for evaluation questions

determine the skills and labour that are required to obtain information

determine when information gathering and analysis can be done

determine who will gather information

analyse and present the results.

### 3.5.3 Project Sustainability

An important aspect that has to be taken into consideration during the project monitoring and evaluation stages is project sustainability. Increasingly, donors want to know how the activity will be continued once their grant is expended. It is a good idea to address this point in every project.

**Financial sustainability**: meaning the proposal should indicate how the project can continue or be sustained after donor funds are expended

**Technical sustainability:** meaning the proposal should indicate how the technical requirements of the project can be continued even after the project period is over; **Managerial sustainability**: meaning the proposal should show that the local target group and or applicant will continue to provide organizational or managerial inputs after donor funding closes.

In this section, we discussed monitoring and evaluation of a development project. Now answer the questions given in C*heck Your Progress-3.*

**Check Your Progress 3**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What do you mean by monitoring and evaluation?

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2. What are the steps involved in monitoring and evaluation of development project?

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## 3.6 LET US SUM UP

Development research is applied in a wide spectrum of fields such as agriculture, watershed, forestry, poverty reduction, gender issues, technology assessment, bio diversity, health, nutrition, reproductive health, education, resettlements and rehabilitation of project affected people, and so on. Whatever might be the broad areas of application, development research needs to start with the appraisal of the existing situation. Then comes project formulation and implementation.

The project formulation goes through five phases, viz., situation appraisal, needs assessment, project designing, project implementation plan, and developing indicators for evaluation.

While formulating the project, we need to be clear about the monitoring system we are going to adopt. Monitoring should encompass issues related to inputs, activities, process, outputs and impacts. It is essential that we need to develop indicators related to above issues. While we develop indicators we should be able to differentiate between process monitoring and progress monitoring. Process monitoring is basically concerned with key processes for project success whereas progress monitoring is primary concerned with physical inputs and outputs. We should also decide in advance what type of evaluation system we are going to adopt for the project. The Participatory Evaluation System is quite essential for development project because it eliminates many of the shortcomings that we find in conventional forms of evaluation.

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## 3.8 CHECK YOUR PROGRESS-POSSIBLE ANSWERS

**Check Your Progress 1**

1. The methods used for the appraisal of situation are Needs Assessment, Stakeholder Analysis, Social Assessment, Beneficiary Assessment, Social Audit, Participatory Poverty Assessment, Sustainable Livelihood Analysis, Analysis of Hunger, Vulnerability Analysis, Institutional Analysis, and Participatory Evaluation.
2. There are five areas where this research can be particularly interesting, relevant, and rewarding. These include
   (i) research on development policy
   (ii) working with civil society or Non-Governmental Organisations (NGOs)
   (iii) interpreting the imagery of development
   (iv) understanding the historical construction of development
   (v) using the potential of information and communication technologies (ICTs) to contribute to development practices.

**Check Your Progress 2**

1. A proposal is 'a statement of purpose and plan' that is presented for someone's acceptance. It intends to persuade that person / agency to fund your project. Its components are: Title Page, Table of Contents, Project Summary, Introduction, Project Context, Problem Statement, Objectives, Anticipated Outcomes or Results, Implementation Plan (work scope), Project Evaluation, Project Budget, Project Sustainability, Appendices.
2. Types of Project Proposals can be explained at two levels, based on time and nature. Projects based on time are at the pilot or experiment level and at full length project level. Pilot projects are usually meant for experimentation. It can be for understanding a specific situation or for testing the validity of a solution at the micro level before it is scaled up at full length project level. Projects based on nature are
   (i) Research Project Proposals
   (ii) Action Project Proposals
   (iii) Business Project Proposals

**Check Your Progress 3**

1. Monitoring and evaluation is a management tool for tracking progress of ongoing projects. The basic idea is to compare actual performance with plans and to measure actual results against expected results. It means, checking the progress, watching, tracking, finding the relative position of a project as to where the project stands compared to where it should be as per plan.
2. The steps involved in participatory monitoring and evaluation are review objectives and activities, review reasons for evaluation, why are we doing evaluation, what do we want to know, develop evaluation

questions, decide who will do the evaluation, identify the direct indicators and indirect indicators, identify the information sources for evaluation questions, determine the skills, and labour that are required to obtain information, determine when information gathering and analysis can be done, determine who will gather information.

# MDV-106: RESEARCH METHODOLOGY IN DEVELOPMENT STUDIES

(6 CREDITS)

| BLOCK | UNIT NOS | UNIT TITLES |
|---|---|---|
| 1 | | **Fundamentals of Social Science Research** |
| | 1 | Social Science Research: An Overview |
| | 2 | Components of Social Science Research |
| | 3 | Research Designs |
| | 4 | Research Project Formulation |
| **2** | | **Development Research** |
| | **1** | **Basics of Development Research** |
| | **2** | **Methods of Development Research** |
| | **3** | **Development Research Applications** |
| 3 | | Measurement and Sampling |
| | 1 | Measurement |
| | 2 | Scales and Tests |
| | 3 | Reliability and Validity |
| | 4 | Sampling |
| 4 | | **Data Collection** |
| | 1 | Quantitative Data Collection Methods and Devises |
| | 2 | Qualitative Data Collection Methods and Devises |
| | 3 | Data Sources |
| 5 | | **Data Analysis** |
| | 1 | Overview of Statistical Tools |
| | 2 | Use of Computer in Data Analysis |
| | 3 | Data Processing and Analysis |
| | 4 | Report Writing |

Indira Gandhi National Open University
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# MDV-106
# Research Methodology in Development Studies

Block

# 3

## MEASUREMENT AND SAMPLING

**UNIT 1**
**Measurement** **5**

**UNIT 2**
**Scales and Tests** **20**

**UNIT 3**
**Reliability and Validity** **36**

**UNIT 4**
**Sampling** **50**

## PROGRAMME DESIGN COMMITTEE


Prof. Amita Shah
Gujarat Institute of Development Research, Ahmedabad

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

Prof. J. S. Gandhi (Rtd)
Jawaharlal Nehru University, New Delhi

Prof. Gopal Krishnan (Rtd)
Punjab University, Chandigarh

Prof. S. Janakrajan
Madras Institute of Development Studies, Chennai

Prof. Kumar B. Das
Utkal University, Bhubaneswar

Prof. Nadeem Mohsin (Rtd)
A.N.Sinha Institute of Social Sciences, Patna

Prof. P. Radhakrishan
Madras Institute of Development Studies, Chennai

Prof. Ramashray Roy (Rtd)
Centre for Study of Developing Societies, Delhi

Prof. R. P. Singh ( Rtd)
Ex-Vice-Chancellor, MPUAT, Udaipur

Prof. K. Vijayaraghavan
Indian Agriculture Research Institute, New Delhi

Dr. Nilima Shrivastava
IGNOU, New Delhi

Prof. B. K. Pattanaik
IGNOU, New Delhi

Dr. Nehal A. Farooquee
IGNOU, New Delhi

Dr. P.V.K.Sasidhar
IGNOU, New Delhi


## PROGRAMME DESIGN COMMITTEE (REVISED)


Prof. T.S. Papola
Institute for Studies in Industrial Development, New Delhi

Prof. S. Janakrajan
Madras Institute of Development Studies, Chennai.

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

Prof. Preet Rustagi
Institute for Human Development, Delhi

Prof. Gopal Iyer (Rtd)
Panjab University, Chandigarh

Dr. S. Srinivasa Rao
Jawaharlal Nehru University, New Delhi

Dr. S. Rubina Naqvi
Hindu College, University of Delhi, Delhi

Prof. Nadeem Mohsin (Rtd)
A.N.Sinha Institute of Social Sciences, Patna

Prof. Rajesh
University of Delhi, New Delhi

Prof. B. K. Pattanaik
IGNOU, New Delhi

Prof. Nehal A. Farooquee
IGNOU, New Delhi

Prof. P.V.K. Sasidhar
IGNOU, New Delhi

Dr. Pradeep Kumar
IGNOU, New Delhi

Dr. Nisha Varghese
IGNOU, New Delhi

Dr. Grace Don Nemching
IGNOU, New Delhi


## COURSE PREPARATION TEAM


**Unit Writer:**

Dr. V. Sailaja
S. V. Agricultural College, Tirupati (Unit 1)

Mr. P. Shukla
Saket, New Delhi ( Unit 2)

Prof. P. V. K. Sasidhar
IGNOU, New Delhi ( Unit 3)

Prof. V. K. Tiwari
National Institute of Health and Family Welfare
New Delhi (Unit 4)

**Editing and Proof Reading:**

Dr. Nisha Varghese, IGNOU

Prof. B. K. Pattanaik, IGNOU

Prof. Nehal A. Farooquee, IGNOU

Prof. P.V.K.Sasidhar , IGNOU

**Course Coordinator :** Dr. Nisha Varghese, E-mail : nishavarghese@ignou.ac.in

**Programme Coordinators :** Prof. P.V.K. Sasidhar, Prof. B.K. Pattanaik, Prof. Nehal A. Farooquee,


## PRINT PRODUCTION


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# BLOCK 3 MEASUREMENT AND SAMPLING

In development research we have to deal with various social and psychological variables. Their measurement is one of the vital stages in the research process. The measurement of social and psychological variables is a complex and demanding task. There has been increased interest in measurement in social sciences during the past 35 years. The purpose of this block is to make you understand the basic concepts of measurement and sampling.

Unit 1 on '**Measurement'** is devoted to discussing the meaning and nature of measurement, the need and importance of measurement, the levels of measurement, the use of appropriate statistical tests at different levels of measurement, the criteria for judging the measuring instruments and various sources of errors in measurement.

Unit 2 on '**Scales and Tests'** discusses the meaning of scales, important scaling techniques, different types of rating scales, guidelines for construction of rating scales and rating errors. In the second part, this unit discusses the tests, their types and test construction

Unit 3 on **'Reliability and Validity'** discusses the meaning of reliability, important methods for assessing the reliability of measuring instruments, the concept of validity, approaches of validation of measuring instruments, types of validities and the relationship between reliability and validity.

Unit 4 on **'Sampling'** deals with: meaning and concept of sampling, types of sampling, sample design process, errors in sampling and determination of sample size.

# UNIT 1 MEASUREMENT

## Structure

1.1 Introduction

1.2 Measurement – Meaning and Concept

1.3 Importance of Measurement

1.4 Measurement Postulates

1.5 Kinds of Measurement

1.6 Admissible Statistical Tests for Measurement

1.7 Criteria for Judging the Measuring Instruments

1.8 Sources of Errors in Measurement

1.9 Let Us Sum Up

1.10 Key Words

1.11 References and Selected Readings

1.12 Check Your Progress – Possible Answers

## 1.1 INTRODUCTION

Generally, the term measurement is understood as measurement of length, weight, quantity etc. In statistics however, measurement is more broadly used to refer to the ways in which the variables are defined or categorised. In statistics it is broadly termed as scales of measurement. In research one has to deal with different kinds of data. There are certain variables, the data for which meet the requirements with respect to the parameters of the population. Such data can be subjected to various mathematical as well as statistical operations. They are known as parametric data. Nonparametric data on the other hand lack those parameters and hence cannot be added, subtracted, multiplied or divided. Measurement of these two different kinds of data needs different scales of measurement. This unit will deal with the different scales of measurement used in measuring different kinds of data.

After studying this unit you will be able to

- explain the meaning and concepts of measurement in social science research
- describe the levels of measurement that quantify social variables.
- distinguish between various levels of measurement that have been used in the social science research
- describe the importance of measurement.

## 1.2 MEASUREMENT–MEANING AND CONCEPT

Measurement is an inseparable part of any science, natural or social. Any science aims to obtain a specific and accurate measurement of the events, of the characteristics of the different units of a phenomenon, and, of the inter-relationship between the units. Measurement is assigning numbers to objects or events according to rules (Stevens, 1946). The purpose is to

have information in a form in which variables can be related to each other. In social science research we have to deal with various social and psychological variables. Their measurement is one of the vital stages in the research process. Measurement of social and psychological variables is a complex and demanding task.

Measurement, simply speaking, is the assignment of numerals or other symbols or signs (male, female, occupational categories, for example) to objects or events according to a set of operational rules. Measurement always refers to some property of the object or event and not the object or event by itself. In this measuring process, the observer follows a scheme or procedure by which observed events can be classified into non-overlapping categories unambiguously, and the categories are given labels - numerals or symbols. The basic assumption in measurement theory is that every event or object posses a specific quantity of the property under observation. This quantity of the property can be compared directly against a standard scale (as when we measure the length or mass of a material) or can be evaluated fairly accurately by trained observers (judges or experts assessing the level of performance of a student in a debate or in class examination). Often the measurement operations involve the use of mechanical devices such as thermometer, barometer, measuring tape, or weighing scale. The use of such mechanical devices is the least observer dependent, and, hence, the measurements are fairly precise, accurate, and objective. The thermometer, for example, when applied to a given object, gives a number, the temperature. This is a technical refinement of the precision of a crude judgment into categories such as very hot, hot, warm, cold, etc., that are obtained by the impression of the observer when he touches an object with his finger. In social sciences, too, we make use of a physical (not necessarily mechanical) component or stimulus.

Social science research follows a standardized procedure or mechanism, as is followed in the physical sciences. When a scale is applied on a person, it gives us a number (or symbol) on his attitude, IQ, interest, emotional stability, motivation, and so on. It follows, then, that a measurement operation is always a standardized way of proceeding, which may or may not make use of mechanical devices or stimuli, but which always results in classification of the objects measured into some non-overlapping categories labelled by numerals, or simply by symbols. From the viewpoint of mathematics, measurement operation is a standardized rule that maps each of a set of objects into one, and only one, of a set of several categories or numbers.

The first principle of a scientific study is to describe, objectively, what a scientist observed, under what circumstances and communicate the same as precisely as possible. A scientist reports not only what he has observed, but also states the circumstances and the methods he used for such observations. This is a high priority condition because others must be given a chance to verify those observations. In fact, specification of the conditions of observation is the first step in the measurement of a given phenomenon.

Although arguments continue over the nature of measurement, measurement of some form or other has always been there even when social sciences were no more than a branch of speculative philosophy. Quantitative principles from physics and chemistry have given us very highly precise

and accurate measurement in these fields. Biological sciences, off late, have established principles that are nearly at par with those found in physical sciences while, social sciences lag much behind in this respect.

## 1.3 IMPORTANCE OF MEASUREMENT

"Measurement consists of identifying the values which may be assumed by some variable, and representing these values by some numerical notation. The numerical notation is systematically and consistently assigned, that is, it is assigned according to some set of rules."

Thus, the numerals assigned to the variables, indicate different conditions of the variables or different values of the variables or different degrees or intensity of a quality possessed by units. From the above it is evident that

(i) measurement is a purely descriptive process

(ii) measurement implies that the attributes of persons or objects are possessed in varying degrees and the degree of variation can be measured and represented

(iii) measurement, in essence, is a numerical process.

Common objects of measurement in sociology are individual's characteristics, interactions, interrelations, consciousness, participation, socialization, motivation, etc. Some of the properties, of the individuals are visible and easily measurable, such as age, income, height, etc. Some characteristics are abstract and it is difficult to measure them.

These days, both in sociology and psychology, the measurement of beliefs and attitudes is common because of the greater emphasis on a democratic form of government which demands an assessment of peoples' attitude and opinion, from time to time. Besides this, public opinion studies are carried on regularly by various public and governmental agencies. Even the commercial organizations measure peoples' opinion and attitude to know the future market of their products. Polling agencies measure people's opinion and attitude to know the people's preferences for particular political parties and candidates. Thus, they want to predict, on the basis of such polling, the possibility of winning for any particular candidate. Attitudinal studies may also help in predicting an individual's future behaviour and their possible reactions towards different developmental programmes. Such studies might also help in making policies and specially in implementing them. For example, the study of beliefs and attitudes of Indian people towards illness and health measures or family size would help in instituting a social and educational programme to mobilize the people towards vaccination or adoption of family planning.

Measurement and quantification of variables, beliefs, attitudes, etc., do help in statistical manipulation of them, in experiment, and in testing specific hypothesis related to them. Thus, ultimately, it helps in the development and advancement of a theory.

## 1.4 MEASUREMENT POSTULATES

There are three postulates that are basic to measurement. A postulate is an assumption that is an essential prerequisite for carrying out some operations or line of thinking. In this case, it is an assumption about the relations between the objects being measured.

The three postulates that are basic to measurement are as follows.

**(a)** Either (a=b) or (a =/= b) but not both. This postulate says 'a' is either equal to 'b' or not equal to 'b', but not to both. We must be able to assert, either that one object is the same in a characteristic as another, or, it is not the same. In measurement 'the same' does not necessarily mean complete identity. It can mean 'sufficiently the same' to be classed as members of the same set.

Example: Duration of variety X is greater than variety Y:

Yield of variety X is greater than variety Y

Height of a person X is greater than person Y.

**(b)** If (a=b) and (b=c) then (a=c). This postulate says, "If 'a' equals 'b', and 'b' equals 'c', then 'a' equals 'c'. If one member, of a universe is the same as another member, and the second member is the same as third member, then the first member is the same as the third member. This postulate enables a researcher, to establish the quality of set members, on a characteristic by comparing objects.

Example: As large farmers who have T.V. and radio have the same level of mass media exposure as that of the small farmer having T.V. and radio, and, this, in turn, is equal to the marginal farmer having T.V. and radio.

**(c)** If (a>b) and (b>c) then (a>c). The third postulate is of more immediate and practical importance for our purpose. It says "If 'a' is greater than 'b', and 'b' is greater than 'c', then 'a' is greater than 'c'. Other symbols or words can be substituted for greater than (>) less than (<), such as, is at a greater distance than, is stronger than, and so on. Most measurement in psychology and education depends on this postulate. It must be possible to assert ordinal rank order statements, such as 'a' has more property than 'b', 'b' has more of property than 'c', thus, 'a' has more property than 'c'.

Example: Yield of variety X is more than variety Y and yield of variety Y is more than variety Z.

The rate of adoption is higher in innovators than early adopters, than early majority. Innovators> Early -adopters; Early adopter > early majority, then, Innovator > early majority.

In the above section you have studied about the meaning and postulates of measurement. Now, answer the questions given in *Check Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What do you mean by measurement?

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2. Briefly narrate different postulates of measurement?

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## 1.5 KINDS OF MEASUREMENT

The theory of measurement in social sciences actually consists of a system of distinct theories each concerned with a distinct level of measurement. A set of data often will satisfy some of the levels, but not others. It is, therefore, necessary to understand the basic nature of data before applying a particular level of measurement. Choice of an appropriate statistical model for analysis is largely dependent on this level of measurement achieved. The higher the level of measurement, the more informed we are about a variable.

### 1.5.1 Nominal or Categorical Scale

Measurement, in its simplest, most primitive, and weakest form exists when we can substitute numbers (without meaning its numeral values) or symbols to real objects. That is, we use these symbols or numbers merely to classify or categorize objects, persons or even characteristics. A scientist, at the simplest level, must think of a classification scheme so that the different recorded events can be fitted into this scheme of classification. We give each category of event or object a name, or a number, or a symbol for convenience of identification. These symbols or numbers then constitute a nominal or classificatory scale. The categories making up the scale must be mutually exclusive (each observation can be put under only one category) and exhaustive (there are sufficient number of categories so that each observation can be put under some category) and unordered. The categories making up a nominal scale are usually called attributes. Thus, for mammals the attribute, sex, has only two categories: male and female. A population can be classified by the occupations they follow, or, by their rural-urban origin; STD dialling code 033 indicates all telephone subscribers in the Calcutta telephone zone; blue, brown, black, etc., are categories of human eye colour.

How does a scientist get to such a classification scheme? The sources are many. A doctor uses the history of a disease and the symptoms a patient shows for diagnosing a disease into different categories. The physicists

classify elementary particles as electrons, protons, and neutrons depending upon whether the particles are charged negatively, positively, or are neutral. The common sources that are tapped for such classification are listed below.

1. Theoretical considerations (as in atomic structure).
2. Observed similarities and differences in appearance/ behaviour of the objects studied (The Periodic Table of Elements was developed from the observation that certain elements tend to give similar chemical reactions).
3. Practical considerations (the attitude of a group of voters is better understood and explained if they are classified by their age, caste, sex, occupation, etc).

Whatever nature the classification scheme may take, it must adhere to the principles that follow.

In a nominal scale, the scaling operation consists of partitioning a given class into a set of mutually exclusive sub classes. The member of any sub class must be equivalent in the characteristic or the attribute being scaled. The only relation used in this scaling is equivalence. *A* sign of equality (=) symbolizes the relationship. In addition, the relationship of equality is reflexive, symmetric, and transitive. By reflexive we mean x = x for all values of x; by symmetry we mean that, if the relationship of equality holds between x and y, it also holds between y and x, i.e., if x = y, then y = x; by transitivity we mean if x = y, and y = z, then x = z.

Such a classification scheme utilizes only a part of the information about the objects or events being classified. We said earlier, we never measure an object or an event. An object may have many distinguishable properties or attributes. The scientist singles out those attributes only that have relevance to the objectives of his study. Therefore, the act of measurement, however simple or elementary, requires some degree of abstraction from the complex of properties possessed by the event or the object. The level of measurement in a nominal scale is so elementary and crude that many scientists would not like to consider it as measurement at all. Nevertheless, such classification into mutually exclusive categories is a necessary condition for all higher levels of measurement.

On a nominal scale, we are able to classify objects or events into non-overlapping categories purely on the basis of some qualitative character of the studied variable.

### 1.5.2 Ordinal Scale

The ordinal scale enables the researcher to categorize individuals, objects, or survey responses on the basis of a particular characteristic that they have in common. For example, sometimes, the objects in one class of a nominal scale are not merely different from objects in another class on the same scale; they stand in some kind of relationship. Typical relationships among the classes are that the members of one class have more of some property or characteristic than those in other classes. Such a relationship is often designated by the symbol (>), which means ‘greater than’. The symbol > is used to express all such relations between classes as ‘preferred to’, ‘more than, ‘greater than’, ‘higher than’, etc. Conventionally, the number 1 is assigned to the class, which numerically has larger quantity of the property

than all other classes. Number 2 is assigned to that class that has less of the property compared to that of the class given the number 1, but more of it than the rest of the classes, and so on. That is, the numbers in such a classification indicate the place of a category or class in an ordered series. In a sprint event, whoever touches the finishing tape first is given the number 1; the person coming second, the number 2, and so on, for other sprinters, no matter if the second sprinter comes 1 second or 0.04 seconds after the first, the third runner taking 4 seconds, or, more than the runner in the second spot. Such numbers, in an ordered series, constitute an ordinal scale.

The ordinal numbers actually state the relative position or the amount of the characteristic relative to others. The rank of a category depends only upon how many categories are ahead of it in respect to the quantity of the characteristic under comparison and not upon how many classes follow it. The differences of the ordinal numbers do not speak about the absolute differences in the amount of the characteristic the objects posses. **A** secures the first position by aggregating a total of 520 in the examination, **B** coming second with a total of 515, and **C** places in the third spot scoring 450. Although the rank differences between **A** and **B**, and between **B** and **C** are the same, the differences in absolute term of marks obtained in the examination are different. All we can say from an ordinal scale is that **A** is best in the group, **B** the second best (only one has a better record than him); and, **C** is the third best, coming after **A** and **B**, and, so on, with other orders. A large variety of measurements in psychology, sociology and other sciences yield only ordinal data. When a measuring instrument produces ordinal numbers, it is called ordinal scaling.

It is not necessary that the classes in an ordinal scale be expressed only by integers. We can as well use the normal sequence of letters of alphabet to indicate ordering. In many examinations grades A, B, C, D, etc are awarded to indicate the order of classes. We can use any symbol in an ordinal scale as long as the numbers or symbols parallel the order in which the objects are arranged in increasing or decreasing order of possession of the characteristic under observation. However, numerals are more frequently used to help undertake certain statistical operations.

The ordinal scale preserves the relationship of equivalence (=) as when two or more persons have the same level of education and income. It incorporates another relation ‘greater than’ (>). The latter relation is non-reflexive, asymmetrical, but transitive. It really does not matter what number or symbols are given to the pair of classes so long we give a higher grade to the class, that is ‘greater than’ the other. Although we usually give lower numbers for the more preferred grades (1 for the most preferred, 2 for the second most preferred, etc.), we can use higher numbers to denote ‘greater’ or ‘more preferred’ so long we remain consistent in allocation of these numbers (we do it in some non-parametric tests*)*. Allotting the lowest number 1 to the highest rank has the advantage that the rank identification of the class or the individual does not change if more lower order classes or individuals possessing less of the characteristic under study are added to the series. Since a person or object’s rank is always relative to the ranks of others, the rank of the individual or the object indicated by lower number remains unchanged so long as the number of persons or objects above the individual or the object does not change. Rank 1 given

to a student securing 520 marks remains unchanged as long as no one else scores 520, or more. Similarly, rank 2 awarded to the student scoring 499 will remain the same if no one else scores 499, or more. Both ranks are independent of the size of the sample for which ranks are ascertained. This independence of 'rank numbers' will be missing if lower numbers are assigned to lower ranks, higher to higher.

At the ordinal level of measurement, numbers are assigned to objects or events not only to categorize them, but also to indicate a 'greater than' or 'less than' relationship. The scale has no absolute zero point and there are unequal distances between the scale values. Numbers assigned at the ordinal level provide more information than at the nominal level because they also establish an ordering of the objects or events. For example, various television programmes may be categorized according to popularity and assigned rank 1 to most popular and 5 to least popular ones. The programmes can then be ordered according to popularity, but it cannot be ascertained how much more popular one programme is over another, since the numbers do not indicate equal distances among the scale values.

Ordinal level measurement allows objects or events to be ordered by degree on the basis of possession of some characteristic that can be abstracted and measured quantitatively.

### 1.5.3 Interval Scale

When a scale has all the properties of ordinal and ordered metric scale and when we have additional information about how large the distances (intervals) between any two stimuli are, we have achieved a more powerful measurement, stronger than the ordinal. In such a device, a measurement has been achieved in the sense of an interval scale.

To understand the distance function it is necessary to assign 'real numbers' to all pairs of elements in the ordered set. That is, the position of an element or object in the scale is specified by a real number so that such numbers constitute points on an arithmetic scale with a common and constant unit of measurement. The ratio of any two intervals indicated by the real numbers, however, is independent of the unit of measurement and there is a lowest end point, the zero point. Thus, the ratio of two intervals 32cm and 40cm, and 1 00cm and 140cm is 1:5, which has no unit. If a constant, say 10cm is added to each of the interval points, i.e., if the new intervals are 42cm - 50cm and 110cm - 150cm respectively, the ratio between the two intervals remains the same.

Interval measurement should be used with due caution, especially when comparing differences between two or more attributes. Comparisons are meaningful when the origin, zero, for both the scales is the same and the units of measurements are identical. Measuring temperature with a thermometer, measuring the time from a selected starting moment, measuring the altitude from mean sea level are all done with interval scales.

The interval scale has all the properties of a nominal scale (equivalence relation), an ordinal scale (greater than or transitivity relation) and an ordered metric scale (transitivity relation in respect to distance between classes). In addition, this scale is able to specify the ratio of any two intervals. It is, therefore, to be regarded as more powerful measurement compared to the three others already discussed.

Interval scale puts objects or events into a continuum with such units that measure intervals of equal distance. The starting point zero of the scale is arbitrarily chosen.

### 1.5.4 Ratio Scale

Ratio scale provides the most powerful measurement for it satisfies not only all the characteristics of an interval scale, but has also an additional and vital characteristic - that it has an invariant or absolute zero. This invariant zero point introduces a new dimension in mathematical operations. Not only is the ratio of intervals of two classes independent of origin and unit of measurement, the numbers associated with scale points can be expressed as ratios independent of the unit of measurement. In an interval scale (the origin is arbitrary) we could not say that a score of 60 obtained by A is twice as large as the score of 30 obtained by B, for the simple reason that the zero point was chosen arbitrarily. If 5 is added to each score, the translated score of A will now read as 65 and is not twice as large as B's translated score 35, although the differences between the two sets of scores (60 - 30 and 65 - 35) remain the same. This shows that if we have an absolute zero in a scale, the scale values can no longer be translated, but can only be multiplied (or, divided) by a scalar. In the example cited in connection with measure of authority, we could not possibly associate a 'zero authority' with any regular staff member of a university.

Ratio scale is most commonly encountered in physical sciences. The weights of two objects whether measured in pounds or kilograms always yields the same ratio. The same is true of the length of two objects, or time taken by two individuals to complete a specific job.

A measurement will be said to be in ratio scale if it is possible to operationally attain the four relations: (i) equivalence (ii) greater than (iii) known ratio of any two intervals, and (iv) known ratio of any two real numbers associated with any two points on the scale.

Ratio scale places objects or events on a continuum, which has a rigidly defined starting point (real zero), such that the variable quantities (real numbers) can be expressed in terms of ratio of another number.

**Table 1.1: Examples of Questions in Each of the Five Basic Scale**

| S.No. | ScaleType | Examples |
|---|---|---|
| 1. | Nominal Scale | Do you like the quality of health care services provided by your health centre<br>Yes-1 No-2 |
| 2. | Ordinal Scale | If you are asked to rate the quality of health care services provided by the primary health care centre, how will you rank it?<br>Excellent-1<br>Very Good -2<br>Good-3<br>Average-4<br>Poor-5 |

| | | |
|---|---|---|
| 3. | Interval Scale | In the past twelve months, how many times have you gone for check up to the primary health centre?<br><5 times – 1<br>6-10 times – 2<br>11-15 times – 3<br>>16 times – 4 |
| 4. | Ratio Scale | In the past twelve months, how much of money have you spent on health care?<br>Amount of money spent…… |

## 1.6 ADMISSIBLE STATISTICAL TESTS FOR MEASUREMENT

The application of various statistical tests for different categories of measurement scales are discussed below.

**Statistical Tests for Nominal scale:** since the symbols or labels attached to any category are arbitrary and can be interchanged without altering essential information contained in the scale, the only kind of descriptive statistics that can be used are those, which would not be affected or altered by such interchange. They are crude mode, proportion and frequency. The nominal scale data, however, can be used for testing of hypothesis relating to distribution of events among the classes. Chi-square test, Contingency Coefficient, and certain other tests based on binomial expansion can be used for the purpose.

**Statistical Tests for Ordinal scale:** median is the most appropriate measure of central tendency of the scores that are in an ordinal scale. Obviously, quartile deviation is the measure of dispersion for such data. There are a number of non-parametric tests to test a hypothesis with scores in an ordinal scale - runs test, sign test, median test, Mann Whitney U- test, etc. These tests are often referred to as ‘order statistics’ or ‘ranking statistics’. Interrelations can be computed from rankings of two sets of observations on the same group of individuals. Spearman’s Rank Difference, or Kendall Rank Correlation coefficients are appropriate for such situations.

For applying tests to measurements on an ordinal scale, we make an assumption that the observations are drawn from a distribution, which is essentially continuous. Such assumptions are also made for all parametric tests. A continuous variate is one that is not restricted to having only isolated values. Given a certain limit (interval between two classes), we can have any number of values inserted in between. With an increase in the number of observations, more and more of these values are likely to be represented. It will suffice, at this point, to remind the readers that very often the crudeness of our measuring devices obscures the underlying continuity that may exist. The classification of respondents with respect to an attitude statement into categories strongly agree, agree, neutral, disagree, strongly disagree essentially presumes the presence of a continuum. If a variable is truly continuous and if the instrument for measuring the property in

question is sensitive enough, then the probability of obtaining a tied observation is extremely small.

**Statistical Tests for Interval Scale:** the interval scale preserves both the ordering of objects and the relative differences between them, even though the numbers associated with the position of the object may be changed, following a regular system. A set of observations will be scalable by interval scale if the data permits a linear transformation, that is, if the equation Y = a + bX, where 'a' and 'b' are two positive constants, satisfies a set of real numbers, the numbers are said to be in an interval scale.

All the common parametric tests - arithmetic mean, median, standard deviation, product-moment correlation, etc., are applicable to data that follow an interval scale. Parametric tests for statistical significance like Z, t, F are also applicable to data in interval scale.

**Statistical Tests for Ratio scale:** since the values in a ratio scale are real numbers with a true zero (no upper limit) and only the unit of measurement is arbitrary, the ratios between two numbers and intervals preserve all the information contained in the scale even if these true numbers are multiplied by a true positive constant. Any statistical test, parametric or non-parametric, is usable when a ratio scale is used, such statistical tools as geometric mean and coefficient of variation, which require knowledge of true scores, can be used with observations that are in ratio scale.

**Table 1. 2: Analysis Method in Various Scales**

| Scale | Basic Operation | Measure of Central Tendency | Other Appropriate Statistics |
|---|---|---|---|
| Nominal | Puts objects into classes, i.e., male/female, marital status, occupation | Mode | Chi-square |
| Ordinal | Determination of greater or less, i.e., preference, level of education achieved | Median | Rank Order Correlation, Man Whitney U-test |
| Interval | Determination of equality of intervals or differences, i.e., temperature | Arithmetic Mean | Correlation Coefficient |
| Ratio | Determination of equality of ratios, i.e., weight, income, number of visits | Geometric Mean, Harmonic Mean | Coefficient of Variation |

**Source:** *John boyce, Marketing Research, Mc Graw Hill, Australia, 2005.*

## 1.7 CRITERIA FOR JUDGING THE MEASURING INSTRUMENTS

A measurement, too, must satisfy certain criteria. The most important criteria to be used in evaluating a measurement tool are described below.

i. **Unidimensionality:** this means the scale should measure one characteristic at a time, e.g., the ruler should measure length**,** not temperature.

ii. **Linearity:** this means that a scale should follow the straight-line model. Some scoring system should be devised, preferably one based on inter-changeable units. In a ruler an inch is an inch whether it lies at one end of the ruler or at the other, but in altitude scales such interchangeability cannot be ensured. In such cases, ranking is preferable.

iii. **Validity:** this refers to the ability of a scale to measure what it is supposed to measure.

iv. **Reliability:** this is an attribute of consistency. A scale should give consistent results.

v. **Accuracy and Precision:** a tool should give an accurate and precise measure of what we want to measure.

vi. **Simplicity:** a scale should be as simple as possible; an elaborate, complicated, and over - refined scale may become unduly cumbersome, costly or even useless.

vii. **Practicability:** this is concerned with wide range of factors like cost effectiveness, convenience and interpretability. Some trade off is usually needed between an 'ideal' tool and, that which the budget can afford. The benefit to be derived should be commensurate with the cost incurred.

The tool should be easily administrable; it should contain proper instructions; it should be easily understandable and conveniently arranged for easy completion. In order to enable others to interpret the results of a test, there is need for such aids as a statement of its function, its construction procedure and guides for interpreting the result.

## 1.8 SOURCES OF ERRORS IN MEASUREMENT

Measurement should be precise and unambiguous in an ideal research study. This objective, however, is often not met in entirety. As such, the researcher must be aware about the sources of error in measurement. The following are the possible sources of error in measurement.

**(a) Respondent:** at times the respondent may be reluctant to express strong negative feelings, or, it is just possible that he may have very little knowledge but may not admit his ignorance. All this reluctance is likely to result in an interview of guesses. Transient factors like fatigue, boredom, anxiety, etc., may limit the ability of the respondent to respond accurately and fully.

**(b) Situation:** situational factors may also come in the way of correct measurement. Any condition which places a strain on interviews can have serious effects on the interviewer- respondent rapport. For instance, if someone else is present, he can distort responses by joining in or merely by being present. If the respondent feels that anonymity is not assured, he may be reluctant to express certain feelings.

**(c) Measurer:** the interviewer can distort responses by rewording or reordering questions. His behaviour, style and looks may encourage

or discourage certain replies from respondents. Careless mechanical processing may distort the findings. Errors may also creep in because of incorrect coding, faulty tabulation and /or statistical calculations, particularly in the data analysis stage.

**(d) Instrument:** error may arise because of the defective measuring instrument. The use of complex words, beyond the comprehension of the respondent, ambiguous meanings, poor printing, inadequate space for replies, response choice omissions, etc., are a few things that make the measuring instrument defective, and may result in measurement errors. Another type of instrument deficiency is the poor sampling of the universe of items of concern.

The researcher must know that correct measurement depends on successfully meeting all of the problems listed above. He must, to the extent possible, try to eliminate, neutralize, or, otherwise deal with all the possible sources of error so that the final results may not be contaminated.

In the above sections, you read about various kinds of measurement and statistical tests to be used in measurement. Now answer the questions given in *Check Your Progress-2*.

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is interval scale?

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2. Write three important criteria for judging the measuring instruments.

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## 1.9 LET US SUM UP

In this unit, we discussed the meaning, concept, postulates and levels of measurement. Measurement is an undetachable part of any science, natural, or social. Any science aims to obtain a specific and accurate measurement of the events, of the characteristics of the different units of a phenomenon and of the inter-relationship between the units. The theory of measurement in social sciences really consists of a system of distinct theories each concerned with a distinct level of measurement. A set of data often will satisfy some of the levels, but not others. It is, therefore, necessary to understand the basic nature of data before applying a particular level of measurement. The choice of an appropriate statistical model for analysis is largely dependent on this level of measurement achieved.

Sometimes discrimination is made between scales on the basis of power of measurement. The scales like nominal, ordinal, and ordered metric scales are less powerful because they do not make use of all the information contained in the data. As such, such measurements are referred to as scales by many of its users. The more powerful measurements like interval and ratio scales, on the other hand, make full use of all information contained in a set of observations, and, therefore, are labelled as measurements; whereas, the former scales refer mostly to qualitative aspects of measurement, the latter ones deal with quantitative measurements.

## 1.10 KEY WORDS

**Measurement** : the process of assigning symbols/numbers to dimensions of phenomena in order to characterize the status of a phenomena as precisely as possible.

**Scale** : a device to measure something. Scaling technique is used in ordering a series of items along some sort of continuum. In short, they are methods of turning a series of qualitative facts into a quantitative series.

**Validity** : refers to the ability of a scale to measure what it is supposed to measure.

**Reliability** : an attribute of consistency. A scale should give consistent results.

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## 1.12 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress 1**

1. Measurement consists of identifying the values which may be assumed by some variable, and representing these values by some numerical notation. The numerical notation is systematically and consistently assigned, that is, it is assigned according to some set of rules.

2. The three postulates basic to measurement can be written as:

   (a) Either (a=b) or (a =/= b), but not both. We must be able to assert either that one object is the same in a characteristic as another, or it is not the same.

   (b) If (a=b) and (b=c) then (a=c). This postulate enables a researcher to establish the quality of set members, on a characteristic by comparing objects

   (c) If (a>b) and (b>c) then (a>c). Most measurement in psychology and education depends on this postulate.

**Check Your Progress 2**

1. When a scale has all the properties of ordinal and ordered metric scale, and, when we have additional information about how large the distances (intervals) between any two stimuli are, we have achieved a more powerful measurement, stronger than ordinal. In such a device, a measurement has been achieved in the sense of an interval scale.

2. The most important criteria to be used in evaluating a measurement tool are unidimensionality, reliability and validity.

# UNIT 2 SCALES AND TESTS

**Structure**

2.1 Introduction

2.2 Scales: Meaning and Techniques

2.3 Types of Rating Scales

2.4 Uses and Guidelines for Construction of Rating Scales

2.5 Rating Errors

2.6 Tests

2.7 Types of Objective Test Questions

2.8 Test Construction

2.9 Let Us Sum Up

2.10 Key Words

2.11 References and Selected Readings

2.12 Check Your Progress – Possible Answers

## 2.1 INTRODUCTION

In extension and development research, we quite often encounter the problem of measurement. This is especially true when the measurement concepts are complex and when we do not possess the standardised measurement tools. To overcome this, social science researchers develop self reporting measuring instruments to assess people's knowledge, opinion, perceptions, attitudes etc., on extension and development programmes. Technically speaking these reporting measurement instruments are popularly called as scales and tests. The scales and tests are one of the most popular methods of observation and data collection in behavioural as well as social sciences.

After studying this unit, you should be able to:

- discuss the meaning and applicability of scales and tests
- describe the important types of scales and tests
- explain the test as well as scale construction methodology

## 2.2 SCALES: MEANING AND TECHNIQUES

Scales are also popularly called as rating scales. 'Rating' is a term applied to an expression of opinion or judgment regarding some situation, object or character. A rating scale is a psychological measuring instrument that requires the rater or observer to assign the rated object to categories or continuum that have numbers assigned to them.

The rating scale is very useful device in assessing quality – especially when quality is difficult to measure objectively in the development programmes.

*Example:* How good is the Mahatma Gandhi National Rural Employment Guarantee Programme?

The above question can be hardly answered objectively. In this context, rating scales measure or order entities with respect to quantitative attributes

or traits of the above programme. Certain rating scales permit estimation of magnitudes of the programme on a continuum, while other methods provide only for relative ordering of the entities.

### 2.2.1 Important Scaling Techniques

The two important scaling techniques are:

Comparative scaling

Non-comparative scaling

With comparative scaling, the items are directly compared with each other.

*Example:* Do you prefer weekly or daily payment of wages under Mahatma Gandhi National Rural Employment Guarantee Programme (MNREGA)?

Here, the respondent compares 'weekly' or 'daily' payments and gives his choice to confer his / her opinion or views.

In non-comparative scaling each item is scaled independently of the others.

*Example*: How do you feel about daily payment of wages under Mahatma Gandhi National Rural Employment Guarantee Programme (MNREGA)?

Unlike the above, in this case there is no comparison and the respondent has to give his / her opinion on 'daily' payment of wages under MNREGA.

**Activity 1:** Visit a nearly development department and enquire about scales and tests that they are using in measurement of outcomes of development programmes. Write your observations.

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## 2.3 TYPES OF RATING SCALES

The rating scale involves qualitative description of a limited number of aspects of a thing or of traits of a person. These ratings may be in such forms as:

1. like – dislike ( 2 categories)
2. above average – average – below average ( 3 categories)
3. like very much – like somewhat – neutral – dislike somewhat – dislike very much (5 categories)
4. excellent – good- average – below average - poor (5 categories)
5. always – often – occasionally – rarely – never (5 categories)
6. very strongly agree – strongly agree – agree – neutral – disagree- strongly disagree - very strongly disagree ( 7 categories)

There is no specific rule whether to use a two points scale, three point scale or with more points. In practice, odd number scales with three, five

or seven points are popularly used for the simple reason that more points on a scale provide an opportunity for greater sensitivity of measurement.

Some of the important types of rating scales are:

i. The graphic rating scale

ii. The descriptive rating scale

iii. The numerical rating scale

iv. The itemized rating scale

### 2.3.1 Graphic Rating Scale

Graphic rating scale (also called continuous rating scale) is quite simple and is commonly used in practice. Graphic scale makes use of continuum along which the rater places a mark (?) on a line to indicate his / her rating with respect to certain characteristics. The line is usually labeled at each end. There are sometimes a series of numbers, called scale points under the line.

*Example:* Teachers often describes students' personality during evaluation. The following is an example of graphic rating scale on personality rating of students.

*Directions:* Please give your frank opinion concerning the students' characteristics by putting an 'X' at the point along the scale that best describes the student.

a. Cooperation _____

(Consider willingness to work with others) Obstructive Always willing

b. Emotional Stability _____

(Consider reactions in stress) Unstable Well balanced

**Advantages**

One of the major advantages of graphic rating scale is that they are relatively easy to use.

Graphic scale provides opportunity for a given discrimination as that of which the mater is capable and the fineness of scoring can be as great as desired.

**Limitations**

Respondents may check at almost any position along the continuum which increases the difficulty of analysis.

Meanings of the terms like obstructive, always willing, etc., may depend upon respondent's frame of reference.

To overcome the limitations, several other rating variants (example: boxes replacing line) may be used.

### 2.3.2 Descriptive Scale

It is a variation of the graphic rating scale. It provides descriptive works or phrases that indicate the degree to which an individual is believed to possess certain characteristic.

*Example of a behavioural rating scale:*

Direction:- For each of the items listed in this scale, place a 'X' in one of the columns to indicate the extent to which you feel that the student possesses the particular characteristic/ kind of behaviour.

| Item | Never | Seldom | Sometime | Usually | Always |
|---|---|---|---|---|---|
| Listens to others opinion | | | | | |
| Accepts constructive criticism | | | | | |

*Example*: Suppose you would like to collect data on liking of information sources on development programmes from your study respondents. The following is an example of five-points graphic rating scale on liking of information sources.

How do you like the following information sources for obtaining information on development programmes?

| Information source | Liking of information source | | | | |
|---|---|---|---|---|---|
| | Like very much | Like Some what | Neutral | Dislike Some what | Dislike very much |
| *Institutional Sources* | | | | | |
| BDO | | | | | |
| VDO | | | | | |
| Extension Personnel | | | | | |
| Any other (Please specify) | | | | | |
| *Non Institutional Sources* | | | | | |
| Other Beneficiaries | | | | | |
| Village Key Personnel | | | | | |
| Own Family Members | | | | | |
| Any other (Please specify) | | | | | |
| *Mass Media Sources* | | | | | |
| Radio | | | | | |
| TV | | | | | |

### 2.3.3 Numerical Rating Scale

The numerical scale makes use of numbers to indicate the extent to which an individual is believed to possess certain characteristic or kinds of behaviour.

*Example of a behaviour rating scale:*

Directions: As you rate the student on each of the following items, circle 1 for inferior, 2 for below average 3 for average, 4 for above average and 5 for superior.

| | | | | | |
|---|---|---|---|---|---|
| 1. Cooperates with students | 1 | 2 | 3 | 4 | 5 |
| 2. Cooperates with teachers | 1 | 2 | 3 | 4 | 5 |
| 3. Maintains an attractive appearance | 1 | 2 | 3 | 4 | 5 |

### 2.3.4 Itemized Rating Scale

It is also referred to as specific category scale. In this type of scale, the respondent selects or picks the one that best characterizes the behaviour or characteristic of the object being rated. Suppose a teacher's classroom behaviour is being rated. The characteristics rated say may be alertness or imaginativeness.

A category item might be 'how alert is he / she?' (Check one).

a) very alert

b) Alert

c) Not alert

d) Not at all alert

A slightly different category item might be 'how imaginative is he /she?' (Check one)

a) Extremely imaginative

b) Very imaginative

c) Imaginative

d) Unimaginative

e) Very unimaginative

f) Extremely unimaginative

## 2.4 USES AND GUIDELINES FOR CONSTRUCTION OF RATING SCALES

### 2.4.1 Uses of Rating Scales

Rating scales are most commonly used instruments for making appraisals. Typically, they direct attention to a number of aspects or traits of the thing to be rated and provide a scale for assigning values to each of the aspects of characteristics of a person or phenomenon through the use of a series of numbers, qualitative terms, and named attributes of verbal descriptions.

Rating scales have been successfully used in:

Teacher rating – for selection, evaluation and prediction.

Personality rating – for various purposes.

Testing the validity of many objective instruments like inventories of personality.

School appraisal – including appraisal of courses, practices and programmes.

### 2.4.2 Guidelines in Construction of Rating Scales

i. Rating scales include three factors:

The subjects or phenomena to be rated

The continuum along which they will be rated

The judges who will do the rating

The subjects or phenomena to be rated are usually a limited number of aspects of a thing, or of traits of a person. Therefore, only the most significant aspects for the purpose of the study should be chosen.

ii. A rating scale may have as many divisions as can be readily distinguished by the rates. Practically most scales have no more than 7 divisions. However, usually they contain five divisions. By numbering each division in sequence the description can be converted into arithmetic values for averaging and for further statistical application.

iii. The rating scale is composed of two parts:

an instruction which names the subject and defines the continuum and

a scale which defines the points to be used in rating

iv. Usually we can arrange the rating scales in four ways:

a. On a straight line eg:

---

Very good Good Average Poor Very poor

b. Ratings be marked in a column at the right with an instruction to encircle / underline the response.

IGNOU course material was: Very good/ Good/Average/ Poor/ Very poor

c. The scale can run down the page and look much like a checklist.

Example: For me the concepts presented in IGNOU course material;

was very difficult to understand

was difficult to understand

was reasonably understandable

was clearly understandable

contained nothing new.

d. The scale may call for ranking like which course of the IGNOU's programme helped you most? Rank them by starting with one for the best unto least

*Example:* Suppose there are four courses in the programme viz., a, b, c, d and out of the four 'c' helped you most

| | | | |
|---|---|---|---|
| c | = | 1 | 'c' is ranked highest. |
| b | = | 3 | |
| d | = | 2 | |
| a | = | 4 | |

The other way is rank these courses in order of merit – starting with 1 for best

1c 3b 2d 4a

This type of ranking is a higher form of rating whereby individuals or phenomena are arranged in order of merit (i.e.) they are given position determined by their relation to the others in the group, not by certain predetermined standards. However this cannot be used when large numbers are concerned.

The investigator must arrange his items in any or all of the above forms according to the nature of the item and its purpose.

v. Anyone can serve as a rater where non-technical opinions, likes, dislikes and matters of easy observation are to be rated. But only well-informed and experienced persons should be selected for rating where technical competence is required.

vi. Pooled judgements increase the reliability of any rating scale. Employ several judges, depending on the rating situation to obtain desirable reliability. Individual ratings when combine into final rating give a safer assessment.

## 2.5 RATING ERRORS

Rating scales are subjected not only to errors inherent in their design but also to errors that are related to the way in which raters have marked the scale. Some of them are discussed below for your understanding.

**Halo Effect :** This is an error that occurs when a rater tends to rate an individual high or low on several characteristics because of a general impression that the rater has towards subject whom (s)he is rating. For example if a teacher assesses the quality of all essay test questions higher / lower then they should be based on the answer of the first question.

**Personal Bias :** It is an error that is made when a rater is prejudiced with regard to a certain group and tends to rate individuals who belong to that group too high or too low.

**Logical Error**: It results when the rater does not fully understand the term used in the rating scale.

**Error of Central Tendency:** It occurs when a rater does not have enough information about the individual to be rated and tends to rate the person as average. The rater feels that average ratings are safer to make than extreme ratings, because errors that are as a result of guessing will perhaps be smaller.

**Generosity Error:** It occurs because sometimes raters are very reluctant to give any ratings at the lower end of the scale. They tend, therefore, to rate every one as average or above average on all characteristics.

**Error of Severity**: This is an important source of constant error. It is a general tendency to rate all individuals too low on all characteristics.

**Error of Leniency:** This is the opposite to error of severity. The general tendency is to rate too high. A good fellow who likes every body and the likeness is reflected while rating.

It is impossible to eliminate these kinds of errors, but certain steps can be taken to minimize them. One suggested step is to inform the rater, either orally or in writing, about the possible source of error in rating and then urge him/her to be as objective as possible. Another suggestion is to construct the rating scale in such a way as to lower the possibility of error on the rater's part.

### 2.5.1 How to Overcome the Errors in Rating Scales?

There will be a certain amount of measurement error which results from the structural characteristics of rating scales. By adhering to the following rules of construction, however, it is possible to minimise these kinds of errors.

i. Provide direction to assist the rater in the use of the scale

ii. Use only enough items to obtain the information needed

iii. Clearly define each characteristic on which an individual is rated

iv. Use only those trails or characteristics in rating scales that can be observed readily

v. Define clearly the degree or different levels of gradation that are to be used in the scale (At least 4 or 5 gradations are recommended)

vi. Provide ample space between the items so that the descriptive phrases and the rating lines are not crowded.

vii. Position the ' average' or 'neutral' phrase at the centre of the rating line

viii. Try to avoid the use of phrases that are so extreme at the end positions of the scale that the raters will tend to avoid making them.

Till now you have read about the meaning, types and uses of rating scales. You have also read about the rating errors. Now try and answer the questions given in *Check Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What do you mean by a rating scale?

.....

.....

.....

.....

2. Write the examples for the following categorization of rating scales

3 divisions: .....

.....

.....

5 divisions: .....

.....

3. Name the four important types of rating scales.

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4. Name the common rating errors.

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.....

.....

## 2.6 TESTS

The tests are frequently used in education and psychological researches and more recently in development studies to measure the achievement and personality tract of various categories of respondents.

According to the dictionary 'test' is defined as a series of questions on the basis of which some information is sought. According to Bean (1953) a test is "an organized succession of stimuli designed to measure quantitatively or to evaluate qualitatively some mental process, trait or characteristics".

The two types of tests popularly used are:

Objective Tests

Teacher-Made Tests

### 2.6.1 Objective Tests

There are various types of objective tests viz.,

i. Achievement Test

ii. Diagnostic Test

iii. Intelligence Test

iv. Aptitude Test

v. Personality Test

**Achievement Test**

Achievement or proficiency test is one, which measures the extent to which a person has acquired certain information or proficiency as a function of instruction or training. The achievement test is used in order to assess the achievement of a person in certain areas. For example a teacher can conduct a test to assess the student achievement in mathematics.

**Diagnostic Test**

This test intends to assess the strength and weakness of a person in one or more than one areas of his/her activities. It is conducted with a view to carry out interventions in weak areas. It also makes an enquiry about the weak areas of the respondent who may be a student, employee or worker.

**Intelligence Test**

The intelligence test is prepared to measure the intelligence of a person. This test is used by the psychologists and educationists to measure the intelligence of students. Intelligence is measured in terms of intelligence quotient (IQ). The intelligence quotient is the ratio of the mental age to the chronological age. This ratio is multiplied by hundred for obtaining an integral value of quotient. The IQ gives an index of ability.

$$IQ = \frac{\text{Mental Age}}{\text{Chronological Age}} \times 100$$

**Aptitude Test**

An aptitude is a person's conditions, a pattern of traits and demand to be indicative of his potentialities. According to Freeman (1965) aptitude is a combination of characteristics indicative of an individual's capacity to acquire some specific knowledge. The aptitude test is used in various competitive examinations such as banking, insurance and management organizations.

**Personality Test**

Personality test intends to measure the personality traits of the individuals. Some of the personality traits are cooperation, discipline, leadership, personal appearance, punctuality, patriotism, confidence, team spirit, etc.

### 2.6.2 Teacher Made Tests

The teacher made test are also called the non-standardized tests. Teachers have the obligation to provide the best possible instructions to the students. In order to judge the performance of the students, teachers assess the performances of the students from time to time. These are useful:

To assess the extent and degree of student's progress

To ascertain individual strength and weaknesses

To motivate the students

To provide immediate feedback

To provide continuous evaluation

## 2.7 TYPES OF OBJECTIVE TEST QUESTIONS

Various types of objective test questions used in research studies are as follows:

i. True/ False

ii. Multiple choice

iii. Fill in the blanks

iv. Matching

v. Completion

**True/ False Test:** The true/false or yes/no or right/wrong type of tests are most commonly used. It is used to determine the respondent's ability to recall the facts.

*Example*: India follows mixed economy system True ☐ False ☐

**Multiple Choices Test:** In the multiple choice test, the respondents are given multiple option of a question. Here the choices or the alternatives should be written in such a way that it may not create ambiguity in the mind of respondents. The multiple choices may contain more than one valid choice.

*Example*: Which is not the indicator of Human Development Index?

i. Life Expectancy ☐

ii. Literacy ☐

iii. Per capita income ☐

iv. Poverty level ☐

**Fill in the Blanks**: In the fill in the blanks question, the respondent is asked to supply correct answer to the blank left in the statement. However, while formulation of fill-in-the-blanks test, too many blanks should not be provided as it will create confusion in the minds of respondents. One example of fill in the blanks is given below:

*Example*: The first five year plan of India started in the year ———— test, there are two columns right and left. The items on the left column are to be paired with items on the right column. Items on the left constitute a set of related streams called premises and items on the right are is called cassette options or responses of the items.

*Example*: Match column A with B

| | Column A | Column B |
|---|---|---|
| 1. | Mouse | Bicycle |
| 2. | Wheel | Computer |
| 3. | Remote | Television |

**Completion**: Completion test is one which is presented in the form of an incomplete statement. This is also called supply type of test.

*Example*: There is a famous saying ‘All is well that ends well’.

## 2.8 TEST CONSTRUCTION

Construction of a test is very important in order to arrive at accuracy in the result. The various steps adopted in test construction are as follows:

i. Planning of the test

ii. Writing items of the test

iii. Preliminary administration of the test

iv. Item Analysis

v. Establishing Reliability of the test

vi. Establishing Validity of the test

vii. Preparation of norms for the final test

viii. Preparation of manual and reproduction of the test

**Planning of the Test:** At the outset, the tests are to be carefully planned. While planning, the test constructor has to take into consideration, the general and specific objectives of the test in clear terms and the nature of the content or items to be included.

**Writing Items of the Test:** Item writing is one of the very important aspects of test construction. Although there is no set rule for item writing, yet lot depends on the ingenuity, intuition, experience, knowledge, practice and imagination of the test constructor. It can be said that writing test item is essentially an art.

**Preliminary Administration:** After the items are written, it is better to try them out. It will help the test constructor to find out the weaknesses and inadequacies in test items. It helps in finding out the appropriate length and time limit of test administration.

**Item Analysis**

After the items are being written, they are carefully analysed and reviewed. In item analysis, items are validated and suited for the purpose. The objectives of item analysis are as follows:

Helps to indicate the difficulty level of the item such as which is more difficult, moderately difficult or easy.

Helps to provide indication regarding the ability of the item to discriminate between inferior and superior item.

Two common indices used in item analysis are:

Difficulty Index

Discrimination Index

**Difficulty Index:** The difficulty index indicates how difficult an item is? The difficulty value of an item indicates the proportion or percentage of candidates who have given correct answer. This proportion or percentage is called Item Difficulty Index. The formula used for the calculation of item difficulty index of each item is given below.

$$IDI = \frac{R}{N}$$

IDI = Item difficulty index

R = Number of right responses

N = Total number of candidates attempting that item.

Besides this method which takes into consideration all the examinees, there is also another method which can determine the index on the basis of only a portion of the examinee. The formula is:

$$IDI = \frac{R_U + R_L}{N_U + N_L}$$

Where

IDI = Item Difficultly Index

$R_U$ = Right responses in the Upper group

$R_L$ = Right responses in the Lower group.

$N_U$ = Number of examinees in Upper group

$N_L$ = Number of examinees in the lower group

For example if there are 200 examinees of a test, $N_U$=50 and $N_L$=50. Out of these groups $R_U$=25 and $R_L$=25

Then:

$$IDI = \frac{25+25}{50+50} = \frac{50}{100} = 0.50$$

**Discrimination Index:** The discrimination index distinguishes between the well- informed examinees to that of the less-informed examinee. It is the degree to which the single item separates the superior from the inferior individuals in the trait or group of traits being measured.

$$DI = \frac{R_H - R_L}{N}$$

Where:

DI = Discrimination Index

$R_H$ = Number of rights in the higher ability group

$R_L$ = Total Number of rights in the lower ability group.

N = Total number of examinees in higher ability group.

Let us explain this with the help of an example. After getting the responses from 100 examinees they were divided into upper group (25%) and lower group (25%). Suppose in a particular item, right responses in the upper group is 14 and right responses in the lower group is 9, then the item discrimination index is:

$$DI = \frac{14-9}{25} = 0.20$$

This value of 0.20 clearly states that item has negligible discriminatory power. Such items are usually dropped or suitably modified.

The factor which influences item difficulty and item discrimination index are:

The ambiguity and complexity of items in a test item may lower the difficulty index value of the item.

Previous learning experiences may be helpful in deciding the item difficulty index or discrimination index.

It depends on the ability of the test constructor to effectively frame the distracters. They must be appealing to those who do not know the correct answer.

**Establishing Test Reliability:** The final test is administered to find out its reliability. Reliability is the degree to which a test produces consistent results.

**Validity of the Test:** Validity indicates how well a test measures what it is supposed to measure. There are various kinds of validity viz., criterion-referenced validity and construct validity.

**Norms of the Test:** Norms are set to meaningfully interpret the scores obtained on the test. The common types of norms are the age norms, the grade norms, the percentile norms, etc. For example a test constructed for class-V student should not be administered over the class-VIII student.

**Preparation of the Manual and Reproduction Test:** Finally, the constructors have to produce a manual which will give a clear cut instruction regarding the procedures of the test administration, the scoring methods, time limit, etc.

In this section you have read about the tests, types of test questions and test construction. Now try and answer the questions given in *Check Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What do you mean by test?

   .....

   .....

   .....

2. Name the various types of objective tests.

   .....

   .....

   .....

3. Name the various types of objective test questions.

   .....

   .....

   .....

4. Write the objectives of item analysis.

   .....

   .....

   .....

## 2.9 LET US SUM UP

In this unit we started by discussing the meaning of rating scales and understood that rating scale is very useful device in assessing quality – especially when quality is difficult to measure objectively. Then we examined the two important scaling techniques viz., comparative and non-comparative scaling techniques. We also described the four types of rating scales viz., graphic, descriptive, numerical and itemized rating scales with examples. Later we discussed the important rating errors. In the second part of the unit we have discussed the concept and two types of tests viz., objective and teacher -made tests. Later various types of objective tests viz., achievement, diagnostic, intelligent and aptitude tests were discussed. At the end we discussed the test construction methodology.

## 2.10 KEYWORDS

| | | |
|---|---|---|
| **Scales and Tests** | : | They are the self reporting measuring instruments to assess people's knowledge, opinion, perceptions, attitudes etc. |
| **Rating Scale** | : | Is a psychological measuring instrument that requires the rater or observer to assign the rated object to categories or continuum that have numbers assigned to them. |
| **Index** | : | Indices are similar to scales except multiple indicators of a variable are combined into a single measure. |
| **Graphic Rating Scale** | : | Graphic scale makes use of continuum along which the rater places a mark (?) on a line to indicate his / her rating with respect to certain characteristics. |
| **Descriptive Scale** | : | It provides descriptive works or phrases that indicate the degree to which an individual is believed to possess certain characteristic. |
| **Numerical Rating Scale** | : | It makes use of numbers to indicate the extent to which an individual is believed to possess certain characteristic or kinds of behaviour. |
| **Itemized Rating Scale** | : | In this type of scale, the respondent selects or picks the one that best characterizes the behaviour or characteristic of the object being rated. |
| **Halo Effect** | : | An error that occurs when a rater tends to rate an individual high or low because of a general impression that the rater has towards subject. |
| **Error of Leniency** | : | The general tendency to rate too high. |
| **Test** | : | Test is an organized succession of stimuli designed to measure quantitatively or to evaluate qualitatively some mental process, trait or characteristics. |
| **Achievement Test** | : | Is one which measures the extent to which a person has acquired certain information or proficiency as a function of instruction or training. |
| **Diagnostic Test** | : | This test intends to assess the strength and weakness of a person in one or more than one areas of his/her activities. |
| **Intelligence Quotient** | : | It is the ratio of the mental age to the chronological age multiplied by hundred. |
| **Difficulty Index** | : | The difficulty index indicates how difficult an item is in the test. |
| **Discrimination Index** | : | The discrimination index distinguishes between the well- informed examinees to |

that of the less-informed examinee. It is the degree to which the single item separates the superior from the inferior individuals in the trait or group of trait being measured.

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## 2.12 CHECK YOUR PROGRESS–POSSIBLE ANSWERS

**Check Your Progress 1**

1. A rating scale is a psychological measuring instrument that requires the rater or observer to assign the rated object to categories or continuum that have numerical assigned to them.
2. Three divisions: above average – average – below average

   Five divisions: like very much – like somewhat – neutral – dislike somewhat – dislike very much
3. The four important types of rating scales are: graphic; descriptive; numerical and itemized rating scales.
4. The common rating errors are: halo effect; personal bias; logical error; error of central tendency; generosity error; error of severity and error of leniency.

**Check Your Progress 2**

1. Test is an organized succession of stimuli designed to measure quantitatively or to evaluate qualitatively some mental process, trait or characteristics.
2. Various types of objective tests are : achievement test; diagnostic test; intelligent test; aptitude test and ; personality test.
3. Various types of objective test questions are : true/ false; multiple choice; fill in the blanks; matching and; completion.
4. The objectives of item analysis are : to indicate the difficulty level of the item such as which is more difficult, moderately difficult or easy and ; to provide indication regarding the ability of the item to discriminate between inferior and superior item.

# UNIT 3 RELIABILITY AND VALIDITY

## Structure

3.1 Introduction

3.2 Reliability

3.3 Methods of Determining the Reliability

3.4 Validity

3.5 Types of Validity

3.6 Reliability Or Validity - Which is More Important?

3.7 Let Us Sum Up

3.8 Keywords

3.9 References and Selected Readings

3.10 Check Your Progress – Possible Answers

## 3.1 INTRODUCTION

Dear learners, in the first unit of this block, we discussed that measurement of social and psychological variables is a complex and demanding task. In development research, the common term for any type of measurement devise is 'instrument'. Thus the instrument could be a test, scale, questionnaire, interview schedule etc. An important question that is often addressed is what is the reliability and validity of the measuring instrument? Therefore, the purpose of this unit is to make you understand the concept of reliability and validity and their interrelationship in extension and development research.

After studying this unit you should be able to:

- discuss the meaning of reliability and methods of determining the reliability of measuring instruments.
- describe the meaning of validity, approaches and types of validating measuring instruments.
- differentiate the interrelationship between reliability and validity of measuring instruments.

## 3.2 RELIABILITY

In the context of development research, one of the most important criterions for the quality of measurement is reliability of the measuring instrument. A reliable person for instance, is one whose behavior is consistent, dependable and predictable – what (s)he will do tomorrow and next week will be consistent with what (s)he does today and what (s)he has done last week. An unreliable person is one whose behavior is much more variable and one can say (s)he is inconsistent.

The inherent aspects and synonyms of reliability are:

- dependability
- stability

consistency

predictability

accuracy

equivalence

### 3.2.1 What is Reliability of Measuring Instrument?

Reliability means consistency with which the instrument yields similar results. Reliability concerns the ability of different researchers to make the same observations of a given phenomenon if and when the observation is conducted using the same method(s) and procedure(s).

**Stability and Equivalence Aspects of Reliability**

Stability and equivalence deserves special attention among different aspects of reliability,

The *stability* aspect is concerned with securing consistent results with repeated measurements of the same researcher and with the same instrument. We usually determine the degree of stability by comparing the results of repeated measurements.

The *equivalence* aspect considers how much error may get introduced by different investigators or different samples of the items being studied. A good way to test for the equivalence of measurements by two investigators is to compare their observations of the same events.

### 3.2.2 How to Improve Reliability?

The reliability of measuring instruments can be improved by two ways.

i. By standardizing the conditions under which the measurement takes place i.e. we must ensure that external sources of variation such as boredom, fatigue etc., are minimized to the extent possible to improve the *stability* aspect.

ii. By carefully designing directions for measurement with no variation from group to group, by using trained and motivated persons to conduct the research and also by broadening the sample of items used to improve *equivalence* aspect.

## 3.3 METHODS OF DETERMINING THE RELIABILITY

The three basic methods for establishing the reliability of empirical measurements are:

i. Test - Retest Method

ii. Alternative Form Method / Equivalent Form / Parallel Form

iii. Split-Half Method

### 3.3.1 Test - Retest Method

One of the easiest ways to estimate the reliability of empirical measurements is by the test - retest method in which the same test is given to the same people after a period of time. Two weeks to one month is commonly considered to be a suitable interval for many psychological tests. The reliability is equal to the correlation between the scores on the same test

obtained at two points in time. If one obtains the same results on the two administrations of the test, then the test – retest reliability coefficient will be 1.00. But, invariably, the correlation of measurements across time will be less than perfect. This occurs because of the instability of measures taken at multiple points in time. For example, anxiety, motivation and interest may be lower during the second administration of the test simply because the individual is already familiar with it.

**Advantages**

This method can be used when only one form of test is available.

Test – retest correlation represent a naturally appealing procedure.

**Limitations**

Researchers are often able to obtain only a measure of a phenomenon at a single point of time.

It is expensive to conduct test and retest and sometimes impractical as well.

Memory effects lead to magnified reliability estimates. If the time interval between two measurements is short, the respondents will remember their early responses and will appear more consistent than they actually are.

Require a great deal of participation by the respondents and sincerity and devotion by the research worker as behavioural changes and personal characteristics are likely to influence the re-test as they keep changing from day to day.

The validity process of re-measurement may intensify difference in momentary factors such as anxiety, motivation etc.

The interpretation of test-retest correlation is not necessary straightforward. A low correlation may not indicate low reliability, may instead signify that the underlying theoretical concept itself has changed.

*Example*: The attitude of a person towards functioning of a public hospital may be very different before and after the person's visit. The true change in this example is interpreted as instability of attitude scale measurement.

The longer the time interval between measurements, the more likely that the concept has changed.

The process of measuring a phenomenon can induce change in the phenomenon itself. This process is called reactivity. In measuring a person's attitude at test, the person can be sensitized to the subject under investigation and demonstrate change during retest. Thus the test - retest correlation will be low.

### 3.3.2 Alternative Form Method / Equivalent Form / Parallel Form

The alternative form method which is also known as equivalent / parallel form is used extensively in education, extension and development research to estimate the reliability of all types of measuring instruments. It also requires two testing situations with the same people like test- retest method.

But it differs from test – retest method on one very important regard i.e., the same test is not administered on the second testing, but an alternate form of the same test is administered. Thus two equivalent reading tests should contain reading passages and questions of the same difficulty. But the specific passages and questions should be different i.e., approach is different. It is recommended that the two forms be administered about two weeks apart, thus allowing for day –to- day fluctuations in the person to occur. The correlation between two forms will provide an appropriate reliability coefficient.

**Advantages**

The use of two parallel test forms provides a very sound basis for estimating the precision of a psychological or educational test

Superior to test- retest method, because it reduces the memory related inflated reliability.

**Limitations**

Basic limitation is the practical difficulty of constructing alternate forms of two tests that are parallel.

Requires each person's time twice.

To administer a secondary separate test is often likely to represent a somewhat burdensome demand upon available resources.

### 3.3.3 Split-Half Method

Split - half method is also a widely used method of testing reliability of measuring instrument for its internal consistency. In split-half method, a test is given and divided into halves and are scored separately, then the score of one half of test are compared to the score of the remaining half to test the reliability.

In split-half method, 1st-divide test into halves. The most commonly used way to do this would be to assign odd numbered items to one half of the test and even numbered items to the other, this is called, Odd-Even reliability. 2nd- Find the correlation of scores between the two halves by using the Pearson *r* formula. 3rd- Adjust or revaluate correlation using Spearman-Brown formula which increases the estimate reliability even more.

Spearman-Brown formula

$$R = \frac{2r}{1+r}$$

r = estimated correlation between two halves (Pearson r).

**Advantages**

Both, the test–retest and alternative form methods require two test administrations with the same group of people. In contrast the split–half method can be conducted on one occasion.

Split-half reliability is a useful measure when impractical or undesirable to assess reliability with two tests or to have two test administrations because of limited time or money.

**Limitations**

Alternate ways of splitting the items results in different reliability estimates even though the same items are administered to the same individuals at the same time.

*Example:* The correlation between the first and second halves of the test would be different from the correlation between odd and even items.

**Major Limitations of Reliability Estimating Methods**

Test-retest method: Experience in the first testing usually will influence responses in the second testing.

Alternative form method: It can be quite difficult to construct alternative forms of a test that are parallel.

Split-half method: The correlation between the halves will differ depending on how the total number of items is divided into halves.

Alternate form method provide excellent estimate of reliability in spite of its limitation of constructing two forms of a test. To overcome this limitation, it is recommended to, randomly divide a large collection of items in half to have two test administrations.

Till now you have read about reliability and the three methods of determining the reliability along with their advantages and disadvantages. Now try and answer the questions given in *Check Your Progress -1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What do you mean by reliability?

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2. Write the three basic methods of determining the reliability?

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3. Write the major limitations in reliability determining methods?

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## 3.4 VALIDITY

According to Goode and Hatt, a measuring instrument (scale, test etc) possesses validity when it actually measures what it claims to measure. The subject of validity is complex and very important in extension and development research because it is in this more than anywhere else, that the nature of reality is questioned. It is possible to study reliability without inquiring into the nature and meaning of one's variable. While measuring certain physical characteristics and relatively simpler attributes of people, validity is no great problem. For example, the anthropometrics measurements of a pre-school child i.e., head and chest circumference can be measured by a measuring instrument having standard number of centimetres or inches. The weight of the child can be measured in pounds and kilograms. On the other hand, if a child development professional wishes to study the relation between malnutrition and intellectual development of pre-school children, there are neither any rule to measure the degree of malnutrition nor any scales or clear cut physical attributes to measure intellectual development. It is necessary in such cases to invent indirect means to measure these characteristics. These means are often so indirect that the validity of the measurement and its product is doubtful.

**Validity of Measuring Instrument or Measuring Phenomenon?**

We defined validity as the extent to which any measuring instrument measures what it is intended to measure. Strictly speaking, one validates not a measuring instrument, but an interpretation of data arising from a specified procedure. This distinction is central to validation, because it is quite possible for a measuring instrument to be relatively valid for measuring one kind of phenomenon but entirely invalid for assessing other phenomenon. Thus, one validates not the measuring instrument itself, but the measuring instrument in relation to the purpose for which it is being used.

### 3.4.1 Approaches to Validation of Measuring Instrument

Every measuring instrument, to be useful, must have some indication of validity. There are four approaches to validation of measuring instruments:

i. Logical validity / Face validity

ii. Jury opinion

iii. Known-group

iv. Independent criteria

**i) Logical Validity**

This is one of the most commonly used methods. It refers to either theoretical or commonsense analysis, which concludes simply that, the items, being what they, the nature of the continuum cannot be other than what is stated to be. Logical validation or face validity as it is sometimes called is almost always used because it automatically springs from the careful definition of the continuum and the selection of items. Such measure, which focuses directly on behavior of the kind in which the tester is interested, is said to have logic / face validity.

*Example*: The reading speed is measured by computing how much of a passage person reads with comprehension in a given time and the ability to solve arithmetic problems by success in solving a sample of such problems.

**Limitation**

It is not wise to rely on logical and commonsense validation alone. Such claims for validity can at best be merely plausible and never definite. More than logical validity, it is required to render satisfactory use of a measuring instrument.

**ii) Jury Opinion**

This is an extension of the method of logical validation, except that in this case the confirmation of the logic is secured from a group of persons who would be considered experts in the field in which the measuring instrument is being used.

*Example:* If a scale to measure mental retardation of pre-school children is constructed, psychologists, psychiatrists, paediatrician, clinical psychologists, social workers and teachers might constitute the jury to determine the validity of the scale.

**Limitation**

Experts too are human and nothing but logical validity can result from this approach. Therefore, jury validation can be considered only slightly superior to logical validation.

**iii) Known-Group**

This technique is a variant of the jury procedure. In this case, the validity is implied from the known attitudes and other characteristics of analytical groups, rather than from their specific expertise. Thus, if a scale were being devised for the purpose of measuring the attitudes of people towards the Church, the questions could be tested by administering them to one group known to attend Church, to be active in Church activities and otherwise to give evidence of a favourable attitude towards this institution. These answers would be compared with those from a group known not to attend Church and also known to oppose the Church. If the scale failed to discriminate between the two groups it could not be considered to measure this attitude with validity. The known group technique of validation is frequently used and should not be discarded for falling somewhat short of perfection.

**Limitation**

There might be other differences between the groups in addition to their known behavior with regard to religion, which might account for the differences in the scale scores.

*Example:* Differences in age, socioeconomic status, ethnic background etc.

Further perhaps the known behavior under the study might be associated with a differential inclination to agree or disagree on a question in general. Hence careful use of the known group technique should be made.

**iv) Independent Criteria**

Abstractly speaking, this is an ideal technique but its application is usually difficult. There are four qualities desired in a criterion measure. In order of their importance they are:

*(a)* *Relevance:* We judge a criterion to be relevant if standing on the criterion measure corresponds to the scores on scale.

*(b)* *Freedom from bias:* By this we mean that the measure should be one on which each person has the same opportunity to make a good score. Example of biasing factors are such things as variation in the quality of equipment or conditions of work for a factory worker, a variation in the quality of teaching received by studying in different classes.

*(c)* *Reliability:* If the criterion score is one that jumps around from day to day, so that the person who shows high job performance one week may show low job performance the next or who receives a high rating from one supervisor gets a low rating from another, then there is no possibility of finding a test that will predict that score. A measure that is completely unstable by itself cannot be predicted by anything else.

*(d)* *Availability:* Finally, in the choice of a criterion measure we always encounter practical problems of convenience and availability. How long will we have to wait to get a criterion score for each individual? How much is it going to cost? Any choice of a criterion measure must make a practical limit to account.

However, when the independent criteria are good validation, it becomes a powerful tool and is perhaps the most effective of all techniques of validation.

In this section you have read about validity and various approaches to validation of a measuring instrument. Now try and answer the questions given in *Check Your Progress -2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Do you agree that ‘one validates not the measuring instrument, but the purpose for which it is being used’? Write your agreement or disagreement.

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2. Name the four approaches to validation of measuring instrument.

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## 3.5 TYPES OF VALIDITY

The most important classification of types of validity is that prepared by a Joint Committee of American Psychological Association, the American

Educational Research Association and the National Council on measurements used in education. There are three types of validity:

i. Content validity

ii. Criterion validity ( Predictive validity and Concurrent validity)

iii. Construct validity.

### 3.5.1 Content Validity

The term content validity is used, since the analysis is largely in terms of the content.

Content validity is the representativeness or sampling adequacy of the content. Consider a test that has been designed to measure competence in using the English language. How can we tell how well the test in fact measures that achievement? First we must reach at some agreement as to the skills and knowledge that comprise correct and effective use of English, and that have been the objectives of language instruction. Then we must examine the test to see what skills, knowledge and understanding it calls for. Finally, we must match the analysis of the test content against that of the course content and instrumental objectives, and see how well the former represents the latter. If the test represents the objectives, which are the accepted goals for the course, then the test is valid for use.

### 3.5.2 Criterion Validity

The two types of criterion validities are predictive validity and concurrent validity. They are much alike and with some exceptions, they can be considered the same, because they differ only in the time dimension. They are characterized by prediction and by checking the measuring instrument either now or in future against some outcome.

*Example:* A test that helps a researcher / teacher to distinguish between students who can study by themselves after attending the class and those who are in need of extra and special coaching, is said to have concurrent validity. The test distinguishes individually who differ in their present status. On the other hand, the investigator may wish to predict the percentage of passes during the final examination for that particular period. The adequacy of the test for distinguishing individuals who differ in the future may be called as predictive validity.

**Predictive Validity Vs. Concurrent Validity**

Predictive validity concerns a future criterion which is correlated with the relevant measure.

*Example:* Tests used for selection purposes in different occupations are, by nature, concerned with predictive validity. Thus a test used to screen applications for the post of ‘health extension and development workers’ could be validated by correlating their test scores with future performance in fulfilling the duties associated with health extension work.

Concurrent criterion is assessed by correlating a measure and the criterion at the same point of time.

*Example:* A verbal report of voting behaviour could be correlated with participation in an election, as revealed by official voting records.

### 3.5.3 Construct Validity

Both content and criterion validities have limited usefulness for assessing the validity of empirical measures of theoretical concepts employed in development studies. In this context, construct validity must be investigated whenever no criterion or universe of content is accepted as entirely adequate to define the quality to be measured. Examination of construct validity involves validation not only of the measuring instrument but of the theory underlying it. If the predictions are not supported, the investigator may have no clear guide as to whether the shortcoming is in the measuring instrument or in the theory.

Construct validation involves three distinct steps.

a. specify the theoretical relationship between the concepts themselves

b. examine the empirical relationship between the measures of the concepts

c. interpret the empirical evidence in terms of how it clarifies the construct validity of the particular measure.

Indeed strictly speaking, it is impossible to validate a measure of a concept in this sense unless there is a theoretical network that surrounds the concept.

In this section you have read about the various types of validity. Now try and answer the questions given in *Check Your Progress – 3.*

**Check Your Progress 3**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Name the three types of validity.

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2. Write the major difference between predictive and concurrent validities.

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## 3.6 RELIABILITY OR VALIDITY - WHICH IS MORE IMPORTANT?

The real difference between reliability and validity is mostly a matter of definition. Reliability estimates the consistency of your measurement, or more simply the degree to which an instrument measures the same way each time it is used under the same conditions with the same subjects. Validity, on the other hand, involves the degree to which you are measuring what you are supposed to, more simply, the accuracy of your measurement.

Reliability refers to the consistency or stability of the test scores; validity refers to the accuracy of the inferences or interpretations you make from the test scores. Note also that reliability is a necessary but not sufficient condition for validity (i.e., you can have reliability without validity, but in order to obtain validity you must have reliability). In this context, validity is more important than reliability because if an instrument does not accurately measure what it is supposed to, there is no reason to use it even if it measures consistently (reliably).

Let us examine the following three principles to understand the relationship between reliability and validity and to answer the question which is more important.

a. A test with high reliability may have low validity.

b. In the evaluation of measuring instruments, validity is more important than reliability.

c. To be useful, a measuring instrument must be both reasonably valid and reasonably reliable.

Consider the following four figures to understand easily the complex relationship between reliability and validity (Source: Patten, 2005).

In Fig. 3.1, the gun is aimed in a valid direction towards the target, and all the shots are consistently directed, indicating that they are reliable.

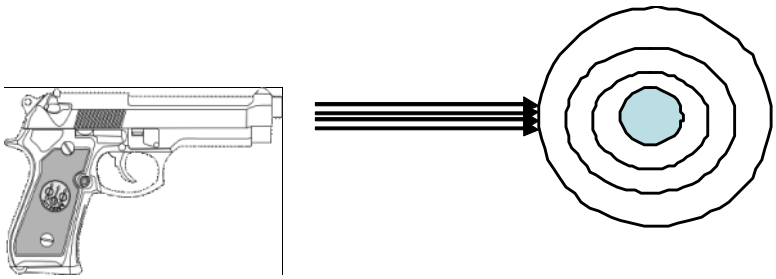

**Fig. 3.1: Reliable and valid**

In Fig. 3.2, the gun is also aimed in the direction of the target, but the shots are widely scattered, indicating low consistency or reliability. Thus the poor reliability undermines an attempt to achieve validity.

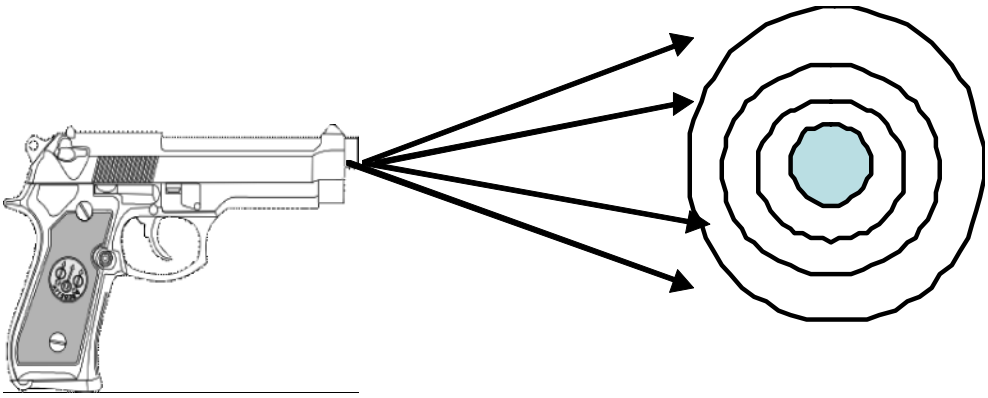

**Fig. 3.2: Unreliable which undermines the valid aim of the gun – Not useful**

In Fig. 3.3, the gun is not pointed at the target, making it invalid, but there is great consistency in the shots in one direction, indicating that it is reliable (In a sense, it is very reliably invalid).

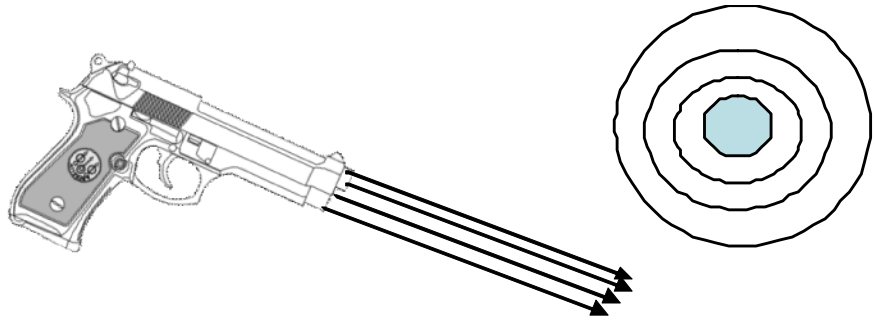

**Fig. 3.3: Reliable but invalid – Not useful**

In Fig. 3.4, the gun is not pointed at the target making it invalid, and the lack of consistency in the direction of the shots indicates its poor reliability.

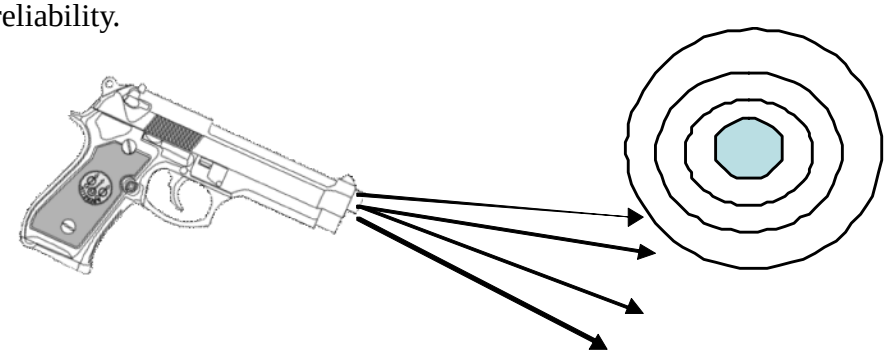

**Fig. 3.4: Unreliable and invalid – Not useful**

We may arrive at a conclusion that Fig. 3.1 represents the ideal in measurement. However, due to the limitations of measuring instruments in development studies / social and behavioural sciences, we should not expect perfect reliability and validities. The direction of gun should be off at least a small amount - indicating a less than perfect validity. We also should expect some scatter in the shots, indicating less- than - perfect reliability. Clearly, our first priority should be to point the gun in the correct general direction, which promotes validity and then work on increasing reliability. This indicates that both reliability and validity are important in measurement, but among them validity is more important.

In this section you have read about the relative importance of reliability and validity. Now try and answer the questions given in *Check Your Progress-4*.

**Check Your Progress 4**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Among reliability and validity, which is more important and why?

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## 3.7 LET US SUM UP

In this unit we started by discussing the meaning of reliability and understood that reliability means consistency with which the instrument yields similar results. Later we highlighted that, among different aspects of reliability, two aspects i.e. stability and equivalence deserve special attention. We discussed the three important methods for assessing the reliability of measuring instruments. For the limitations mentioned in the discussion, neither test- retest method nor split-half method is recommended for estimating reliability. In contrast, the alternative form method is excellent for estimating reliability.

In the second part of the unit we have discussed the concept of validity and understood a measuring instrument possesses validity when it actually measures what it claims to measure. We examined the four approaches of validation of measuring instruments: logical validity / face validity, jury opinion, known-group and independent criteria. We also discussed the three types of validities and found that both content and criterion validities have limited usefulness in assessing the quality of development measures. In contrast, construct validation has generalized applicability in the development research by placing the measure in theoretical context.

In the third and final part of the unit, we discussed, the relationship between reliability and validity and concluded that both reliability and validity are important in measurement, but among them validity is more important.

## 3.8 KEY WORDS

**Reliability** : Reliability means consistency with which the instrument yields similar results.

**Validity** : Validity is the ability of a measuring instrument to actually measure what it claims to measure.

**Logical Validity** : It refers to either theoretical or commonsense analysis, which concludes simply that, the items, being what they, the nature of the continuum cannot be other than it is stated to be.

**Jury Opinion** : The confirmation of the logic is secured from a group of persons who would be considered experts in the field in which the measuring instrument is being used.

**Known-Group** : In this case, the validity is implied from the known attitudes and other characteristics of analytical groups, rather than from their specific expertise.

**Content Validity** : Content validity is the representativeness or sampling adequacy of the content.

**Predictive Validity** : It concerns a future criterion which is correlated with the relevant measure.

**Concurrent Validity** : It is assessed by correlating a measure and the criterion at the same point of time.

**Construct Validity** : Construct validity involves validation of not only the measuring instrument but of the theory underlying it.

## 3.9 REFERENCES AND SELECTED READINGS

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Patten M.L. (2005). *Understanding Research Methods – An Overview of the Essentials*. Pyrczak Publishing, USA.

## 3.10 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress 1**

1. Reliability estimates the consistency of our measurement, or more simply the degree to which an instrument measures the same way each time it is used in under the same conditions with the same subjects.
2. The three basic methods of determining the reliability are : test – retest method; alternative form method and split-half method.
3. The major defect of test-retest method is that experience in the first testing usually will influence responses in the second testing. The practical limitation of alternative form method is that it can be quite difficult to construct alternative forms of a test that are parallel. The major problem with the split-half method approach is that the correlation between the halves will differ depending on how the total number of items is divided into halves.

**Check Your Progress 2**

1. Yes. I agree with the statement 'one validates not the measuring instrument, but the purpose for which it is being used' because it is quite possible for a measuring instrument to be relatively valid for measuring one kind of phenomenon, but entirely invalid for assessing other phenomenon.
2. The four approaches to validation of measuring instrument are: logical validity /face validity; jury opinion; known-group and; independent criteria.

**Check Your Progress 3**

1. The three types of validity are : Content validity; Criterion validity (Predictive validity and Concurrent validity) and Construct validity.
2. Predictive validity concerns a future criterion which is correlated with the relevant measure. Concurrent criterion is assessed by correlating a measure and the criterion at the same point in time.

**Check Your Progress 4**

1. Validity is more important than reliability because if an instrument does not accurately measure what it is supposed to, there is no reason to use it even if it measures consistently (reliably).

# UNIT 4 SAMPLING

## Structure

4.1 Introduction

4.2 Sampling: Meaning and Concepts

4.3 Types of Sampling

4.4 Sample Design Process

4.5 Errors in Sampling

4.6 Determination of Sample Size

4.7 Let Us Sum Up

4.8 Key Words

4.9 References and Selected Readings

4.10 Check Your Progress – Possible Answers

## 4.1 INTRODUCTION

Sampling has been an age old practice in everyday life. Whenever we want to buy a huge quantity of a commodity, we decide about the total lot by simply examining a small fraction of it. It has been established that the sample survey if planned properly, can give very precise information. Since in surveys only a part of the population is surveyed and inference is drawn about the whole population, the results are likely to be different from the population values. But the advantage with the sample survey is that this type of error can be measured and controlled and it can be eliminated to a great extent by employing properly trained persons in surveys. The other advantages of sample surveys are that it is less time consuming and involves less cost. Usually, the population is too large for the researcher to attempt to survey all of its members. A small, but carefully chosen sample can be used to represent the population. The sample reflects the characteristics of the population from which it is drawn.

After studying this unit, you should be able to

- discuss the meaning and importance of sampling
- describe the steps and criteria involved in selecting a sampling procedure
- distinguish between different types of sampling
- explain the process of determination of sampling size

## 4.2 SAMPLING: MEANING AND CONCEPTS

### 4.2.1 Meaning of Sampling

According to Levin and Rubin, statisticians use the word, population, to refer not only to people, but, to all items that have been chosen for study. They use the word, sample, to describe a portion chosen from the population.

According to Croach and Housden, a sample is a limited number taken from a large group for testing and analysis, on the assumption that the sample can be taken as representative for the whole group.

According to Boyce, sampling makes an estimate about some of the characteristics of a population. To sample is to make a judgment or a decision about something after experiencing just part of it.

### 4.2.2 Concepts in Sampling

For clarity and brevity, some concepts and preliminaries of sampling theory, which are used in the study material, are discussed below.

*Sampling Units and Population:* a unit may be taken as a well defined and identifiable element or a group of elements on which observations can be made. The aggregate of these units is termed as population and the population is said to be finite, if the units are countable. The population is sub-divided into suitable small units known as sampling units for the purpose of sampling. Sampling units may consist of one or more elementary units and each elementary unit belongs to one and one sampling unit.

*Sampling Frame:* a sampling frame is a list of sampling units with identification particulars indicating the location of the sampling units. A sampling frame represents the population under investigation, and it is the base of drawing a sample. As far as possible, it should be up-to–date, i.e., free from omissions and duplications.

*Sample:* a fraction of the population is said to constitute a sample. The number of units included in the sample is known as the size of the sample.

*Sampling Fraction:* the ratio of the sample size, n, to the population size, N, is known as sampling fraction and it is denoted by (n / N).

*Sampling Procedure/Method:* this is the method of selecting a sample from a population.

*Census:* this denotes all the elements or units of a population which are used to explain the features of population. It usually refers to complete enumeration of all persons in the population.

*Population Parameter and Sample Estimator:* any function of the values of units in the population, such as population mean or populatio n variance, is termed a population parameter. There can only be one set of values for a population and the population values are treated as constant. However, the function of the values of the units in the sample, such as sample mean and sample variance, is known as a statistic. The value of the mean and variance differ from sample to sample and, therefore, it is a random variable.

### 4.2.3 Sampling Advantages

Some of the key advantages of sampling are:

(i) it costs less

(ii) takes less time

(iii) data are acquired quickly

(iv) fewer mistakes are likely

(v) a more detailed study can be done.

Now that you have read about the meaning and concept of sampling, answer the following questions in *Check Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What do you mean by sampling? What are the advantages of sampling?

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2. What is the difference between a parameter and an estimator?

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## 4.3 TYPES OF SAMPLING

There are broadly two types of sampling:

(i) Probability sampling

(ii) Non-probability sampling

### 4.3.1 Probability Sampling

A probability sample is one in which each element of the population has a known, non zero chance of being included in the sample. Probability methods include simple random sampling, systematic sampling, and stratified sampling.

**1. Simple Random Sample**

The random sample entails that each and every individual in a population has an equal chance of being included in the sample and that the selection of one individual is in no way dependent upon the selection of another person. The two popularly used methods in random sampling are

(i) draw of lottery

(ii) using a random number table.

(i) In lottery draw, for example, if we have to select a sample of 25 students from a total of 600 students in a college, then we make separate slips of paper for 600 students and put them in a box and thoroughly mix them. After that, a person is asked to pick up one slip. Here, the probability of each of the student being selected in the sample is 1/600. This procedure is continued till the sample size is acquired.

(ii) Another method of simple random sampling is to use a random number table for drawing 25 students from a total of 600 students. The procedure for using a random number table follows.

1. Number each element in the sample frame from 001 to 600.
2. Decide a random starting point in the table. Any point will do. Say second row in the second column (Appendix 1).
3. Look at the first three digits at that point, because there are three digit in 600.
4. Then, if the number is less than 600, include it in the sample; if not then look for a number where the first three digits are less than 600.
5. From that point you can move in any direction. Select only three digit numbers that are less than 600, until you have 25 such numbers.

Note: You can move in any direction in the random number table because every digit has been placed in the table at random.

For example, here if we start from the second row in the third column, then, the random numbers are: 31684; 09865; 14491; 34691, continuing till 25 samples are selected.

**2. Systematic Random Sample**

Designing a Systematic Random Sample is sometimes quite difficult and time consuming and therefore, Systematic Random Sample, like Simple Random Sample, also uses a list of all members of the population in its sampling frame. However, instead of using random numbers to select the sample elements, the researcher applies a skip interval to the list to produce a sample of the required size.

$$\text{Skip interval} = \frac{\text{number of elements in the population}}{\text{the required sample size}}$$

$$K = \frac{N}{n}$$

K = skip interval

N = Universe size

n = Sample size

For example if we have to select a sample of 100 persons from a universe of 1000 population, then the skip is 10. In this case one number between 1 and 10 has to be selected. Suppose 5 is selected, then the first sample would be $5^{th}$ and the next one $15^{th}$, $25^{th}$, $35^{th}$, $45^{th}$, and so on. One of the advantages of this method is that it is more convenient than other methods and simple to design. Again, it is used with very large populations.

**3 Stratified Random Sample**

In Stratified Random Sampling, the target population of N units is first divided into k subpopulations of $N_1, N_2, ....., N_k$ units. These populations are non-overlapping and together they comprise the whole population. So that

$$N_1 + N_2 + ..... + N_k = N$$

The sub-populations are called strata. The number in each stratum should be known. A sample is drawn from each stratum independently. The sample sizes within 'k' strata are denoted by $n_1, n_2, ....., n_k$ respectively. If the total sample size 'n' is to be drawn from the target population then

$$n_1 + n_2 + ..... + n_k = n$$

If a simple random sample is drawn in each stratum, the whole procedure is described as stratified random sampling.

Stratified random sampling requires more than making a list of elements (and estimating the number of elements on the list). It also involves ordering that list by sub groups (or strata) and then, to do sampling randomly or systematically within those sub groups. This method of sampling is used for the following reasons.

It can reduce the errors in the statistical estimates calculated from the sample.

It allows you to create a sample that is a good representative of the various sub groups in the population that you find to be of special interest.

For example, the selected village may have households of SC, ST, OBCs, Others, Minority. The village population first may be divided into smaller sub groups of different sections of population (stratum) and, thus, the village sample may consist of households from each stratum so that sample may contain all the important characteristics of the village population. In the case of SRS, the sample of all strata/ sub groups sometimes may not be included or covered adequately.

This method helps in conducting and managing a large scale survey to be conducted in a country like India. The agency conducting the survey may have field offices in different locations; each one can supervise the survey for a part of the population.

The basic idea is that it sub-divides the heterogeneous population into homogeneous sub-populations. If each stratum is homogenous in itself, a precise estimate of any stratum mean can be obtained from a small sample, thus, saving a lot of time and cost.

There are two types of stratified samples.

A **proportionate stratified sample** selects the number of elements from each stratum so that the stratum sample size ( $n_1, n_2, ....., n_k$ ) is proportional to their respective stratum population size ($N_1, N_2, ....., N_k$ ).

Consider the following examples:

A selected village may have households of SC(10%), ST (5%), OBCs (45%), Others (30%), Minority (10%). A village sample of 100 may constitute the households of various casts in the above proportion/ percentage so that the sample may contain all important characteristics of village population.

Hospital patients are stratified according to age, dividing the population into those who are aged 50years or above, and, those who are under 50. If there are twice as many people aged 50 or above admitted

to the hospital as those under 50, a proportionate stratified sample will include twice as many people aged 50 or above.

A **disproportionate stratified sample** selects the number of elements from each stratum so that the stratum sample size is not proportional to the stratum population size. The most common reason for selecting this type of sample is when you want to study a relatively rare but important subpopulation, such as younger patients suffering from heart disease. Proportionate stratification may result in too few elements being selected so that little, if any, statistical analysis can be done. Consequently, even if these patients represent only 1% of the population, you might decide to make them 10% of the final sample. However, once we combine values of all stratums, the size of the higher selected proportion needs to be readjusted which is called weighted estimate.

**4. Probability Proportional to Size (PPS) Sample**

It has been observed that the elementary units of the population vary in size. Such ancillary information about the size of the unit can be utilized in selecting the sample so as to get better and efficient estimates of the population parameter. For example villages with larger geographical area are likely to have larger area under food crops; therefore, in estimating the production, it would be desirable to adopt a sampling scheme in which villages are selected with probability proportional to geographical area. When units vary in their size and the variable under study is directly related with the size of the unit, the probabilities may be assigned proportional to the size of the unit.

**Probability Proportional to Size (PPS) Sampling** assures higher probability of selection to sampling unit which are larger in size. This technique was initially used in estimation of crop production, fruits production etc because productivity is directly related with the size of field. In social science surveys also characteristics of village population is influenced by the size of population. The **procedure of selecting the sample** is described below.

Suppose you have to select 5 villages from the list of 10 using PPS sampling. First arrange all villages in ascending or descending order of population size as may be seen in column 2 of the table 1. Then, in the third column, find the cumulative sum of population size and in the fourth column, assign them range of serial numbers as shown below in the table.

**Table 1: Village population Size**

| Serial Number | Village Population Size | Cumulative Sum of Population Size | Cumulative Population Size Interval |
|---|---|---|---|
| **1** | **2** | **3** | **4** |
| 1 | 200 | 200 | 0001 - 0200 |
| 2 | 250 | 450 | 0201 - 0450 |
| 3 | 300 | 750 | 0451 - 0750 |
| 4 | 350 | 1100 | 0751 - 1100 |
| 5 | 400 | 1500 | 1101- 1500 |
| 6 | 450 | 1950 | 1501 - 1950 |

| | | | |
|---|---|---|---|
| 7 | 500 | 2450 | 1951 - 2450 |
| 8 | 550 | 3000 | 2451 - 3000 |
| 9 | 600 | 3600 | 3001 - 3600 |
| 10 | 650 | 4250 | 3601 - 4250 |
| Total | 4250 | | |

Please notice that the total population of all villages in the target population is a four digit number (4250). Therefore, initially, a random number in four digits, which is less than or equal to the total population of all villages (4250), is selected from the random number table. For example, it is 0331 which will correspond to serial number 2. Next random number is 4320; therefore, it may be discarded. The next number selected is 1296; therefore, it will correspond to serial number 5. The next random numbers may be 1553, 2402 and 3640 which will correspond to serial numbers 6, 8, and 10 respectively. In this way, selected villages will be serial numbers 2, 5, 6, 8, 10.

### 5 Cluster Sample

**Cluster sampling** is a sampling technique used when natural groupings are evident in a statistical population. It is often used in marketing research. In this technique, the total population is divided into these known groups (or clusters) and a sample of the groups is selected. Then the required information is collected from the elements within each selected group. This may be done for every element in these groups, or a sub sample of elements may be selected within each of these groups. The technique works best when most of the variation in the population is within the groups, not between them.

Briefly, the procedure for selecting a cluster sample is given below.

The population is divided into N groups, called clusters.

The researcher randomly selects n clusters to include in the sample.

The number of observations within each cluster is known:

$$M = M1 + M2 + M3 + \ldots\ldots\ldots + MN$$

Each element of the population can be assigned to one, and only one, cluster.

Cluster sampling should be used only when it is economically justified - when reduced costs can be used to overcome losses in precision. This is most likely to occur in the following situations.

Constructing a complete list of population elements is difficult, costly, or impossible. For example, it may not be possible to list all elementary units of the populations, for example all households in village, block, etc. However, it would be possible to randomly select a subset of villages, blocks (stage 1 of cluster sampling) and, then, interview the head of family in a house of the selected cluster (stage 2).

The population is concentrated in natural clusters (city blocks, schools, hospitals, etc.). For example, to conduct personal interviews of operating room nurses, it might make sense to randomly select a sample of hospitals (stage 1 of cluster sampling) and then interview all of

the operating room nurses at that hospital. Using cluster sampling, the interviewer could conduct many interviews in a single day at a single hospital. Simple random sampling, in contrast, might require the interviewer to spend all day travelling to conduct a single interview at a single hospital.

As discussed above, in the cluster sampling method, the primary selecting unit is not a household, rather a natural cluster of households, viz., hamlets in villages, or, created clusters, viz., schools, malls, etc., may be decided. The first list of clusters may be selected using the SRS or the PPS sampling techniques. Then, from each selected cluster, all units, or, some of the units, may be selected as per the required sample size using Stratified Random Sampling or the Systematic Random Sampling techniques.

This sampling technique is quite popular in evaluation surveys in health – it is also called the 30 Cluster Sampling Technique. This is also a rapid method of data collection as the researcher can collect more data in less time due to the decrease in transportation time as compared with other sampling techniques.

### 4.3.2 Non-Probability Sampling

A **non-probability sample** is one in which a case in a sample is chosen in such a manner that it gives you information for the sample itself and makes it possible to generalize the findings for the population with certain degree of precision. Such a sample is also called a purposive sample. This kind of sampling is primarily used to collect information on market surveys to know the attitude, opinion, behaviour, reactions of individuals. There are many types of non-probability samples, including snowball sampling, convenience, purposive/ judgment, quota sampling, etc.

1. **Convenience Sample**

   The convenience sample is so called because it is relatively easy to obtain and contact. In this method the investigators are usually asked to select the people for the interview in accordance to the instructions from the researcher. The benefit of a convenience sample is that the interviewer can usually get interviews done quickly and cheaply. Convenience sampling is appropriate for exploratory research.

2. **Judgments Sample:**

   A judgment sample is similar to that of convenience sample. In a judgment sample, the researcher selects samples that are believed to represent the population. The selection of samples is based on the knowledge of the population and the characteristics which the sample is to represent. It is less costly and very useful for forecasting.

3. **Quota Sample:**

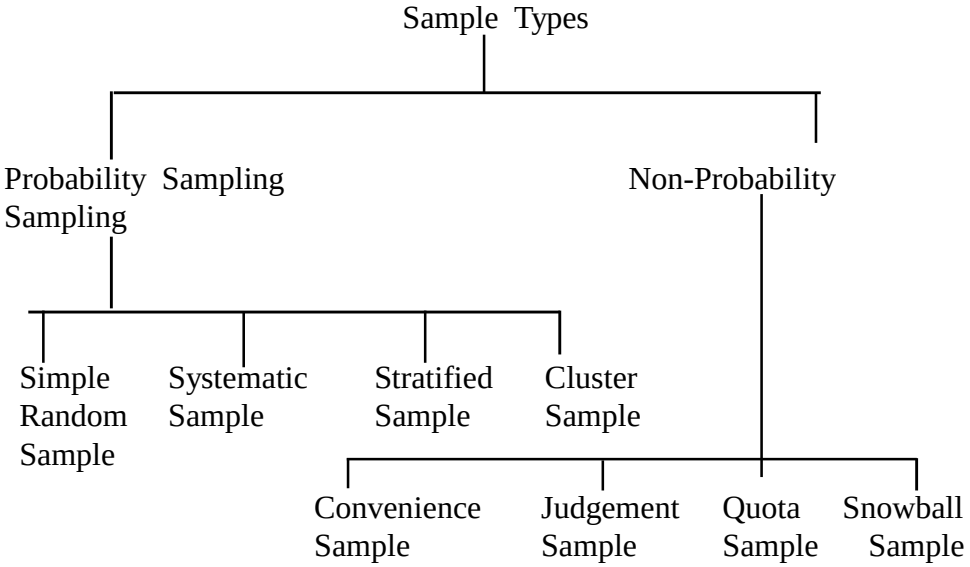
   Quota sampling is like stratified sampling. In quota sampling, the population is categorized into several strata which consist of an expected size, and the samples are considered to be important for the population they represent. The advantages of quota sample are that it involves a short time duration, is less costly, and gives moderate representation to a heterogeneous population.

**4. Snowball Sample:**

This is one of the important types of non-probability sampling. In snowball sampling, the investigator encourages the respondents to give the names of other acquaintances and it continues growing in size and chains until the research purpose is achieved. It is also, therefore, known as networking, chain, or referred sampling method. It is very useful in the study of networking and is less costly.

A comprehensive overview of the various types of sampling can be seen in Figure 4.1

**Fig. 4.1: Types of Sample**




## 4.4 SAMPLE DESIGN PROCESS

The sample design process follows five steps as given in Box-1

**Box - 1 Sample Design Process**

| | |
|---|---|
| Step-1 | Define the Population |
| Step-2 | Decide if it would be better to take a sample or a census |
| Step-3 | If possible, construct or obtain an appropriate sampling frame |
| Step-4 | Decide whether to use a probability sample or a non-probability sample |
| Step-5 | Select the sampling method |

**Source:** John Boyce (www.mhhe.com/av/boyceze)

**Step- 1: Define the Population**

We use the word, population, frequently in our day-to-day conversations, for example, 'The population of India', or, 'The population of Punjab', or, 'The population of Kerela'. However, the meaning of the word, population, in research is different from what we use in day-to-day conversation. A research population may be defined as 'a clearly defined group of entities that have some characteristics in common'. This means

the kind of people on whom we wish to base our research project. Sometimes, in research, we use the word, universe, instead of population.

In a research project, our intention is to learn or infer something about the population. Whether we would use a sample or a population has to be clearly defined. For example, if we want to conduct a study on road safety, then the task of defining the population for a survey would be whether we should

interview only the people who drive two wheelers

interview only the people who drive four wheelers

interview the pedestrians

interview only who are hand rickshaw pullers or ride bi-cycle.

Therefore, judging a population is the starting of the sampling process.

**Step-2: Decide whether to take a sample or a census**

After judging the population, the next step in the sampling process is to decide whether to take a sample or a population in your research project. In a census, usually every member of the population is interviewed. While in a sample method only selected members of the population are included. From the census we obtain data that are called population parameter, and from the sample we obtain statistics in a parameter. A parameter is a measurement of a characteristic of a population, while a sample statistic is used as an estimate of a population parameter.

Usually, in individual research, we use census when the population is small, and sample when the population is large.

**Step-4: Decide whether to use a probability sample or a non-probability sample**

The fourth step in the sampling process is whether to use probability sampling or non-probability sampling. In a probability sample, the sample elements are chosen by random selection, while in non-probability sampling, each sample element is chosen according to whether the researcher decides that it should be included or not.

**Step-5: Select the sampling method**

Last, but not least in the sampling process, is the selection of the sampling method. In the probability sampling method, the following four principal kinds of probability sampling are used: the simple random sample, the systematic sample, the stratified sample, and the cluster sample. The main non-probability sampling methods are the convenience sample, the judgment sample, the quota sample, and the snowball sample.

**Sampling Frame**

A sampling frame is a listing of all the elements from which you will draw the sample. In the ideal situation, the sampling frame will include all elementary units in the target population. A list of employees in an organization can create a sampling frame that exactly matches the population of interest. You should try to ensure that the sampling frame has the following characteristics.

It is actually created from the target population.

It is as complete a list as possible of the elements in the population.

In this section, you have read about the various types of sampling and the sample design process. Now, answer the following questions in *Check Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is a stratified sample?

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.....

.....

.....

2. What is a cluster sample and when is it best used?

.....

.....

.....

.....

3. What do you understand by a quota sample?

.....

.....

.....

.....

## 4.5 ERRORS IN SAMPLING

Many mistakes and errors in social science research happen because of misleading and biased sampling. A sample which does not represent the population is called a biased sample. According to Yule and Kendal, "Bias may be due to imperfect instruments, the personal qualities of the observer, defective techniques and other cases. Like experimental error, it is difficult to eliminate entirely, but usually may be reduced to relatively small dimensions by taking proper care." There are two types of errors such as sampling errors and non-sampling errors. These are discussed below:

**(i) Sampling Error**

By definition, when you have collected a sample from a population, you have less than complete information about the population. This, in turn, means that there is a chance that the sample statistics you calculate, (for example, the mean of a variable, a frequency distribution, etc.) may not be an unbiased estimate of the population parameter.

The error in the sample estimate is not an intrinsic impediment to analysis. For probability samples, sampling theory allows you to calculate the expected amount of error given a particular sample size, sampling method, and the specific statistic of interest. In general terms, the sampling error for a statistic can be defined as:

$$\text{Standard error} = \sqrt{\frac{\text{Variance}}{n}} = \frac{sd}{\sqrt{n}} \qquad \text{..... (1)}$$

Where n refers to the number of respondents (sample size).

As the sample size increases, the standard error of a statistic decreases; as the variance, or dispersion, of a statistic increases, so does its sampling error.

Sampling error decreases rapidly as the sample size increases from a few hundred to about 1000 respondents. However, there is rarely any reason to select larger samples while comparing the increased cost of survey with reduction in sampling error (see 'Calculating the Sample Size', in next section).

The formula for the standard error of a proportion is simple and easy to apply:

$$\text{Standard error} = \sqrt{\frac{p \times (1-p)}{n}} \qquad \text{..... (2)}$$

Here, p represents the proportion of successes (favourable response, those who received the benefits), {q = (1-p)} represents the proportion of failures (those who did not receive the benefits), and n is the total number of respondents. The standard error of a statistic is greatest when p and (1-p) are equal, which occurs when each is 0.50, or 50%, of the sample.

**(ii) Non-Sampling Error**

Before discussing how to determine sample size, we will briefly review other sources of error in surveys. When you read a news article that reports the results of a national poll, the error in the estimates is always listed, derived, generally speaking, from Equation 2. However, experienced survey researchers know that errors due to other sources are typically greater than the error due to sampling alone. Following are some other types of errors.

Measurement errors, caused by poorly written questions, poorly designed questionnaires, respondent errors in completing questionnaires, and so on.

Non-response errors, caused because the respondents are not a representative subset of the population.

Data coding errors, caused, by errors in coding and entering the data.

Of these error sources, the first two are typically more severe. In mail surveys, non-response error is often the most serious problem.

There are two critical characteristics of these non sampling errors. First, as mentioned above, their sum is often greater than the sampling error. Second, and more insidious, these errors are often impossible to estimate for any one survey, especially measurement and non-response errors. Consequently, using Equation 1 and Equation 2 to estimate the error in a statistics often provides a false sense of security.

Experienced survey researchers take this fact into account by being more cautions in discussing survey results than the sampling error alone would indicate, and you should do the same. Ideally, the other sources of error

would balance themselves out so that errors in one direction negate errors in the other directions, but you cannot assume that this is the case.

## 4.6 DETERMINATION OF SAMPLE SIZE

The sample size can be determined by:

(i) Using a formula

(ii) Using a table

### 4.6.1 Determining Sample Size Using a Formula

$$n = \frac{Z^2pq}{d^2}$$ (when population is greater than 10,000)

$$nf = \frac{n}{1+(n/N)}$$ (when population is less than 10,000)

n, nf = desired sample size

Z = the standard normal deviate

p = the portion in the target population estimated to have a particular characteristic. If there is no reasonable estimate, then use 50 percent (.50).

q = 1-p

d= degree of accuracy desired, usually set at .05 or occasionally at .02.

n = the estimate of the population size

Z at 99% confidence level i.e. at 1% level of significance = 2.58

Z at 95% confidence level i.e. at 5% level of significance = 1.96

Z at 90% confidence level i.e. at 10% level of significance = 1.65

**Example: (when population is more than 10,000)**

If the proportion of target population with a certain characteristic is .50, the Z statistic 1.96 and we desire accuracy at the 0.05 level, then the sample size is

$$n = \frac{(1.96)^2 \quad (.50*.50)}{(0.05)^2}$$

$$= \frac{3.84*0.25}{(.0025)}$$

$$= \frac{0.96}{0.0025}$$

$$= 384$$

If we use the more convenient 2.0 for the Z statistic, then the sample size will be smaller.

$$nf = \frac{400}{1+ (400)/1000}$$

$$= \frac{400}{1.4}$$

$$= 286$$

### 4.6.2 Determining Sample Size by Using a Table

Another way to determine sample size is to rely on published tables which provide the sample size for a given set of criteria. Table 1 presents sample size values that will be appropriate for many common sampling problems. The table includes sample sizes for both continuous and categorical data assuming alpha levels of .10, .05, or .01.

**Table 1: Table for Determining Minimum Returned Sample Size for a Given Population Size for Continuous and Categorical Data**

| Population size | Sample size | | | | | |
|---|---|---|---|---|---|---|
| | Continuous data (margin of error= .03) | | | Categorical data (margin of error= .05) | | |
| | alpha= .01 t=1.65 | alpha= .05 t=1.96 | alpha= .01 t=2.58 | p=.50 t=1.65 | p=.50 t=1.96 | p=.50 t=2.58 |
| 100 | 46 | 55 | 68 | 74 | 80 | 87 |
| 200 | 59 | 75 | 102 | 116 | 132 | 154 |
| 300 | 65 | 85 | 123 | 143 | 169 | 207 |
| 400 | 69 | 92 | 137 | 162 | 196 | 250 |
| 500 | 72 | 96 | 147 | 176 | 218 | 286 |
| 600 | 73 | 100 | 155 | 187 | 235 | 316 |
| 700 | 75 | 102 | 161 | 196 | 249 | 341 |
| 800 | 76 | 104 | 166 | 203 | 260 | 363 |
| 900 | 76 | 105 | 170 | 209 | 270 | 382 |
| 1,000 | 77 | 106 | 173 | 213 | 278 | 399 |
| 1,500 | 79 | 110 | 183 | 230 | 306 | 461 |
| 2,000 | 83 | 112 | 189 | 239 | 323 | 499 |
| 4,000 | 83 | 119 | 198 | 254 | 351 | 570 |
| 6,000 | 83 | 119 | 209 | 259 | 362 | 598 |
| 8,000 | 83 | 119 | 209 | 262 | 367 | 613 |
| 10,000 | 83 | 119 | 209 | 264 | 370 | 623 |

In this session you studied about errors in sampling and determination of sample size. Now, answer the questions given in *Check Your Progress-3.*

**Check Your Progress 3**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is sampling error?

.....

.....

.....

.....

2. How is the sample size determined using the formula?

.....

.....

.....

.....

## 4.7 LET US SUM UP

In this unit, we discussed the meaning and various concepts in sampling particularly of sample and population. There is also a detailed discussion on the sample types and sample design process. There are two types of sampling such as probability and non-probability sampling. The types of probability sampling are the Simple Random Sample, the Systematic Sample, the Stratified Sample, and the Cluster Sample, while different types of non-probability sample are the Convenience Sample, the Quota Sample, the Judgment Sample, and the Snowball Sample. The unit also discusses various steps of the sampling design process. This is followed by two of the very important concepts of sampling: the determination of sample size and errors in sampling.

## 4.8 KEY WORDS

**Sample** : a sample is simply a subset of a larger aggregation, i.e., typically a population and it contains all the characteristics of a population,

**Sampling** : the process of selection of subjects/study elements to create a sample for collecting information about a population.

**Standard Error** : this is the expected amount of error while estimating the specific statistic of interest, using a particular sample size and sampling method with respect to actual population value.

**Sampling Error** : while collecting information from a sample, there is a chance that the sampling statistics may not be equal to the same values in the population. The error is that the sample does not contain complete information about the population.

**Confidence Interval** : this gives the probability of the sample estimate falling within the interval.

**Sample Size** : the number of elementary units in a sample is called a sample size.

# Appendix 1

## Random Number Table

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2711 | 8182 | 75997 | 79866 | 58095 | 83319 | 80295 | 79741 | 74599 | 84379 |
| 94873 | 90935 | 31684 | 63952 | 9865 | 14491 | 99518 | 93394 | 34691 | 14985 |
| 54921 | 78680 | 6635 | 98689 | 17306 | 25170 | 65928 | 87709 | 30533 | 89736 |
| 77640 | 97636 | 37397 | 93379 | 56454 | 59818 | 45827 | 74164 | 71666 | 46977 |
| 61545 | 835 | 93251 | 87203 | 36759 | 49197 | 85967 | 1704 | 19634 | 21898 |
| | | | | | | | | | |
| 17147 | 19519 | 22497 | 16857 | 42426 | 84822 | 92598 | 49186 | 88247 | 39967 |
| 13748 | 4742 | 92460 | 85801 | 53444 | 65626 | 58710 | 55406 | 17173 | 69776 |
| 87455 | 14813 | 50373 | 28037 | 91182 | 32786 | 65261 | 11173 | 34376 | 36408 |
| 8999 | 57409 | 91185 | 10200 | 61411 | 23392 | 47797 | 56377 | 71635 | 8601 |
| 78804 | 81333 | 53809 | 32471 | 46034 | 36306 | 22498 | 19239 | 85428 | 55721 |
| | | | | | | | | | |
| 82173 | 26921 | 28472 | 98958 | 7960 | 66124 | 89731 | 95069 | 18625 | 92405 |
| 98594 | 25168 | 89178 | 68190 | 5043 | 17407 | 48201 | 83917 | 11413 | 72920 |
| 73881 | 67176 | 93504 | 42636 | 38233 | 16154 | 96451 | 57925 | 29667 | 30859 |
| 46071 | 22912 | 90326 | 42453 | 88108 | 72064 | 58601 | 32357 | 90610 | 32921 |
| 44492 | 19686 | 12495 | 93135 | 95185 | 77799 | 52441 | 88272 | 22024 | 80631 |
| | | | | | | | | | |
| 31984 | 72170 | 37722 | 55794 | 14636 | 5148 | 54505 | 50113 | 21119 | 25228 |
| 51574 | 90692 | 43339 | 65689 | 76539 | 27909 | 5467 | 21727 | 51141 | 72949 |
| 35350 | 76132 | 90925 | 92124 | 92634 | 35681 | 43690 | 89136 | 35599 | 84138 |
| 46943 | 36502 | 1172 | 46045 | 46991 | 33804 | 80006 | 35542 | 61056 | 75666 |
| 22665 | 87226 | 33304 | 57975 | 3985 | 21566 | 65796 | 82915 | 81466 | 89205 |
| | | | | | | | | | |
| 39437 | 97957 | 11838 | 10433 | 21564 | 51570 | 73558 | 27495 | 34533 | 57808 |
| 77082 | 47784 | 40098 | 97962 | 89845 | 28392 | 78187 | 6112 | 8169 | 11861 |
| 24544 | 25649 | 43370 | 28007 | 6779 | 72402 | 62632 | 53956 | 24709 | 6978 |
| 27503 | 15558 | 37738 | 24849 | 70722 | 71859 | 83736 | 6016 | 94397 | 12529 |
| 24590 | 24545 | 6435 | 52758 | 45685 | 90151 | 45616 | 49644 | 92686 | 84870 |
| | | | | | | | | | |
| 48155 | 86226 | 40359 | 28723 | 15364 | 69125 | 12609 | 57171 | 86857 | 31702 |
| 20226 | 53752 | 90648 | 24367 | 83314 | 14 | 19207 | 69413 | 97016 | 86290 |
| 70176 | 73444 | 38790 | 53626 | 93780 | 18626 | 68766 | 24371 | 74639 | 30782 |
| 10169 | 41465 | 51935 | 5711 | 9799 | 79077 | 88159 | 33437 | 68519 | 3040 |
| 81084 | 3701 | 28598 | 70013 | 63794 | 53169 | 97054 | 60303 | 23259 | 96196 |
| | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 69202 | 20777 | 21727 | 81511 | 51887 | 16175 | 53746 | 46516 | 70339 | 62727 |
| 80561 | 95787 | 89426 | 93325 | 86412 | 57479 | 54194 | 52153 | 19197 | 81877 |
| 8199 | 26703 | 95128 | 48599 | 9333 | 12584 | 24374 | 31232 | 61782 | 44032 |
| 98883 | 28220 | 39358 | 53720 | 80161 | 83371 | 15181 | 11131 | 12219 | 55920 |
| 84568 | 69286 | 76054 | 21615 | 80883 | 36797 | 62845 | 39139 | 90900 | 18172 |
| | | | | | | | | | |
| 4269 | 35173 | 95745 | 53893 | 86022 | 77722 | 52498 | 84193 | 22448 | 22571 |
| 10538 | 13124 | 36099 | 13193 | 37706 | 44562 | 57179 | 44693 | 67877 | 1549 |
| 77843 | 24955 | 25900 | 69843 | 95029 | 93859 | 93634 | 20205 | 66294 | 41218 |
| 12034 | 94636 | 49455 | 76362 | 83532 | 31062 | 69903 | 91186 | 65768 | 55949 |
| 10524 | 72823 | 47641 | 93315 | 80875 | 28090 | 97728 | 52560 | 34937 | 79548 |
| | | | | | | | | | |
| 68935 | 76632 | 46984 | 61772 | 92786 | 22651 | 7086 | 89754 | 44143 | 97687 |
| 83450 | 65665 | 29190 | 43709 | 11172 | 34481 | 95977 | 47535 | 25658 | 73898 |
| 90696 | 20451 | 24211 | 97310 | 60446 | 73530 | 62865 | 96574 | 13829 | 72226 |
| 49006 | 32047 | 93086 | 112 | 20470 | 17136 | 28255 | 86328 | 7293 | 38809 |
| 74591 | 87025 | 52368 | 59416 | 34417 | 70557 | 86745 | 55809 | 53628 | 12000 |
| | | | | | | | | | |
| 6315 | 17012 | 77103 | 968 | 7235 | 10728 | 42189 | 33292 | 51487 | 64443 |
| 62386 | 9184 | 62092 | 46617 | 99419 | 64230 | 96034 | 85481 | 7857 | 42510 |
| 86848 | 82122 | 4028 | 36959 | 87827 | 12813 | 8627 | 80699 | 13345 | 51695 |
| 65643 | 69480 | 46598 | 4501 | 40403 | 91408 | 32343 | 48130 | 49303 | 90689 |
| 11084 | 46534 | 78957 | 77353 | 39578 | 77868 | 22970 | 84349 | 9184 | 10603 |

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## 4.10 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress 1**

1. Generally, a sample implies a small representative of a large whole. This sampling method is frequently used in social science research

to save time. Some of the key advantages of sampling are: (i) it costs less; (ii) takes less time; (iii) data are sometimes wanted quickly; (iv) fewer mistakes are likely; (v) a more detailed study can be done.

2. Any function of the values of units in the population, such as the population mean or population variance, is termed, a population parameter. There can only be one set of values for a population, there population values are treated as constant. However, the function of the values of the units in the sample, such as the sample mean and sample variance is known as a statistic. The value of the mean and variance differs from sample to sample and, therefore, it is a random variable.

**Check Your Progress 2**

1. In stratified sampling, the target population of N units is first divided into k subpopulations of $N_1, N_2, ....., N_k$ units. These populations are non-overlapping and together they comprise the whole population, so that

$$N_1 + N_2 + ..... + N_k = N$$

The sub-populations are called strata. The number in each stratum should be known. A sample is drawn from each stratum independently. The sample sizes within 'k' strata are denoted by $n_1, n_2, ..... , n_k$ respectively If the total sample size n is to be drawn from the target population then

$$n_1 + n_2 + ..... + n_k = n$$

If a simple random sample is drawn in each stratum, the whole procedure is described as stratified random sampling.

2. Cluster sampling is a sampling technique used when natural groupings are evident in a statistical population. It is often used in marketing research. In this technique, the total population is divided into these known groups (or clusters) and a sample of the groups is selected. Then, the required information is collected from the elements within each selected group. This may be done for every element in these groups or a sub sample of elements may be selected within each of these groups. The technique works best when most of the variation in the population is within the groups, not between them.

3. Quota sampling is like stratified sampling. In quota sampling, the population is categorized into several strata which consist of an expected size and they are considered to be important for the population they are supposed to represent. The advantages of the quota sample are: shorter time duration, less costly, and gives moderate representation to a heterogeneous population.

**Check Your Progress 3**

1. By definition, when you have collected a sample from a population, you have less than complete information about the population. This, in turn, means that there is a chance that the sample statistics you calculate, (for example, the mean of a variable, a frequency distribution,

etc.) may not be unbiased estimate of the population parameter. This error is called sampling error.

2. The calculation of the sample size is concerned with the number of respondents required. To determine the number to select for the sample drawn from the sampling frame, you must estimate the non-response rate. The actual sample size to be drawn is:

$$Sample\ size = \frac{Number\ of\ respodents}{\mathrm{Re}\,sponse\ rate}$$

So, if any survey organization decides that they need 700 respondents, and the expected response rate from the population is 50%, then 700/ 0.50, or 1400, customers must be drawn from the sampling frame.

# MDV-106: RESEARCH METHODOLOGY IN DEVELOPMENT STUDIES

(6 CREDITS)

| BLOCK | UNIT NOS | UNIT TITLES |
|---|---|---|
| 1 | | **Fundamentals of Social Science Research** |
| | 1 | Social Science Research: An Overview |
| | 2 | Components of Social Science Research |
| | 3 | Research Designs |
| | 4 | Research Project Formulation |
| 2 | | **Development Research** |
| | 1 | Basics of Development Research |
| | 2 | Methods of Development Research |
| | 3 | Development Research Applications |
| **3** | | **Measurement and Sampling** |
| | **1** | **Measurement** |
| | **2** | **Scales and Tests** |
| | **3** | **Reliability and Validity** |
| | **4** | **Sampling** |
| 4 | | **Data Collection** |
| | 1 | Quantitative Data Collection Methods and Devises |
| | 2 | Qualitative Data Collection Methods and Devises |
| | 3 | Data Sources |
| 5 | | **Data Analysis** |
| | 1 | Overview of Statistical Tools |
| | 2 | Use of Computer in Data Analysis |
| | 3 | Data Processing and Analysis |
| | 4 | Report Writing |

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# MDV-106
# Research Methodology in Development Studies

Block

# 4

## DATA COLLECTION

**UNIT 1**
**Quantitative Data Collection Methods and Devices** **5**

**UNIT 2**
**Qualitative Data Collection Methods and Devices** **22**

**UNIT 3**
**Data Sources** **36**

## PROGRAMME DESIGN COMMITTEE


Prof. Amita Shah
Gujarat Institute of Development Research, Ahmedabad

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

Prof. J. S. Gandhi (Rtd)
Jawaharlal Nehru University, New Delhi

Prof. Gopal Krishnan (Rtd)
Punjab University, Chandigarh

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Prof. Kumar B. Das
Utkal University, Bhubaneswar

Prof. Nadeem Mohsin (Rtd)
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Prof. P. Radhakrishan
Madras Institute of Development Studies, Chennai

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Prof. R. P. Singh ( Rtd)
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Prof. K. Vijayaraghavan
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IGNOU, New Delhi

Prof. B. K. Pattanaik
IGNOU, New Delhi

Dr. Nehal A. Farooquee
IGNOU, New Delhi

Dr. P.V.K.Sasidhar
IGNOU, New Delhi


## PROGRAMME DESIGN COMMITTEE (REVISED)


Prof. T.S. Papola
Institute for Studies in Industrial Development, New Delhi

Prof. S. Janakrajan
Madras Institute of Development Studies, Chennai.

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

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A.N.Sinha Institute of Social Sciences, Patna

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University of Delhi, New Delhi

Prof. B. K. Pattanaik
IGNOU, New Delhi

Prof. Nehal A. Farooquee
IGNOU, New Delhi

Prof. P.V.K. Sasidhar
IGNOU, New Delhi

Dr. Pradeep Kumar
IGNOU, New Delhi

Dr. Nisha Varghese
IGNOU, New Delhi

Dr. Grace Don Nemching
IGNOU, New Delhi


## COURSE PREPARATION TEAM


**Unit Writer:**

Mr. P. Shukla
Saket, New Delhi (Unit 1)

Dr. V. Sailaja
S. V. Agricultural College, Tirupati (Unit 2)

Dr. Nisha Varghese
SOEDS, IGNOU (Unit 3)

**Editing and Proof Reading:**

Prof. V.K.Jain (Rtd) (Content Editor)
NCERT, New Delhi

Mr. Praveer Shukla (Language Editor), New Delhi

Dr. Nisha Varghese, IGNOU

Prof. B. K. Pattanaik, IGNOU

Prof. Nehal A. Farooquee, IGNOU

Prof. P. V. K. Sasidhar, IGNOU

**Course Coordinator :** Dr. Nisha Varghese, E-mail : nishavarghese@ignou.ac.in

**Programme Coordinators :** Prof. P.V.K. Sasidhar, Prof. B.K. Pattanaik, Prof. Nehal A. Farooquee,


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# BLOCK 4 DATA COLLECTION

Block 4 on **'Data Collection'** with three units gives an overview of various tools and techniques of data collection and various sources of secondary data needed for conducting development research.

Unit 1 on '**Quantitative Data Collection Methods and Devices**' discusses the meaning and concept of quantitative data. The unit also gives a detailed account of different methods and devises of quantitative data collection.

Unit 2 on '**Qualitative Data Collection Methods and Devices**' discusses the meaning and concept of qualitative data. This unit also discusses different methods and devises of qualitative data collection.

Unit 3 on '**Data Sources**' provides information about various sources of secondary data that will be useful for development research.

# UNIT 1 QUANTITATIVE DATA COLLECTION METHODS AND DEVICES

**Structure**

1.1 Introduction

1.2 Primary Data Collection: Meaning and Methods

1.3 Questionaire Methods of Data Collection

1.4 Interview Schedule

1.5 Secondary Data Methods

1.6 Let Us Sum Up

1.7 References and Selected Readings

1.8 Check Your Progress - Possible Answers

## 1.1 INTRODUCTION

There are two types of primary research: one is done through quantitative data collection and the other, through qualitative data collection. Customarily, quantitative data collection means using numbers to assess information. As you are aware, some kinds of information are numerical in nature, for example, a person's age, or annual income. The answers to these questions are in numbers.

Quantitative data is used for testing of a hypothesis and drawing inferences. Quantitative data is collected by using the following two set of data resources:

i. Primary data

ii. Secondary data.

In this unit, we will discuss in detail, methods of collecting primary and secondary data, along with the advantages and disadvantages of the methods.

After reading this unit, you should be able to

explain the primary data collection methods

discuss the questionnaire and interview methods of data collection

describe secondary methods of data collection

## 1.2 PRIMARY DATA COLLECTION: MEANING AND METHODS

Data which are originally collected by the investigators are called primary data, while the secondary data are collected through some other sources. For example, information collected by an investigator from a student regarding his class, caste, family background, etc., is called primary data. On the other hand, if the same information is collected about the student from the school record and register, then it is called secondary data.

However, the difference between primary and secondary data is largely of degree, and there is hardly any watertight difference between them. The data collected through primary sources by one investigator may be secondary in the hands of others. For example, field data collected by an investigator for writing his thesis is primary to him, and when the same data is used by another investigator, for reference purposes, then it became secondary data. Let us discuses the methods that are used to collect primary and secondary data.

There are various types of quantitative primary data gathering tools, but the important ones among them are

The Questionnaire

The Interview Schedule

## 1.3 QUESTIONNAIRE METHOD OF DATA COLLECTION

Questionnaires are a popular method of data collection. Although they look easy, it is difficult to design a good questionnaire. Careful design of a questionnaire is vital for the collection of required facts and figures. Any frivolous attempt in framing a questionnaire will lead to either shortage, or, collection of unnecessary information neither of which will be useful to your research. Questionnaire design depends on whom, and, from where information has to be collected; what facts and figures need to be collected; and the calibre of the informants.

The questionnaire can be broadly categorized into two types:

(i) structured questionnaire

(ii) unstructured questionnaire.

**i. Structured questionnaires** are prepared in advance. They contain definite and concrete questions. The structured questionnaire may contain close ended questions and open ended responses. In the close ended questionnaire, the question setter gives alternative options for which the respondent has to give definite response. The best example of the close ended questionnaire format is the one that leads respondents to the “Yes” or “No”/ “True” or “False” answers.

**ii. Unstructured questionnaires** are those that are not structured in advance, and the investigators may adjust questions according to their needs during an interview.

### 1.3.1 Methods of Data Collection Using Questionnaires

Questionnaire methods are conducted in different ways. A few important methods are outlined here.

**i. Personal Interview**

In personal interviews, the interviewer or investigator personally approaches the interviewee and administers questions. This method is largely followed in research and studies and the accuracy of data is very high. However, it is an expensive method.

### ii. Mail Questionnaire

In this method, the investigator mails the questionnaire to respondents and respondents are requested to fill it up and return it to the investigator. In many cases, a self addressed stamped envelope is sent along with the questionnaire to facilitate the return of the questionnaire mail immediately. This method is usually adopted where the respondents are widespread and the investigator has limited resources to approach them. The success of this method depends of the literacy level of the respondents and the accuracy of the address database. One of the drawbacks of this method is that, sometimes, the respondents do not take the questionnaire seriously, and, as a result the answer may not be accurate.

**Implementing a Mail Survey**

Design a written questionnaire with identification number.

Pretest questionnaire to assure validity and reliability.

Select sample population.

Two weeks before mailing the survey, send an advance letter

Mail the questionnaire including a cover letter and a stamped, self-addressed envelope

Send a postcard a week or so later, thanking those who responded and reminding those who did not return the questionnaires

Three weeks after mailing the first questionnaire, send a follow-up letter stating that a response has not been received, including a replacement questionnaire and a stamped, self-addressed envelope.

In developing the mailing schedule avoid holidays.

For most purposes, a 60 to 90 percent return rate is considered satisfactory.

**Source :** *Suvedi et.al., 2008*

### iii. Telephone

In this method, the investigator administers a questionnaire by seeking responses from the respondent over the telephone. It is largely administered to the urban respondents where telephone facilities are widely available. However, the success of this method depends on the availability of telephone with the respondents. It is also an expensive method of administering a questionnaire.

**Implementing a Telephone Survey**

Arrange the facilities for survey.

Identify the sample and their telephone numbers.

Send an advance letter if addresses are available with information on when you will be likely to contact respondents, during working or non-working hours and how much time you need.

Prepare well on the background information about the survey to answer respondents questions, if any.

Develop an interview schedule.

Decide on the number of calls to make to each number. In local surveys six to seven calls are customary.

Decide how to handle refusals.

Stick to the time schedule

**Sample Call Sheet for Telephone Interviews**

A call-sheet is used for each number chosen from the sampling frame. The interviewer records information that allows the supervisor to decide what to do with each number that has been processed. Call sheets are attached to questionnaires after an interview is completed.

**Telephone Interview Call Sheet**

Survey title : ——————————————

Questionnaire identification number ——————————————-

Area code & number ( ) ——————— & ——————————

| Contact attempts | Date Time Result code & comments Interviewer I.D. |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| Additional comments | |
| Code | **Result Codes** |
| | No answer after seven rings |
| | Busy, after one immediate redial |
| | Answering machine (residence) |
| | Household language barrier |
| | Answered by nonresident |
| | Household refusal |
| | Disconnected or other non-working number |
| | Temporarily disconnected |
| | Business or other non-residence |
| | No one meeting eligibility requirement |
| | Contact only |
| | Selected respondent temporarily unavailable |
| | Selected respondent unavailable during field period |
| | Selected respondent unavailable because of physical/ mental handicap |

| | |
|---|---|
| | Language barrier with selected respondent<br>Refusal by selected respondent |
| | Partial interview |
| | Respondent contacted - completed interview |
| | Other |

| **Sample Help Sheet for Interviewers** | |
|---|---|
| Name of sponsoring agency: | |
| Purpose of study: | |
| Contact person for survey: | |
| Size of survey: | |
| Identity of interviewer: | |
| How respondents name was obtained: | |
| Issues of confidentiality: | |
| How to get a copy of results: | |
| How will results be used: | |

(Source : Suvedi et.al., 2008)

**iv. E-Mail**

With the IT revolution, nowadays, questionnaires are attached to the e-mails and sent to respondents who send an answer through return e-mail. The success of this method depends on the availability of internet facilities.

## 1.3.2 Qualities of a Good Questionnaire

Questionnaire framing is the most arduous task in social science research. Careful framing of questionnaires is essential to obtain reliable data. Some of the principles that need to be taken into consideration while framing a questionnaire are as follows:

i. **It must be simple**: the questions must be simple and straightforward. They must also be short, which could be easily answered.

ii. **Begin with a covering letter**: the front page of the questionnaire must contain an introduction to investigator or institution collecting data, and the purpose of the quest. If the questionnaires are to be returned by mail, then, the address to which they are to be sent must be clearly mentioned.

iii. **The number of questions must be kept to a minimum**: the questions asked in the questionnaire must be kept to a minimum and restricted to the subject and topic of the study. Any questions which do not have direct bearing on the problem must be avoided.

iv. **Minimum use of Technical Terms**: try to avoid the technical terms as far as possible. If abbreviations are used, they need to be explained with illustrations, either separately or in the questionnaire itself. However, the investigator should be conversant about those technical terms.

v. **Questions must be logically arranged**: here lies the acumen of the investigator or question setter. He, or, she must arrange the questions in such a way that such questions should flow naturally from the answer to the previous question.

vi. **Avoid asking controversial questions**: do not include questions which are controversial in nature, or, are too personal or specific to community sentiments. Hypothetical questions, too, need to be avoided.

vii. **Pre testing of questionnaire**: before final administration, questionnaire need to be pre tested among a small number of respondents. This will give an opportunity to the investigator to rectify the problems, and, if required, any addition and deletion of questions.

### 1.3.3 Physical form of Questionnaire

While designing the questionnaire, the physical form of the questionnaire may be meticulously prepared. The following factors need to be taken into consideration.

i. **Size:** the size of the questionnaire depends on the scope of the study. Adequate space should be provided for recording the comments and suggestions of the respondents. However, a single space is needed for recording the response. The Coding of questionnaire will reduced the need for space. Taking all these factors into consideration, the size of the questionnaire can be fixed, accordingly.

ii. **Quality of the paper**: good quality paper should be used in the question so that it lasts for a longer period. Except for the front page, white papers may be used in other pages.

iii. **Covering Letter**: Every questionnaire must have a covering letter. The purpose of the questionnaire must be clearly mentioned. Assurance should be given that the information gathered will be used only for research purpose, and be given confidential treatment.

### 1.3.4 Advantages of Questionnaires

The advantages of questionnaires are:

i. they are less expensive compared to the interview schedule and can be administered over a large number of respondents.

ii. they are less time consuming.

iii. since the interviewer is not present during the administration of a questionnaire, respondents may feel more free and have greater confidence in answering questions

iv. one of the advantages of the questionnaire method is that once it is standardized, then, the information collected from the respondents becomes more uniform.

### 1.3.5 Disadvantages of Questionnaires

Some disadvantages of questionnaires are:

i. In a questionnaire, there is no personal contact between the investigator and the respondents because of which clarifications on responses, if needed, cannot be sought.

ii. a questionnaire is not a suitable mode when a spontaneous answer is required through probing

iii. it is possible that the investigator may not get a response for all questions. Sometimes the responses may be vague or incorrect information may be provided

iv. there is the chance that information may be manipulated.

**Sample Questionnaire**

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MA in Development Studies

**Title: Functioning of Primary School in Bhilwara village**

1. Name of the State .....
2. Name of the District .....
3. Name of the Block.....
4. Name of the Village.....
5. Name of the Teacher (Respondent) .....
6. Sex: Male/Female…….
7. Age ……..
8. Educational Qualification.....
9. Caste……..
10 Marital Status ……
11. Years of Teaching .....
12. Training received, if any.....
13. If yes, write the subjects taught in the training programme ...
14. Subject you are teaching
    Mathematics .....
    Science .....
    Literature .....
    Any other; specify .....
15. Medium in which you are teaching
    English.....
    Hindi .....
    Any other, specify.....
16. In your opinion, which students were performing better in the class:
    General Caste .....
    SC .....
    ST .....
    Girls .....
    Boys ..... …….

17. Your interaction with the

| Categories | Frequent | Occasional | Not at all |
|---|---|---|---|
| Parents | | | |
| Father | | | |
| Mother | | | |

18. The role of Panchayat in your school management

    Good .....

    Average .....

    Poor .....

19. Functioning of the Village Education Committee

    Good .....

    Average .....

    Poor .....

    Areas of their involvement .....

20. In your opinion, who are the real beneficiaries of rural education?

    Economically Poor .....

    Girl Children .....

    Socially backward .....

    All .....

21. Write the main problems of your School

    1 .....

    2 .....

    3 .....

22. What are your suggestions for improvement of the school conditions?

    1 .....

    2 .....

    3 .....

In this section, you studied about quantitative data collection and the questionnaire method of data collection. Now, answer the questions given in *Check Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is primary data?

.....

.....

.....

2. What are the advantages of a questionnaire?

.....

.....

.....

## 1.4 INTERVIEW SCHEDULE

Interview schedule is a common practice in research. The schedule puts the whole thing in a structured form, so that the tabulation and analysis of data becomes easier. The basic difference between the schedule and the questionnaire is that in case of former, the presence of a field investigator or interviewer is a must, while the same may not be mandatory in the latter case. In other words, in the case of the interview schedule, the field investigator is an essential component. In other aspects, there is not much difference between the interview schedule and the questionnaire.

Some important aspects need to be taken into consideration in the preparation and execution of interview schedule.

**i.** **Selection of Respondents:** the selection of respondents is the key to interview schedule administration. The respondents are selected through various sampling methods and their names and addresses are noted down. The field investigator approaches them for data collection by filling up the interview schedule.

**ii.** **Training of the Field Staff:** before sending field investigators for data collection, try to give them proper training on the interview schedule. If possible, some orientation on various aspects of the problem may be given. It will enable the field investigator to effectively interact with the respondents. Nowadays, the NFHS (National Family Health Survey), RCH (Reproductive and Child Health) surveys and many base line surveys conducted by various agencies spend a lot of money in training of the field investigators before sending them for data collection.

**iii.** **Method of Conducting an Interview:** the field investigators must be practiced in conducting interviews; otherwise, respondents sometimes may not allow them to take the interviews. He must approach the respondents politely, introduce himself/herself and tell them the purpose of interview and the confidentiality involved in it. The respondents must be approached by the field investigator according to their convenience. Getting correct information from the informants depends on the skill of the field investigator.

**iv.** **Editing of the Interview Schedule**: editing of the interview schedule is a must before sending it for tabulation and analysis. While checking the schedule, one must notice the number of cases allotted, number of cases contacted, and number of cases lost due to refusal. The field supervisor must check the schedule filled up by the field investigator. If information is missing from any schedule then the field investigators could be sent again for data collection. If the schedules have codes for different alternative responses, these should also be checked, and, if any contradiction exists must be shared before sending it for final data entry and tabulation.

**Sample Interview Schedule**

**Title: Socio-Economic study of Households Lines in Jadupur Village**

**(To be filled by the Head of the Household Or Any Adult Member of the family)**

Name of the Respondent: .....

**I) Identification of Village .....**

1. Name of the Village .....

**II) Identification of Household: .....**

1. Household Survey No .....
   (marked by the survey team)
2. Name of the Head of the Household .....
3. Religion .....
4. Caste/Sub Caste, Specify… .....

**III. Housing Condition: .....**

**1. Type of House;**

(i) Kacha (…..)
(ii) Pacca (…..)
(iii) Semi Pacca (…..)
(iv) Any other (…..)

**2. Main source of drinking water;**

(i) Government/own hand pump (…..)
(ii) Tap/pipe (…..)
(iii) Canal/river (…..)
(iv) River/well/pond (…..)
(v) Any others, specify…… …… ……

**3. Toilet facilities;**

(i) Flush (…..)
(ii) Pit (…..)
(iii) Open field (…..)
(iv) Any other (…..)

**4 A. Main source of light;**

(i) Electricity (…..)
(ii) Kerosene/Oil (…..)
(iii) Gas (…..)
(iv) Any other (…..)

**4 B. Main source of cooking;**

(i) Traditional *chulha* (…..)
(ii) Bio-gas/gas (…..)
(iii) Kerosene/electric stove (…..)
(iv) Any other (…..)

**5. Communication Media;**

(i) Radio/transistor/tape recorder (…..)
(ii) Television (…..)
(iii) Newspaper/magazine (…..)
(iv) Any other (…..)

**6. Agricultural land owned by the household;**

(i) 1-10 Bigha (…..)
(ii) 11-20 Bigha (…..)
(iii) 21-30 Bigha (…..)
(iv) 31-40 Bigha (…..)
(v) 41 Bigha and above (…..)

(Note : One hectare is equivalent to approximately 12 *Bigha*)

**7. Average monthly income of household (Rs. per month);**

(i) Rs.1-1000 (…..)
(ii) Rs.1001-2000 (…..)
(iii) Rs.2001-3000 (…..)
(iv) Rs.3001-4000 (…..)
(v) Rs.4001-5000 (…..)
(vi) Rs.5001 and above (…..)

(Kindly mention actual income of the household……)

IV. **Household Profile**

| S. No. | No.Members of the house hold (start from Head of the house hold) | Relationship | Sex | Age | Marital Status | Education | Occupation | Diseases |
|---|---|---|---|---|---|---|---|---|
| **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** | **(9)** |
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |

Note: 1. If there are more than 15 members in a household, use another household schedule to fill the relevant data of the household profile.

2. If age of any member, under (Col.5) is below 5 years then Col. 6, Col. 7 and Col. 8 are not to be filled.

**Col. (3) Relationship:**

(i) Head of household-01; (ii) Spouse (wife/husband)-02; (iii) Son-03; (iv) Daughter-04 (v) Grandson-05; (vi) Granddaughter-06; (vii) Father-07; (viii) Mother-08; (ix) Grandfather-09; (x) Grandmother-10; (xi) Son in law-11; (xii) Daughter in law-12; (xiii) Brother-13; (xiv) Sister-14; (xv) Brother in law-15; (xvi) Sister in law-16; (xvii) Uncle-17; (xviii) Auntie-18; (xix) Nephew-19; (xx) Niece-20; (xxi) Servant-21; (xxii) Other household member specify……-22. (It should be clear that persons sharing their meals in a single kitchen, are considered as family members)

**Col. (6) Marital Status:**

(i) Currently married-01; (ii) Separated-02; (iii) Widow-03; (iv) Widower-04; (v) Divorced-05; (vi) Never married-06

**Col. (7) Education:**

(i) Illiterate-01; (ii) Literate (non-formal)-02; (iii) Primary-03; (iv) Middle-04; (v) High School-05; (vi) Higher Secondary or Intermediate-06; (vii) Graduate-07; (viii) Post Graduate and above-08; (ix) Professional or Technical Education-09; (x) Any other, specify……..-10.

**Col. (8) Occupation:**

(i) Cultivator-01; (ii) Agricultural/casual labourer-02; (iii) Self-employed -03; (iv) Private service-04; (v) Government service-05; (vi) Household/ domestic activities-06; (vii) Student-07; (viii) Unemployed-08; (ix) Any other, specify……..-09.

**Col. (9) Diseases:**

(i) Tuberculosis (T.B.)-01; (ii) Asthma-02; (iii) Cataract/Blindness-03; (iv) Laprosy-04; (v) Physical impairment-05; (vi) Malaria during last 3 months-06; (vii) Diabetes-07; (viii) Hypertension-08; (ix) Heart Problem-09; (x) Any other specify……..-10.

### 1.4.1 Advantages of Interview Schedule

(i) the interview probes the problem in detail which gives scope to gather detailed information

(ii) there is a personal touch between the investigator and the respondents and, therefore, detailed and exhaustive information can be collected

(iii) there is greater accuracy in getting the information

(iv) the interview method is particularly suitable for illiterate respondents.

### 1.4.2 Disadvantages of Interview

Some disadvantages of the interview schedule method are

(i) it is a time consuming and expensive method, compared to the questionnaire method

(ii) lack of objectivity is a common lacuna of the interview method

(iii) the interview method sometimes leaves investigators at the mercy of respondents.

Now that you have read about interview schedule, try and answer the following questions in *Check Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are the advantages of the interview schedule method?

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2. What aspects need to be taken into consideration while preparing an interview schedule?

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## 1.5 SECONDARY DATA METHODS

Secondary data are collected by investigators from sources other than primary respondents. Secondary data are collected from both, published and unpublished sources. The main resources of secondary data are given below.

i. Official publication of the Central Government such as Census, NSSO Report, Human Development Report, SRS report, etc.

ii. Research and study reports of bilateral and multilateral organizations such as WHO, World Bank, IMF, UNESCO, UNICEF, etc. A few of them include, the World Development Report, World Development Indicators, Human Development Report, etc.

iii. Reports brought out by committees and commissions such as the Mandal Commission Report, the National Planning Commission Report, the Human Rights Commission Report, the Population Commission Report, etc.

iv. Policy documents of the Central and State Government such as National Population Policies, National Education Policies, National Health Policies, etc.

v. Publications brought out by the research institutes, universities and organizations.

vi. Publications of data sources on different national and international journals such as Economic and Political Weekly, Indian Economic Journal, etc.

vii. Books and articles published on various subjects.

viii. Official publications of the Reserve Bank of India, State Bank of India, Association of Indian Banking, etc.

ix. Information available in year books and encyclopaedias.

x. Statistical abstracts published both by the Central and State Governments.

xi. Information published in the directories and bulletins of various institutions such as the Indian Council of Social Sciences Research, the Indian Council of Agricultural Research, etc.

xii. Abstracts and index of reports and articles published by various research, teaching, and related organizations.

### 1.5.1 Precautions in the use of Secondary Data

While using secondary data for the study, users have to be careful. Sometimes, the data published by an individual researcher may be full of errors and even drawn from an inadequate sample. Some factors to keep in mind while using the data from secondary sources are listed below.

**Adequacy** –sometimes data available from the secondary, sources are not adequate for the investigation. Data may either be from a different time period, or partially fulfil the requirement of the study. Therefore, adequacy of the data must be ensured before conducting the study.

**Reliability –** before using secondary data, its reliability must be taken into consideration. For example, the reliability on sample size and the sampling method used in the collection of data may be taken into consideration. Besides, the investigator has also to know the degree of bias in collection of data.

**Suitability –**the investigator has to check whether the data is suitable for the purpose of the research study. Sometimes, the secondary data may be suitable for tabular presentation, but, unsuitable for statistical analysis.

The investigator has to take all these factors into consideration before using the secondary data.

In this section you read about the secondary data methods. Now try and answer the questions in *Check Your Progress-3.*

**Check Your Progress 3**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are a few sources of secondary data?

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2. What precautious have to be taken care of while using secondary data?

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## 1.6 LET US SUM UP

This unit describes in detail the various sources and methods of collection of quantitative data. It also deals with the methods of collection of primary data and secondary data. The advantages and disadvantages of various methods of data collection have also been discussed in the unit. The unit also narrates the precautions one has to take while collecting the primary and secondary data.

## 1.7 REFERENCES AND SELECTED READINGS

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## 1.8 CHECK YOUR PROGRESS-POSSIBLE ANSWERS

**Check Your Progress 1**

1. Primary data are those data which are originally collected by the investigators, while the secondary data are used by investigator collected through some other sources. For example, information collected by an investigator from a student regarding his class, caste, family background, etc., is called primary data. On the other hand, if the same information is collected about the student from the school record and register, then it is called secondary data.

2. The advantages of a questionnaire are

   a. it is less expensive compared to interview schedule and can be administered over a large number of sample

   b. it is less time consuming.

c. the interviewer is not present during the administration of questionnaire, the respondents have greater freedom and confidence in answering questions

d. one of the adventures of the questionnaire is that once it is standardized, then there is greater uniformity in getting responses.

**Check Your Progress 2**

1. The advantages of the interview method are as follows:

   a. the interview probes the problem in detail which gives scope to gathering detailed information

   b. there is a personal touch between the investigator and the respondents, and, therefore, detailed and exhaustive information can be collected

   c. there is greater accuracy in getting the information

   d. the interview method is particularly suitable for illiterate respondents.

2. Some aspects need to be taken into consideration while preparing an interview schedule:

   Selection of Respondents: this is the key to interview schedule administration.

   Training of the Field Staff: before sending the field investigator for data collection, try to give them proper training on the interview schedule.

   Method of Conducting an Interview: the field investigator must be apt in conducting the interview, otherwise respondents sometimes may not allow them to take interview

   Editing of the Interview Schedule: the investigator has to do proper editing of the interview schedule before sending it for tabulation and analysis.

**Check Your Progress 3**

1. 1. Official publication of the Central Government such as Census, NSSO Report, Human Development Report, SRS report, etc.

   2. Research and Study Reports of bilateral and multilateral organizations such as WHO, World Bank, IMF, UNESCO, UNICEF, etc. A few of them like World Development Report, World Development Indicators, Human Development Report, etc.

   3. Reports brought out by Committees and Commissions such as Mandal Commission Report, National Planning Commission Report, Human Rights Commission Report, Population Commission Report etc.

2. Some of the factors to be kept in mind while using the data from secondary sources are:

   ***Adequacy*** –sometimes data that is available from secondary sources are not adequate for the research project. Data may either be from a different time period or partially fulfil the requirement of the study.

Reliability – before using the secondary data, its reliability must be taken into consideration. The investigator has also to know the degree of bias in the collection of data.

***Suitability*** –the investigator has to see whether the data is suitable to his or her study. Sometimes, the secondary data available may be suitable for tabular presentation, but unsuitable for statistical analysis.

# UNIT 2 QUALITATIVE DATA COLLECTION METHODS AND DEVICES

**Structure**

2.1 Introduction

2.2 Qualitative Data - Meaning and Concept

2.3 Methods and Techniques of Qualitative Data Collection

2.4 Features of Qualitative and Quantitative Research

2.5 Let Us Sum Up

2.6 Key Words

2.7 References and Selected Readings

2.8 Check Your Progress – Possible Answers

## 2.1 INTRODUCTION

Data Collection is an important aspect of any type of research study. Data collection techniques allow us to systematically collect information about the subject of our study (people, objects, phenomena), and about the environment. In the collection of data we have to be systematic. If data are collected haphazardly, it will be difficult to answer our research questions in a conclusive way. Inaccurate data collection can impact the results of a study and ultimately lead to invalid results.

After studying this unit, you should be able to

- discuss the meaning and concept of qualitative data;
- describe the features of various methods and devices used for qualitative data collection; and
- state the uses and limitations of various qualitative data collection methods.

## 2.2 QUALITATIVE DATA - MEANING AND CONCEPT

Qualitative research is grounded in the assumption that individuals construct social reality in the form of meanings and interpretations, and that these constructions tend to be transitory and situational. Qualitative research typically involves qualitative data, i.e., data obtained through methods such interviews, on-site observations, and focus groups that is in narrative rather than numerical form. Such data are analyzed by looking for themes and patterns. It involves reading, re-reading, and exploring the data. How the data are gathered will greatly affect the ease of analysis and utility of findings.

Qualitative data are descriptive in nature and can be statistically analyzed only after processing and after having them classified into some appropriate categories. Qualitative data can, however, facilitate in-depth analysis of a social situation. There are certain situations where qualitative research alone can provide the researcher with all insights needed to make decisions and take actions; while in some other cases quantitative research might be needed as well.

## 2.3 METHODS AND TECHNIQUES OF QUALITATIVE DATA COLLECTION

Qualitative methods are ways of collecting data which are concerned with describing meaning, rather than with drawing statistical inferences. They provide in-depth and rich descriptions. In this section, a detailed description and comparison of the most commonly used qualitative methods employed in social science research is given. These include observations, in-depth interviews, and focus groups.

### 2.3.1 Observation Method

In our daily life we observe many things and events around us, but this sort of observation is not scientific. Observational techniques are methods by which an individual or individuals gather first hand data on programs, processes, or behaviours being studied. They provide evaluators with an opportunity to collect data on a wide range of behaviours, to capture a great variety of interactions, and to openly explore the evaluation topic. By directly observing operations and activities, the evaluator can develop a holistic perspective, i.e., an understanding of the context within which the project operates. This may be especially important where it is not the event that is of interest, but rather how that event may fit into, or be impacted by, a sequence of events.

Scientific observation is a methodical way of recognizing and noting a fact or occurrence, often involving some sort of measurement. Scientific observations should be specific, and recorded immediately. Understanding the culture of the people and the ability to interact with them are essential for good observation. Researches may be based solely on observation, but in most cases observation precedes other methods of data collection.

**When to use observations:** Observations can be useful during both the formative and summative phases of evaluation. For example, during the formative phase, observations can be useful in determining whether or not the project is being delivered and operated as planned. In the hypothetical project, observations could be used to describe the faculty development sessions, examining the extent to which participants understand the concepts, ask the right questions, and are engaged in appropriate interactions. Such formative observations could also provide valuable insights into the teaching styles of the presenters and how they are covering the material.

**Advantages**

(i) Subjective bias may be eliminated, if observation is done accurately

(ii) Information relates to current state of affairs; and

(iii) It is independent of respondents' willingness or capability to respond.

**Limitations**

(i) A time consuming and expensive method

(ii) A limited amount of information may be available; and

(iii) Extraneous factors may interfere with the task of observation.

**Types of observation:**

**Structured and unstructured observation:** in case the observation is characterized by a careful definition of the units to be observed, the manner of recording the observed information, standardized conditions of observation, and the selection of pertinent data of observation, then the observation is called as structured observation. But, when the observation is conducted without these features thought out in advance, the same is termed an unstructured observation. Structured observation is considered appropriate in descriptive studies, whereas, in an exploratory study, the observational procedure should be relatively unstructured.

**Participant and non-participant observation**: this depends on the degree of involvement of the researcher with the situation being observed. In participant observation, the researcher who may be an outsider, while observing the group, also plays the role of a group member. It is necessary to have the observation in an unbiased way, without getting emotionally involved in the affairs of the group or the community. The main advantage of participant observation is that, it helps the observer to get an intimate knowledge of the group or the community being observed, under natural condition. For example, if one wants to study the fishermen community, reliable information may be obtained through the method of participant observation. Participant observation, however, requires longer time, greater resources, and there may be loss of objectivity, if not properly done. In non-participant observation, the researcher observes the group or the community, while maintaining physical and psychological isolation from them. This ensures collection of information in an objective way.

**Controlled and uncontrolled observation**: when observation takes place according to a definite pre-arranged plan involving experimental procedure, the same is termed as a controlled observation. The aim of a controlled observation is to check any bias due to faulty perception, incomplete information and effect of external stimuli on a specific situation. An uncontrolled observation on the other hand, is one where the researcher observes the behaviour and activities of a group under natural conditions (as they are) without any stimulation from the outside. This method provides a wide range of information and helps in developing an insight about the group or community. Care should, however, be taken against subjective interpretation of observed phenomenon.

**Recording Observational Data**

Observations are carried out using a carefully developed set of steps and instruments. The observer is more than just an onlooker, but, rather, comes to the scene with a set of target concepts, definitions, and criteria for describing events. While, in some studies, observers may simply record and describe, in the majority of evaluations, their descriptions are, or eventually will be, judged against a continuum of expectations.

Observations usually are guided by a structured protocol. The protocol can take a variety of forms, ranging from the request for a narrative, describing events seen to a checklist or a rating scale of specific behaviours/activities that address the evaluation question of interest. The use of a protocol helps assure that all observers are gathering the pertinent information and, with appropriate training, applying the same criteria in the evaluation. For example, an observational approach is selected to gather data on the faculty training sessions, the instrument developed would explicitly guide the observer to examine the kinds of activities in which participants were interacting, the role(s) of the trainers and the participants, the types of materials provided and used, the opportunity for hands-on interaction, etc.

Field notes are frequently used to provide more in-depth background or to help the observer remember salient events if some forms are not completed at the time of observation. Field notes contain the description of what has been observed. The descriptions must be factual, accurate, and thorough without being judgmental and cluttered by trivia. The date and time of the observation should be recorded, and everything that the observer believes to be worth noting should be included. No information should be trusted to future recall.

Technological tools, such as a battery-operated tape recorder or a Dictaphone, laptop computer, camera, and video camera, can make the collection of field notes more efficient and the notes themselves more comprehensive. Informed consent must be obtained from participants before any observational data are gathered.

### 2.3.2 Interview/Questionnaire Method

In these methods, the data are collected by presenting stimuli to the respondents in the form of questions for eliciting appropriate responses from them. The questions may be presented to the respondents in a face-to-face situation as oral-verbal stimuli, and the researcher or personnel trained for the purpose (interviewers, enumerators) note down their oral-verbal responses. This method is known as the interview method, and the set of questions is known as the interview schedule. In another method, the questions are delivered (generally mailed) to the respondents, who note down their responses on it and send it back to the researcher. This method is known as the questionnaire method, and the set of questions is known as a questionnaire.

In both, answers to some systematically organised questions, relevant to the objectives of the study are sought. The questions should be accurate and clearly understood by the respondents, so that the responses are accurate. Both the methods have some advantages and limitations. The success of the questionnaire method depends more on the quality of the questionnaire itself, but in case of interview method much depends upon the honesty and competency of the enumerators.

**Types of interview**

Interviews may be of different types according to the needs of the situation.

***Structured interview*:** For this purpose an interview schedule is used which is well structured with specific questions to be asked. The questions are precisely worded and systematically organised, and are prepared in advance

after requisite pre-testing. The interviewer is not expected to make any change while interviewing the respondents. The data received are comparable and are more amenable to statistical analyses. The structured interview is also known as standardized, controlled or guided interview.

***Unstructured interview***: Here the interviewer proceeds with some well thought out themes or guidelines to be inquired into, and brings out the required information from the respondents through the process of conversation. The situation is free and informal and no interview schedule is used. This provides more flexibility and freedom, but at the same time demands deep knowledge and greater skill on the part of the interviewer. The process may yield good amount of information, but the data lack comparability and are less amenable to statistical analysis. Unstructured interview is suitable for exploratory or formulative research studies.

***Focused interview***: In focused interviews, some specific issue, occurrence, experience, or event is taken into consideration instead of general aspects of a situation. The interviewer has the freedom to decide the manner and sequence in which the questions would be asked, and, has also the freedom to explore reasons and motives. The main task of the interviewer, however, is to confine the discussion to the specific issue under investigation. Such interviews are convenient for development of hypotheses, action research etc. and constitute a major type of unstructured interviews.

***In-depth interview:*** An in-depth interview is a dialogue between a skilled interviewer and an interviewee. Its goal is to elicit rich, detailed material that can be used in analysis. These interviews are designed to discover motives and desires, and, are often used in motivational research. Such interviews are held to explore needs, desires, and feelings of respondents. Such interviews are best conducted face to face, although in some situations telephonic interviewing can be successful.

In-depth interviews are characterized by extensive probing and open-ended questions. Typically, the researcher prepares an interview guide that includes a list of questions or issues that are to be explored and suggested probes for follow up on key topics. The guide helps the interviewer pace the interview and makes interviewing more systematic and comprehensive.

The dynamics of interviewing are similar to a guided conversation. The interviewer becomes an attentive listener who shapes the process into a familiar and comfortable form of social engagement - a conversation - and the quality of the information obtained is largely dependent on the interviewer’s skills and personality. In contrast to a good conversation, however, an in-depth interview is not intended to be a two-way form of communication and sharing. The key to being a good interviewer is being a good listener and questioner. Tempting as it may be, it is not the role of the interviewer to put forth his or her opinions, perceptions, or feelings. Interviewers should be trained individuals who are sensitive, empathetic, and able to establish a non- threatening environment in which participants feel comfortable. They should be selected during a process that weighs personal characteristics that will make them acceptable to the individuals being interviewed; clearly, age, sex, profession, race/ethnicity, and appearance may be key characteristics. Thorough training, including familiarization with the research problem and its goals, is important.

Specific circumstances in which in-depth interviews are particularly appropriate include

complex subject matter

detailed information sought

busy, high-status respondents

highly sensitive subject matter.

### 2.3.3 Case Study Method

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

Pauline V. Young describes case study as "a comprehensive study of a social unit be that unit a person, a group, a social institution, a district or a community."' In brief, we can say that the case study method is a form of qualitative analysis where careful and complete observation of an individual, situation, or an institution is done; efforts are made to study each and every aspect of the concerned unit in minute detail, and then, from case data, generalizations and inferences are drawn.

**Characteristics:** the important characteristics of the case study method are listed below.

i. In this method, the researcher can take a single social unit or more such units for his study purpose.

ii. Here the selected unit is studied intensively, i.e., it is studied in minute detail. Generally, the study extends over a long period of time to ascertain the natural history of the unit so as to obtain enough information for drawing correct inferences.

iii. In the context of this method we make a complete study of the social unit covering all facets. Through this method we try to understand the complexities of factors that are operative within a social unit as an integrated totality.

iv. Using this method, the approach happens to be qualitative and not quantitative. Mere quantitative information is not collected. Every possible effort is made to collect information concerning all aspects of life. As such, the case study method deepens our perception and gives us a clear insight into life. For instance, in the case study method, we not only study how many crimes a man has committed, but we peep into the factors that forced him to commit crimes when we are making a case study of a man who is a criminal. The objective of the study may be to suggest ways to reform the criminal.

v. In respect of the case study method, an effort is made to know the mutual inter-relationship of causal factors.

vi. We study behaviour pattern of the concerned unit directly, and not by an indirect and abstract approach.

vii. The case study method results in fruitful hypotheses, along with the data which may be helpful in testing them, and, thus, this method enables generalized knowledge to get richer and richer. In its absence, generalized social science may get handicapped.

**Assumptions:** the case study method is based on several assumptions. The important assumptions may be listed as follows.

(i) The assumption of uniformity in basic human nature, in spite of the fact that human behaviour may vary according to situations.

(ii) The assumption of studying the natural history of the unit concerned.

(iii) The assumption of comprehensive study of the unit concerned.

**Major phases involved**

(i) Recognition and determination of the status of the phenomenon to be investigated or the unit of attention.

(ii) Collection of data, examination, and history of the given phenomenon.

(iii) Diagnosis and identification of causal factors as a basis for remedial developmental treatment.

(iv) Application of remedial measures, i.e., treatment and therapy (this phase is often characterized as case work).

(v) Follow-up programme to determine effectiveness of the treatment applied.

In this section you have read about the meaning and concept of qualitative data and the tools and techniques of qualitative data collection. Now try and answer the questions given in *Check Your Progress-1*.

**Check Your Progress 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is the difference between the interview method and the questionnaire method?

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2. List out the important assumptions of the case study method.

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### 2.3.4 Focus Groups

Focus groups combine elements of both interviewing and participant observation. The focus group session is an interview, not a discussion group, a problem solving session, or a decision making group. At the same time, focus groups capitalize on group dynamics. The hallmark of focus groups is the explicit use of group interaction to generate data and insights that would be unlikely to emerge without the interaction found in a group. The technique inherently allows observation of group dynamics, discussion, and firsthand insights into the respondents' behaviours, attitudes, language, etc.

Focus groups are a gathering of 8 to 12 people who share some characteristics relevant to the evaluation. Originally used as a market research tool to investigate the appeal of various products, the focus group technique has been adopted by other fields, such as education, as a tool for data gathering on a given topic. Focus groups, conducted by experts, generally take place in a focus group facility that includes recording apparatus (audio and/or visual) and an attached room with a one-way mirror for observation. There is an official recorder who may or may not be in the room. Participants are paid for attendance and provided with refreshments. As the focus group technique has also been adopted by fields other than marketing, some of these features, such as payment or refreshment, have been eliminated.

**When to use focus groups**: When conducting evaluations, focus groups are useful in answering the same type of questions as in-depth interviews. Specific applications of the focus group method in evaluations include

- identifying and defining problems in project implementation
- identifying project strengths, weaknesses, and recommendations
- assisting with interpretation of quantitative findings
- obtaining perceptions of project outcomes and impacts
- generating new ideas.

Although focus groups and in-depth interviews share many characteristics, they should not be used interchangeably.

**Developing a Focus Group**

An important aspect of conducting focus groups is the topic guide. The topic guide, a list of topics or question areas, serves as a summary statement of the issues and objectives to be covered by the focus group. The topic guide also serves as a road map and as a memory aid for the focus group leader, called a moderator. The topic guide also provides the initial outline for the report of findings.

Focus group participants are typically asked to reflect on the questions asked by the moderator. Participants are permitted to hear each other's responses and to make additional comments beyond their own original responses as they hear what other people have to say. It is not necessary for the group to reach any kind of consensus, nor is it necessary for people to disagree. The moderator must keep the discussion flowing and make sure that one or two persons do not dominate the discussion. As a rule, the focus group session should not last longer than 1 ½ hours to 2 hours. When very specific information is required, the session may be as short as 40 minutes. The

objective is to get high quality data in a social context where people can consider their own views in the context of the views of others, and, where new ideas and perspectives can be introduced.

### 2.3.5 Content Analysis

Content analysis consists of analyzing the contents of documents, such as books, magazines, newspapers, and the contents of all other verbal materials, either spoken or printed. Content analysis prior to 1940's was mostly quantitative documentary materials concerning certain characteristics that can be identified and counted. But since the 1950's, content analysis is mostly qualitative analysis, concerning the general importance of the existing documents.

The analysis of content is a central activity whenever one is concerned with the nature of the verbal materials. A review of research in any area, for instance, involves an analysis of the contents of research articles that have been published. The analysis may be at a simple level, or, it may be a subtle one. It is at a simple level when we pursue it on the basis of certain characteristics of the document, or, verbal materials that can be identified and counted (such as on the basis of major scientific concepts in a book). It is at a subtle level when researcher uncovers the attitude, say of the press towards education by feature writers.

### 2.3.6 Other Qualitative Data Collection Methods

This section outlines less common but, nonetheless, potentially useful qualitative methods for project evaluation. These methods include document studies, key informants and alternative (authentic) assessment.

**(i)** **Document Studies**: Existing records often provide insights into a setting and/or group of people that cannot be observed or noted in another way. This information can be found in document form. A document can be defined as "any written or recorded material" not prepared for the purposes of the evaluation, or, at the request of the inquirer. Documents can be divided into two major categories: public records, and personal documents.

**a)** **Public records:** are materials created and kept for the purpose of "attesting to an event or providing an accounting". Public records can be collected from outside (external) or within (internal) the setting in which the evaluation is taking place. Examples of external records are census and vital statistics reports, district office records, newspaper archives, and local business records that can assist an evaluator in gathering information about the larger community and relevant trends. Such materials can be helpful in better understanding the project participants and making comparisons between groups/communities.

For the evaluation of educational innovations, internal records include documents such as student transcripts and records, historical accounts, institutional mission statements, annual reports, budgets, grade and standardized test reports, minutes of meetings, internal memoranda, policy manuals, institutional histories, college/ university catalogues, faculty and student handbooks, official correspondence, demographic material, mass media reports and

presentations, and descriptions of program development and evaluation. They are particularly useful in describing institutional characteristics, such as the backgrounds and academic performance of students, and in identifying institutional strengths and weaknesses. They can help the evaluator understand the institution's resources, values, processes, priorities, and concerns. Furthermore, they provide a record or history that is not subject to recall bias.

**b)** **Personal documents**: are first-person accounts of events and experiences. These "documents of life" include diaries, portfolios, photographs, artwork, schedules, scrapbooks, poetry, letters to the paper, etc. Personal documents can help the evaluator understand how the participant sees the world and what she or he wants to communicate to an audience. And, unlike other sources of qualitative data, collecting data from documents is relatively invisible to, and requires minimal cooperation from, persons within the setting being studied.

The usefulness of existing sources varies depending on whether they are accessible and accurate. In the hypothetical project, documents can provide the evaluator with useful information about the culture of the institution and participants involved in the project, which in turn can assist in the development of evaluation questions. Information from documents also can be used to generate interview questions or to identify events to be observed. Furthermore, existing records can be useful for making comparisons (e.g., comparing project participants to project applicants, project proposal to implementation records, or documentation of institutional policies and program descriptions prior to, and, following the implementation of project interventions and activities).

**(ii)** **Key Informant**: A key informant is a person (or, group of persons) who has unique skills or professional background related to the issue/ intervention being evaluated, is knowledgeable about the project participants, or has access to other information of interest to the evaluator. A key informant can also be someone who has a way of communicating that represents, or, captures the essence of what the participants say and do. Key informants can help the evaluation team better understand the issue being evaluated, as well as the project participants, their backgrounds, behaviours, and attitudes, and, any language or ethnic considerations. They can offer expertise beyond the evaluation team. They are also very useful for assisting with the evaluation of curricula and other educational materials. Key informants can be surveyed or interviewed individually or through focus groups.

In the hypothetical project, key informants (i.e., expert faculty on main campus, deans, and department chairs) can assist with: (1) developing evaluation questions, and; (2) answering formative and summative evaluation questions.

**(iii)** **Performance Assessment**: the performance assessment movement is impacting education from pre-schools to professional schools. At the heart of this upheaval is the belief that for all of their virtues - particularly efficiency and economy - traditional objective, norm-

referenced tests may fail to tell us what we most want to know about student achievement. In addition, these same tests exert a powerful and, in the eyes of many educators, detrimental influence on curriculum and instruction. The search for alternatives to traditional tests has generated a number of new approaches to assessment under such names as alternative assessment, performance assessment, holistic assessment, and authentic assessment. While each label suggests slightly different emphases, they all imply a movement toward assessment that supports exemplary teaching. Performance assessment appears to be the most popular term because it emphasizes the development of assessment tools that involve students in tasks that are worthwhile, significant, and meaningful. Such tasks involve higher order thinking skills and the coordination of a broad range of knowledge.

Performance assessment may involve qualitative activities such as oral interviews, group problem-solving tasks, portfolios, or personal documents/ creations (poetry, artwork, stories). The quality of this product is assessed (at least, before and after training) in light of the goal of the professional development program. The actual performance of students on the assessment measures provides additional information on impact.

## 2.4 FEATURES OF QUALITATIVE AND QUANTITATIVE RESEARCH

In unit 1, we discussed various aspects of quantitative data collection methods. Let us now see the main differences between qualitative and quantitative methods.

| **Qualitative research** | **Quantitative research** |
|---|---|
| Mainly for exploratory purposes and to generate hypotheses | Used to obtain descriptive data |
| Usual purpose is to generate a range and variety of data | Usual purpose is to consolidate the data and obtain a clear picture of the situation |
| The methods of inquiry are informal and flexible | All methods are, carefully planned tightly controlled |
| The researcher usually starts with only a broad indication of the information objectives of the project, but with clear understanding of the overall purpose of the research | The research is confined to a list of research objectives which set out what information is required |
| The researcher usually works from a list of the topics to be covered, but the course of each 'interview' will be influenced by the respondent | The interviewer uses a questionnaire, which must be followed exactly as instructed in every interview |
| Based on small numbers of respondents who take part individually or in small groups | Based on larger numbers of respondents; data are collected from each person individually |

| | |
|---|---|
| It cannot be known how true the findings are of the population from which the respondents are drawn | May be possible to estimate how reliable the findings are. It depends on which sampling method is used |
| Data collection is usually handled by research professionals | Usually done by trained interviewers or through self-completion questionnaires |
| A qualitative project cannot be repeated exactly, because every data collection event in a project is different | Can usually be replicated, because every interview in the project follows the same procedure |
| The findings can rarely be expressed in statistical form | Findings are expressed in number and can be analysed using statistical techniques |
| Analysis and conclusion rely heavily on the researcher's perceptions and interpretation skills | Because statistical procedures are used the analysis is less likely to be disputed |

**Source:** *John Boyce, Marketing Research, MacGraw Hill Pvt Ltd, Australia, 2005.*

In this section you have read about Focus Group Discussion, Content Analysis and other qualitative data collection tools. You also read about features of qualitative and quantitative research. Now try and answer the questions given in *Check Your Progress-2.*

**Check Your Progress 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Differentiate between multiple choice and open ended questions.

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2. What is the importance of pre-testing the interview schedule or questionnaire?

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## 2.5 LET US SUM UP

In this unit, we discussed the meaning and concept of qualitative data collection and found that the selection of appropriate method for data collection and research design depends on nature, scope and objective of

enquiry. Each method of data collection, however, does not suit all categories of research design. The selection and preparation of tools for collecting data depends upon the types of data to be collected. Qualitative data are descriptive in nature and can be statistically analyzed only after processing, and, after having them classified into some appropriate categories. Qualitative data can facilitate in-depth analysis of a social situation. We also discussed the various methods and techniques of qualitative data collection. Finally the differences between qualitative and quantitative research have also been discussed.

## 2.6 KEY WORDS

**Key Informant** : A key informant is a person (or group of persons) who has unique skills or professional background related to the issue/intervention being evaluated, is knowledgeable about the project participants, or has access to other information of interest to the evaluator.

**Content analysis** : Content analysis consists of analyzing the contents of document, such as books, magazines, newspapers and the contents of all other verbal materials either spoken or printed.

**Sociometry** : Sociometry is a technique for describing the social relationships among individuals in a group.

**Case study** : The case study method is a very popular form of qualitative analysis and involves a careful and complete observation of a social unit, be that unit a person, a family, an institution, a cultural group, or even the entire community. It is a method of study in depth rather than breadth.

**Pre-testing** : Pre-testing means testing the interview schedule/ questionnaire in advance to find out whether it is capable of eliciting appropriate responses from respondents.

## 2.7 REFERENCES AND SELECTED READINGS

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## 2.8 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress 1**

1. In the interview method, the questions are presented to the respondents in a face-to-face situation as oral-verbal stimuli, and the researcher, or personnel trained for the purpose (interviewers, enumerators) note down oral-verbal responses. In the questionnaire method, the questions are delivered (generally mailed) to the respondents, who note down their responses on it and send them back to the researcher.

2. (i) The assumption of uniformity in basic human nature, in spite of the fact that human behaviour may vary according to situations.

   (ii) The assumption of studying the natural history of the unit concerned.

   (iii) The assumption of comprehensive study of the unit concerned.

**Check Your Progress 2**

1. There are two principal forms of questions: multiple choice and open ended. For a multiple choice question, the researcher prepares a set of probable replies (generally after pre-testing) and presents it to the respondents. The respondents select a reply or replies considered most appropriate for each of them. In the case of open ended questions, the respondents reply in their own words, which are then recorded.

2. Pre-testing means testing the interview schedule/questionnaire in advance to find out whether it is capable of eliciting appropriate response from the respondents. Pretesting shall help to find out if the questions are properly understood by the respondents and it shall also help to identify whether the questions are logically organized, the replies could be properly recorded in the space provided for, or there is any scope for further improvement. On the basis of the responses obtained, appropriate changes in the interview schedule/questionnaire should be made.

# UNIT 3 DATA SOURCES

## Structure

3.1 Introduction

3.2 Sources of Data

3.3 Process of Sourcing Data

3.4 Qualities of Data Source

3.5 Data Sources for Agriculture

3.6 Data Sources for Infrastructure

3.7 Data Sources for Service Sector

3.8 Other Data Sources

3.9 Global Data Sources

3.10 Let Us Sum Up

3.11 References and Selected Readings

3.12 Check Your Progress – Possible Answers

## 3.1 INTRODUCTION

Data can be defined as the quantitative or qualitative information values of an aspect that one is studying. The aspect can take the quantitative or numerical value for example the average household income of India is $1670 in 2016.The data can be relative or subjective for example the population in Africa on an average are dark skinned. Data is the plural form of the word datum which literally means to give or something given. Data is thought to be the lowest unit of information from which other measurements and analysis can be done. Data can be images, words, figures, facts or ideas. Data in itself cannot be understood and to get information from the data one must interpret the values into meaningful information. Beyond interpretation the data vary considerably based on the type of data collected and the source from where the data is collected. The source of data is important as it gives the full information of the aspect one is studying. The data can vary based on the source and the methodology used to bring out the information. Many a time's data sometimes give weird values which become difficult to explain and turn out unreliable. Thus the source of data is critical for any work in economic, social or political.

After reading this unit you will be able to

- Discuss about the data sources for agricultural data
- Describe the data sources for infrastructure data
- Elaborate on the data sources for service sector data
- Discuss about the global data sources

## 3.2 SOURCES OF DATA

The source of data is the origin from where data is collected. The data is either collected by individuals or private bodies or by Government agencies or Multilateral International Public Organization. The former data

sources are privately owned data and while the later ones are referred to Official Statistics. The private bodies collect information of specific market or sectors which are meant for corporate objectives. While data collected by Government bodies or multilateral international public bodies are official statistics which help economic data users knowledge about a particular topic or geographical area, make comparison between countries or understand changes over time. It provides basic information for decision making, evaluations and assessments at different levels and keep public well informed and assists good policy making and decision making.

### 3.2.1 Broad Sources Classification

Information is collected by private individuals, companies, government bodies or international organisations. Based on the collection design data sources can be classified on many concepts. As suggested Government bodies have an important role in collecting and processing data to compare and evaluate economic, social and political information. These data are called 'Official Statistics' making accessible to public, corporate and policy makers to improve accountability. So the process of data collection is dynamic and at every stage over years improvements are made to give better clarity or to prove a particular objective. The categories of Official statistics range from population, employment, gender, economy, trade, environment and energy. Private or business bodies also collect information to understand demography, tastes and political interest in a way to fulfill their corporate objectives. In both types the users play an important role for the sourcing of data.

***(i) Official Statistics***

The users of Official Statistics follow from a Policy Perspective where data is meant for users in Research which will further provide valuable inputs and validation to the political objectives. The different departments of the Government agencies provide their data with specific objectives cater to their users. The official statistics of the government broadly cover a wider target catering to the general public to whom they are accountable. Then based on the users corporate bodies use their statistics to strategise their business and marketing interest and many a times they synergise with the Government bodies. The maximum utilization is by the Research bodies and individuals who constitute a very small percentage of people.

***(ii) Private Statistics***

The users of private statistics follow a private or business or social objective where data is meant for users to advocate certain objective based on the sponsors mandate. Research users further pursue objectives which would cater to validation or discovering market or social objective which is meant for advocacy. The private statistics target a specific issue of marketing or business interest. The prime users are corporate bodies using the statistics to strategise their business and marketing interest. Theirother users areresearch individuals and bodies which interpret their results and share it with sponsors. Many a times these data are sold to government and individuals for profit. The maximum utilization is by the corporate Sponsors who use it to maximize their objectives.

## 3.3 PROCESS OF SOURCING DATA

Information present everywhere is data and what really matters is how this data is organized. Data has many components before it can be of any use. The main component in any data is the process of collecting the data, who is collecting data and the time of collection of data. These three things are important for data assimilation and further analysis. The first aspect in data sourcing is the process involved in collecting data. If a person goes in the street and asks particular information directly from an individual and it is recorded is called primary sourcing of information. Here the primary source is the individual whom you are getting the information from. Primarily data can be collected directly from the respondents. And if the information collected passes on to another stage in which the information is changed on the basis of parameters and categorization it becomes secondary sourcing information. If the information is collected in a periodic manner over time interval and recorded it becomes secondary information. If the information is analyzed and presented into reports with another categorization and sequence it becomes tertiary sourcing of information. Another important part in the process as suggested earlier who is collecting the information. If the collector has the authority to collect the information and can it represent thesource. This aspect is important as dealt in the earlier section about the authenticity of the data and the reliability of the information. The time of collection of data is crucial in sourcing of data as it provide a relevance and comparability. Sourcing of data involves many aspects like how the information is collated, time and at what level is the data collected. Another important aspect is the quality of the data source and it strongly interlinks with the process of sourcing the same.

### 3.3.1 Forms of Sourcing

As distinguished earlier there are two main sources official source of data and private source of data which can be classified as primary, secondary and tertiary. Most often official sourcing of data is made to make it a formal source of data most often referred to as the most authentic source of data. These data can also take forms in the way the sourcing is done which involves variation in the methodology of collecting data.

**(i) Statistical Survey or sample survey**

This form of sourcing of data involves collecting of information based on inductive approach where we move from specific observation to give the general observation of all. In simple words the recall of specific sets of people or respondents are used to generalize for the whole population. It collects data from a sample of the population and estimating the characteristics of the population by systematic use of methodology.

Advantages of sample survey source

The sample survey takes a small set of observation and it is more relevant for particular time and complete enumeration not possible. It saves cost and time as it involves only few observation and trained staff not required. As sample is done on selected observation at the outset the process clearly indicates the limitation which leaves errors very minimum the bias in enumerator is avoided and the reliability can be assessed easily. For validation in complete enumeration like Census sample survey is usually conducted.

Disadvantages of sample survey source

The sample survey takes a fixed design and cannot be changed throughout the process of data gathering. Sample may not work in conducting controversial issues like religion issues because of recalling difficulty. Sometimes the questions in the survey are standardized and may not be appropriate.

**(ii) Census**

Census is process of sourcing of complete enumeration of a population or groups at a point in time with respect to well defined characteristic (population, production). Data are collected for a specific reference point of time. Usually a Census is taken at regular internal of time for making the sourcing of data comparable. Most Census enumeration is conducted every five to ten years. Data is collected through questionnaire mailed to respondents, via the internet or completed by an enumerator visiting the respondent or contacting them by telephone. The respondents are trained to handle such enumeration and involved huge costs.

Advantages of Census source

The Census enumeration is the most accurate and complete information gathering mechanism and does not include any option of error.It covers a wide spectrum of people covering the complete population. It involves meticulous planning and the Enumerator is adequately trained to gather the desired information.

Disadvantages of Census source

Census involves huge cost as it is sent out to the whole population. It is very time consuming and many a times the data becomes out of date once it is collected. It sometimes excludes people who are temporarily not available during the period. In many unidentifiable issues like fishes census cannot be carried out. It sometimes has a limitation of geographical area.

**(iii) Register Sourcing**

Register is the process of collecting information that is updated continuously for a specific purpose and from which statistics can be collected and produced. It contains information on a complete group of units. It is done by official organization like National Sample Survey Organisation or the National Household Survey.

Advantages of Register sourcing

An advantage of the register sourcing is the total coverage even if collecting and processing represent low cost. It allows producing more detailed statistics than using surveys. Different registers can be combined and linked together on the basis of defined keys (personal identification codes, business identification codes, address codes etc.). Moreover, individual administrative registers are usually of high quality and very detailed.

Advantages of Register sourcing

A disadvantage is the possible under-coverage that can be the case if the incentive or the cultural tradition of registering events and changes are weak, if the classification principles of the register are not clearly defined or if the classifications do not correspond to the needs of statistical production to be derived from them.

There are different types of registers:

Administrative registers or records like National Sample Survey Organization (NSSO) in India help in collecting data. Using the existing administrative data for statistical production may be approved by the public because it can be seen as a cost efficient method; individuals and enterprises are less harassed by a response burden; data security is better as fewer people handle it and data have an electronic format.

Private registers such as registers operated by insurance companies and employer organizations can also be used in the production process of official statistics, providing there is an agreement or legislation on this.

Statistical registers are frequently based on combined data from different administrative registers or other data sources.

For businesses, it is often legally indispensable to be registered in their country to a business register which is a system that makes business information collection easier.

It is possible to find agricultural registers and registers of dwellings.

Even though different types of data collection exist, the best estimates are based on a combination of different sources providing the strengths and reducing the weakness of each individual source.

## 3.4 QUALITIES OF DATA SOURCE

The quality criteria of a national statistical office are the following: relevance, impartiality, dissemination, independence, transparency, confidentiality, international standards[citation needed]. There principles apply not only to the NSO but to all producers of official statistics. Therefore, not every figure reported by a public body should be considered as official statistics, but those produced and disseminated according to the principles. Adherence to these principles will enhance the credibility of the NSO and other official statistical producers and build public trust in the reliability of the information and results that are produced.

1. ***Relevance***

   Relevance is the first and most important principles to be respected for national statistical offices. When releasing information, data and official statistics should be relevant in order to fulfil the needs of users as well as both public and private sector decision makers. Production of official statistics is relevant if it corresponds to different user needs like public, governments, businesses, research community, educational institutions, NGOs and international organizations or if it satisfies basic information in each area and citizen's right to information.

2. ***Impartiality***

   Once the survey has been made, the NSO checks the quality of the results and then they have to be disseminated no matter what impact they can have on some users, whether good or bad. All should accept the results released by the NSO as authoritative. Users need to perceive the results as unbiased representation of relevant aspects of the society. Moreover, the impartiality principle implies the fact that NSOs have to use understandable terminology for statistics' dissemination,

questionnaires and material published so that everyone can have access to their information.

3. ***Dissemination***

In order to maximize dissemination, statistics should be presented in a way that facilitates proper interpretation and meaningful comparisons. To reach the general public and non-expert users when disseminating, NSOs have to add explanatory comments to explain the significance of the results released and make analytical comments when necessary. There is a need to identify clearly what the preliminary, final and revised results are, in order to avoid confusion for users. All results of official statistics have to be publicly accessible. There are no results that should be characterized as official and for the exclusive use of the government. Moreover, they should be disseminated simultaneously.

4. ***Independence***

Users can be consulted by NSOs but the decisions should be made by statistical bodies. Information and activities of producers of official statistics should be independent of political control. Moreover, NSOs have to be free of any political interference that could influence their work and thus, the results. They should not make any political advice or policy-perspective comments on the results released at any time, even at press conferences or in interviews with the media.

5. ***Transparency***

The need for transparency is essential for NSOs to gain the trust of the public. They have to expose to the public the methods they use to produce official statistics, and be accountable for all the decisions they take and the results they publish. Also, statistical producers should warn users of certain interpretations and false conclusions even if they try to be as precise as possible. Furthermore, the quality of the accurate and timely results must be assessed prior to release. But if errors in the results occur before or after the data revision,[22] they should be directly corrected and information should be disseminated to the users at the earliest possible time. Producers of official statistics have to set analytical systems in order to change or improve their activities and methods.

6. ***Confidentiality***

All data collected by the national statistical office must protect the privacy of individual respondents, whether persons or businesses. But on the contrary, government units such as institutions cannot invoke statistical confidentiality. All respondents have to be informed about the purpose and legal basis of the survey and especially about the confidentiality measures. The statistical office should not release any information that could identify an individual or group without prior consent. After data collection, replies should go back directly to the statistical producer, without involving any intermediary. Data processing implies that filled-in paper and electronic form with full names should be destroyed.

7. ***International standards***

The use of international standards at the national level aims to improve international comparability for national users and facilitate decision-

making, especially when controversial. Moreover, the overall structure, including concepts and definitions, should follow internationally accepted standards, guidelines or good practices. International recommendations and standards for statistical methods approved by many countries provide them with a common basis like the two standards of the International Monetary Fund, SDDS for Special Data Dissemination Standards and GDDS for General Data Dissemination System. Their aim is to guide countries in the dissemination of their economic and financial data to the public. Once approved, these standards have to be observed by all producers of official statistics and not only by the NSO.

Till now you have read about data sources, process of data sourcing and the qualities of data sources. Now try and answer the questions given in *Check Your Progress-1*.

**Check Your Progress 1 -**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is Census method of data sourcing?

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2. What are the desirable qualities of a data source?

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## 3.5 DATA SOURCES FOR AGRICULTURE

In this section we will discuss about the various national and international sources of data related to agriculture.

**(I) National Agricultural Data**

Major Sources of data related to agriculture at national level include:

**i. Agriculture Census:** At micro level, the agricultural holding is the ultimate unit for decision making. Agriculture Census collects information regarding operational holdings such as land use and cropping pattern, irrigation status, tenancy data etc. The ninth Agriculture Census data with reference year 2010-11, is now available on public domain. All India Reports on Number and Area of operational holdings has also been published and available in the public domain. The data is available online on the following link:

http://agcensus.dacnet.nic.in/

ii. **Input Survey:** The main aim of input survey is to collect data related to the consumption of various agricultural inputs. The following data are collected in the input survey: chemical fertilizers, HYV seeds, pesticides, farmyard manures/compost, bio-fertilizers, agricultural implements and machinery, livestock and agricultural credit, use of certified/notified seeds, high yielding variety seeds, pest control measurements adopted by cultivators and some personal details of the cultivators like educational qualification, age and size of households. The data is available online on the following link:

http://inputsurvey.dacnet.nic.in/

iii. **Livestock Census:** Livestock Census was first done in 1919. The livestock Census conducted in 2012 is the 19th in the series. Like the population Census, a house to house enumeration is done to ascertain the number, age, sex, etc., of livestock/poultry possessed by every household or household enterprises, non-households or non -household enterprises and institutions in rural & urban areas. The documents related to livestock census is available on the following link:

http://dahd.nic.in/documents/statistics/livestock-census

iv. **Marine Fisheries Census:** The Central Marine Fisheries Research Institute Conducted a well organized marine fisheries census in 1980 covering all maritime states in the mainland. The latest Census data available are of 2010 which is available on the following link:

http://www.cmfri.org.in/marine-fisheries-census/8/2017

v. **Land Use Statistics:** The land use data is very important for planning and policy formulation in agriculture. The Directorate of Economics and Statistics in the Ministry of Agriculture has been collecting the data related to Land Use Classifications, Source wise Irrigation, Crop wise Irrigation and Area under Crops. The data is available online on the following link:

https://data.gov.in/catalog/land-use-statistics-lus

vi. **General Crop Estimation Survey:** The estimates of yield of principal food and non-food crops are obtained from the crop cutting experiments conducted in major states and UTs under the National Programme of Crop Estimation Survey (CES). The results of CES are brought out in annual publication titled "Consolidated Results of Crop Estimation Survey on Principal Crops".

vii. **Integrated Sample Survey of Major Livestock Products:** The Animal Husbandry Statistics Division of the Department of Animal Husbandry, Dairying and Fisheries conducts Integrated Sample Surveys of Major Livestock Products to estimate production of milk, egg, meat and wool. The soft copies of various publications of the Division is available online on the following link:

http://dahd.nic.in/Division/statistics/animal-husbandry-statistics-division

Besides there are also various publications which are available online. These include

1. Agricultural Situation in India (Monthly)
2. Agricultural Prices in India
3. Agricultural Wages in India
4. Cost of Cultivation of Principal Crops
5. Districtwise Area and Production of Principal Crops in India
6. Land Use Statistics at a Glance
7. Farm Harvest Prices of Principal Crops in India
8. Agricultural Statistics at a Glance

## 3.6 DATA SOURCES FOR INFRASTRUCTURE

Infrastructure is the core of development of any economy. Non-availability of infrastructure can seriously hamper the productive capacity of the economy. Statistics related to availability and geographical distribution of infrastructure is important from the policy planning perspective and also for guiding the investment decisions in the infrastructure sector. Infrastructure includes

(a) Construction

(b) Electricity generation, transmission and distribution

(c) Gas generation and distribution through pipes

(d) Water works and supply

(e) Non-conventional energy generation and distribution

(f) Railway tracks, signalling system and stations

(g) Roads and bridges, runaways and other airport facilities

(h) Telephone lines and telecommunications network

(i) Pipelines for water, crude oil, slurry, etc.

(j) Waterways

(k) Port facilities

(l) Canal networks for irrigation

(m) Sanitation and sewerage

Let us look into the type of data and the source of data available on some of these infrastructures.

1. **Railways:** In transport, railways have the most extensive and elaborate database. The data is available on the length of rail networks, passenger and freight transport, energy consumption, earnings and expenditure and administrative statistics. The data is published in the Indian Railway's annual statistical statements and annual report and accounts.

2. **Roads:** The data available on roads include road length for urban, rural, municipal, railways and port roads. Road length: total and surfaced, type of surface, width of road length, number of culverts and bridges on national and state highways. Category wise registered

motor vehicles in states and metropolitan cities. Revenue generated from motor vehicle tax, outlay and expenditure on road transport in different plan periods in center and state, fuel consumption in road transport and enterprises in transport sector activity.

Major sources of data on roads include PWD (Roads/National Highways) of State Governments and Union Territory Administrations, Rural Development and Panchayati Raj Departments. Much data on roads is also available on the Open Government Data Platform India.

3. **Airways:** Air transport as of today has numerous players and as far as the national airlines Indian Airlines and Air India) are concerned, substantial data is available on aircraft hours flown, revenue generated, passengers, freight, mail carried, volume of cargo embarked and disembarked.

4. **Waterways:** Water Transport includes international water transport and domestic water transport including inland waterways.

   (a) Data available on ports include: Commodity-wise capacity availability, cargo traffic handled by major ports, overseas and coastal traffic; import and export by country of origin and by country of destination for major ports, passenger and container traffic at major ports, data is also available on performance for selected indicators, Time series data on port wise employment, revenue and expenditure, net and operating surplus, operating ratio, income, cost, surplus or deficit per tonne of cargo handled for major ports.

   These data can be found in: Annual Administrative Report of Major Ports and Minor Ports, Maritime states for Minor Ports Data, Container Corporation of India, India Ports Association, Monthly Bulletin of Statistics.

   (b) Data available on shipping include: Indian fleet of coastal and overseas ships, Shipping Tonnage, Fleet owned by SCI, Growth of Indian shipping since independence, Share and growth of Indian Fleet and Indian tonnage, Financial Statistics of SCI, Foreign exchange earnings and savings of Indian Shipping Companies, Tanker freight rates - single voyage rates, Dry bulk cargo freight rates, World Sea borne trade etc.

   These data can be obtained from: For overseas trade data can be obtained from Major Ports, other sources of data are Directorate General of Shipping, Shipping Companies, Lloyd's Register - World Fleet Statistics and Statistical Tables, Indian Oil Corporation. Various data on inland water transport can be obtained from State IWT Directorates, Shipping Companies, IWT Companies, Central Water Commission, Central Inland Water Transport Corporation, Inland Waterways Authority of India.

5. **Telecommunication:** This is one of the most rapidly growing segment of infrastructure. The data pertaining to this sector includes equipped capacity, working connections, rural telephony, revenue statistics, telephone traffic, telegraph traffic, staff statistics, etc. Different divisions or cells in the Department of Telecommunications and the statistical

cell under the Economic Research Unit (ERU) in the Department are the main sources of data pertaining to the Sector.

6. **Electricity:** The electricity statistics can mainly be obtained from the Central Electricity Authority. CEA comes out with a publication titled "Public Electricity Supply- All India Statistics" which gives information on: Generating capacity at the national and state level, Actual generation of electricity, Electric power supply and system losses, Transmission, distribution and utilization of electricity, Consumers of electricity and connected load, Urban and rural electrification.

7. **Housing:** Housing is an important component of urban infrastructure as most of the developing countries face the problem of housing shortages in the urban areas. The data related to housing are primarily collected by the National Buildings Organization, Registrar General and Census Commissioner of India and NSSO. The data collected includes number of houses, residential fractions, structure of houses, building material, labour wages, urban indicators, social housing etc.

8. **Urban Infrastructure:** Urban infrastructure includes urban transportation, water supply, sanitation, electricity supply, communications, schooling facilities and public health facilities. The *Handbook on Urban Statistics*, a periodical prepared by National Institute of Urban Affairs. It provides data related to investments on urban infrastructure, various schemes and projects etc. Other sources of data related to urban infrastructure include HUDCO (www.hudcoindia.com), Ministry of Urban Development and Poverty Alleviation (www.urbanindia.nic.in), Society of Development Studies (www.sdsindia.org), Infrastructure Development and Finance Corporation.

9. **Rural Infrastructure:** Some of the important data pertaining to rural infrastructure include that of transportation, sanitation, water, health, electricity, communication, schooling, irrigation, watershed development, rural forestry etc. The data on rural infrastructure is generally scattered in several sources including census, Ministry of Rural Development, the Open Government Data Platform to name a few.

## 3.7 DATA SOURCES FOR SERVICE SECTOR

In India, the service sector holds great importance from the point of view of employment potential and also its contribution to the national income. Hence maintaining a sound statistical database for the service sector is very important. The task becomes difficult due to the vastness of the sector and due to the fact that the new services keep being included and the one's that are obsolete keep being deleted from the list of services in this sector. The important service sectors in India based on their significance in terms of GDP include aviation, telecom, tourism, shipping and ports; and railways and storage. Let us look at the data sources and data availability of some of the important service sectors:

1. **Banking and Insurance:** This is one of the leading service sector in India. To a great extent, banking statistics can be obtained from the Department of Financial Services, Ministry of Finance, Government of India. http://financialservices.gov.in/data-statistics/banking-statistics.

A lot of data on Banking and Insurance services is also available on the Open Government Data Platform of India. Information related to insurance services can also be availed from Insurance Regulatory and Development Authority of India.

2. **Trade:** International trade in goods as well as services has seen upward trend post liberalization. Trade statistics can be obtained from several sources. One of them is the Indian Trade Portal (http://www.indiantradeportal.in/index.jsp) which provides data related to foreign trade, tariffs, export promotion schemes etc. Directorate General of Commercial Intelligence and Statistics also provides export and import data on various goods and services (http://dgciskol.gov.in). The Agricultural & Processed Food Export Development Authority publishes data related to trade and international prices of agricultural products (http://apeda.gov.in/apedawebsite/#).

3. **Aviation:** The data pertaining to aviation can be obtained from the publications of the Ministry of Civil Aviation. Another source of data on aviation is the Open Government Data Platform which gives data related to personal statistics of various airlines, operating traffic statistics and other performance indicators of selected airlines and cargo, operating revenue and expenses per revenue passenger kilometer performed, staff strength, fleet size, employee productivity etc of various airlines.

   http://www.civilaviation.gov.in/

4. **Telecom:** Data related to the telecom sector can be obtained from various publications of the Department of Telecommunication. The Open Government Data Platform also has data related to telecommunication performance, state wise number of telephone lines in rural and urban areas, Foreign Direct Investment in Telecom Sector, Internet Subscribers, Average revenue and minutes of use per user, Number of Telephones (all India and state level) etc.

   http://www.dot.gov.in/#

5. **Tourism:** The Ministry of Tourism, Government of India has two publications titled “Indian Tourism Statistics” and “Indian Tourism Statistics at a Glance” which contain a wealth of information related to the tourism sector. The information available in these publications include tourists arrivals, destinations, source countries, revenue earned, domestic tourists, approved hotels, tour operators and travel agents, various schemes of Ministry of Tourism etc.

   http://tourism.gov.in/

6. **Shipping and Ports:** The services provided by the maritime transport influence the pace and pattern of development. The Ministry of Shipping, Government of India comes out with useful publications which provides various shipping and port statistics. These Publications include: “Indian Shipping Statistics”, “Basic Port Statistics”, “ Statistics of India’s Ship Building and Ship Repairing Industry” and the Annual Reports.

   http://shipping.nic.in/

7. **Railways:** India's national railway system, the Indian Railways, is operated by the Ministry of Railways and is the fourth largest railway network in the world. Data of the Indian Railways can be obtained from the publications of the Ministry of Railways which include 'Indian Railways Statistical Publications', "Indian Railways Annual Statistical Statements', 'Indian Railways Yearbook', 'Indian Railways Annual Report and Accounts', 'Indian Railways Facts and Figures'. All these publications are available online on the following link: http://www.indianrailways.gov.in/railwayboard/view_section.jsp?lang=0&id=0,1,304,366,554.

   The 'Statistical Year Book India' published by the Ministry of Statistics and Programme Implementation also has a section pertaining to the Indian Railways and can be accessed online on the website of the Ministry. http://www.mospi.gov.in/statistical-year-book-india/2016/188). The Open Government Data Platform also has several data pertaining to the Indian Railways.

## 3.8 OTHER DATA SOURCES

There are several other parameters of importance to a development researcher on which relevant and useful data sources are available and discussed in this section.

1. **Government Budget**

   The Union Budget documents and data of various years can be found on this website (https://www.indiabudget.gov.in/rec.asp). The data on budget including the budget estimates, budget provisions by different heads, plan and non-plan subsidies and grants, investments and all other relevant data can be obtained from the Open Government Data Platform.

2. **National Statistic**

   The National Data Bank of the Ministry of Statistics and Programme Implementation provides national level data on various soco-economic parameters including education, health, labour and employment, data on programmes and schemes, data on socio-economic caste census, Census data etc. All this information can be obtained on the following link http://www.mospi.gov.in/national-data-bank. National level census data can also be obtained from official census website http://censusindia.gov.in/. Similarly, data on various macro-economic aggregated like Gross Domestic Product, State Domestic Product etc. can be also obtained from the website of the Ministry of Statistics and Programme Implementation.

3. **National Health**

   Health is an important indicator of development of a country. National level health statistics can be obtained from various sources like the National Family Health Survey Reports which is also available online http://rchiips.org/nfhs/. The Annual Health Survey Report from the Office of the Registrar General & Census Commissioner, India is also an exhaustive repository of health related data and indicators http://censusindia.gov.in/2011-common/AHSurvey.html.

**4. Environment and Forest**

Development and environment have a very strong interrelation and development, if seen in isolation without any consideration for environment, will not be sustainable. There are several sources of data on environment and forest. The Statistical Year Book published annually by the Ministry of Statistics and Programme Implementation has a section on environment and forest which gives data on state wise recorded forest area and forest estimates. The Open Government Data Platform is another source of data on environment and forest.

Besides, there are also private organizations which collect and publish many useful data on different issues.

## 3.9 GLOBAL DATA SOURCES

This section covers some of the commonly used data sources by development researchers.

**1. United Nations Data Sources:**

The United Nations has several data bases which would be of use to the development researchers.

i. **FAO:** The Food and Agriculture Organization of the United Nations has a huge repository of data on food and agriculture for more than 245 countries and the data can be accessed free f charge. It provides data on production, inputs, agricultural emissions, trade, population, food security, forestry, prices, agri-environmental indicators etc. The web link to faostat is http://www.fao.org/faostat/en/#data.

ii. **UN Comtrade Database:** This provides free access to global trade data. The users can extract the data they need or also use the analytical tables provided. It also has link to International Trade Statistics Yearbook which can be downloaded for free. https://comtrade.un.org/

iii. **United Nations Statistical Commission:** UNSC is the highest body of global statistical system. It also contains data on main aggregates of national accounts, population census, demographic data, disability statistics etc. The web link to UNSC is https://unstats.un.org/unsd/statcom/.

iv. **United Nations Conference on Trade and Development:** UNCTAD is a permanent intergovernmental body of the UN, established by the United Nations General Assembly in 1964. Statistics is an inherent part of UNCTAD and it produces more than 150 indicators and time series data pertaining to international trade, economic trends, population and labour force, maritime transport etc. The web link to UNCTAD is http://unctad.org/en/Pages/statistics.aspx.

**2. World Bank**

The World Bank maintains a data catalogue of statistical databases and other data collections. The World Bank open data provides the users with open access to World Bank data. Besides you can also access

data underlying impact evaluations conducted by the World Bank. Data available is time series data, micro data or geospatial data. The web link to the data catalogue is https://datacatalog.worldbank.org/.

**3. OECD Database**

The OECD ilibrary is the online library of the Organization for Economic Cooperation and Development. It is a gateway to OECD's data and consists of its books, papers and statistics. The web link to the data that can be obtained in the OECD ilibrary is https://www.oecd-ilibrary.org/statistics.

Till now you have read about data sources for agriculture, infrastructure, services and international data sources. Now try and answer the questions given in *Check Your Progress-2.*

**Check Your Progress - 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are the sources of agricultural data?

.....

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.....

.....

2. What are the global data sources?

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.....

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.....

## 3.10 LET US SUM UP

Data is an essential part of any research. Timely and accurate data help in generating results which can be further used for policy formulation at various levels. The ability to take timely and useful decisions is crucial to the development process which further necessitates the availability of timely and accurate data which can facilitate in decision making. In this unit you read about the forms of data sourcing. You also read about the qualities of data source. The economy largely consists of three sectors viz the agricultural, industrial and service sector. The data sources for each of these sectors have been discussed separately. Besides, other sources of data which would be of importance to development research have also been discussed. Towards the end, the international data sources have also been discussed.

## 3.11 REFERENCES AND SELECTED READINGS

The following web links can be referred to:

http://agcensus.dacnet.nic.in/

http://inputsurvey.dacnet.nic.in/

http://dahd.nic.in/documents/statistics/livestock-census

http://www.cmfri.org.in/marine-fisheries-census/8/2017

https://data.gov.in/catalog/land-use-statistics-lus

http://dahd.nic.in/Division/statistics/animal-husbandry-statistics-division

www.hudcoindia.com

www.urbanindia.nic.in

http://financialservices.gov.in/data-statistics/banking-statistics

http://www.indiantradeportal.in/index.jsp

http://apeda.gov.in/apedawebsite/#

http://www.civilaviation.gov.in/

http://www.dot.gov.in/#

http://tourism.gov.in/

http://shipping.nic.in/

http://www.mospi.gov.in/statistical-year-book-india/2016/188 https://view_section.jsp?lang=0&id=0,1,304,366,554.

http://www.mospi.gov.in/statistical-year-book-india/2016/188 https://www.indiabudget.gov.in/rec.asp

http://www.mospi.gov.in/national-data-bank

http://rchiips.org/nfhs/

http://censusindia.gov.in/2011-common/AHSurvey.html

http://www.fao.org/faostat/en/#data

https://comtrade.un.org/

https://unstats.un.org/unsd/statcom/

http://unctad.org/en/Pages/statistics.aspx

https://datacatalog.worldbank.org/

https://www.oecd-ilibrary.org/statistics

## 3.12 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress 1**

1. Census is process of sourcing of complete enumeration of a population or groups at a point in time with respect to well defined characteristic (population, production). Data are collected for a specific reference point of time. Usually a Census is taken at regular internal of time for making the sourcing of data comparable. Most Census enumeration is conducted every five to ten years. Data is collected through questionnaire mailed to respondents, via the internet or completed by an enumerator visiting the respondent or contacting them by telephone. The respondents are trained to handle such enumeration and involved huge costs.

2. The desirable qualities of a data source are:
    1. Relevance
    2. Impartiality
    3. Dissemination
    4. Independence
    5. Transparency
    6. Confidentiality
    7. International standards

**Check Your Progress 2**

1. The data sources for agriculture include:
    i. Agriculture Census:
    ii. Input Survey:
    iii. Livestock Census:
    iv. Marine Fisheries Census:
    v. Land Use Statistics:
    vi. General Crop Estimation Survey:
    vii. Integrated Sample Survey of Major Livestock Products:
1. The global data sources include
    1. United Nations Data Sources:

        The United Nations has several data bases which would be of use to the development researchers.

        i. FAO:
        ii. UN Comtrade Database:
        iii. United Nations Statistical Commission:
        iv. United Nations Conference on Trade and Development:
    2. World Bank
    3. OECD Database

# MDV-106: RESEARCH METHODOLOGY IN DEVELOPMENT STUDIES

(6 CREDITS)

| BLOCK | UNIT NOS | UNIT TITLES |
|---|---|---|
| 1 | | **Fundamentals of Social Science Research** |
| | 1 | Social Science Research: An Overview |
| | 2 | Components of Social Science Research |
| | 3 | Research Designs |
| | 4 | Research Project Formulation |
| 2 | | **Development Research** |
| | 1 | Basics of Development Research |
| | 2 | Methods of Development Research |
| | 3 | Development Research Applications |
| **3** | | **Measurement and Sampling** |
| | 1 | Measurement |
| | 2 | Scales and Tests |
| | 3 | Reliability and Validity |
| | 4 | Sampling |
| 4 | | **Data Collection** |
| | **1** | **Quantitative Data Collection Methods and Devises** |
| | **2** | **Qualitative Data Collection Methods and Devises** |
| | **3** | **Data Sources** |
| 5 | | **Data Analysis** |
| | 1 | Overview of Statistical Tools |
| | 2 | Use of Computer in Data Analysis |
| | 3 | Data Processing and Analysis |
| | 4 | Report Writing |

Indira Gandhi National Open University
School of Extension and Development Studies

# MDV-106
# Research Methodology in Development Studies

Block

# 5

## DATA ANALYSIS

**UNIT 1**
**Overview of Statistical Tools** **5**

**UNIT 2**
**Use of Computer in Data Analysis** **44**

**UNIT 3**
**Data Processing and Analysis** **68**

**UNIT 4**
**Report Writing** **82**

## PROGRAMME DESIGN COMMITTEE


Prof. Amita Shah
Gujarat Institute of Development Research, Ahmedabad

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

Prof. J. S. Gandhi (Rtd)
Jawaharlal Nehru University, New Delhi

Prof. Gopal Krishnan (Rtd)
Punjab University, Chandigarh

Prof. S. Janakrajan
Madras Institute of Development Studies, Chennai

Prof. Kumar B. Das
Utkal University, Bhubaneswar

Prof. Nadeem Mohsin (Rtd)
A.N.Sinha Institute of Social Sciences, Patna

Prof. P. Radhakrishan
Madras Institute of Development Studies, Chennai

Prof. Ramashray Roy (Rtd)
Centre for Study of Developing Societies, Delhi

Prof. R. P. Singh ( Rtd)
Ex-Vice-Chancellor, MPUAT, Udaipur

Prof. K. Vijayaraghavan
Indian Agriculture Research Institute, New Delhi

Dr. Nilima Shrivastava
IGNOU, New Delhi

Prof. B. K. Pattanaik
IGNOU, New Delhi

Dr. Nehal A. Farooquee
IGNOU, New Delhi

Dr. P.V.K.Sasidhar
IGNOU, New Delhi


## PROGRAMME DESIGN COMMITTEE (REVISED)


Prof. T.S. Papola
Institute for Studies in Industrial Development, New Delhi

Prof. S. Janakrajan
Madras Institute of Development Studies, Chennai.

Prof. S. K. Bhati
Jamia Millia Islamia, New Delhi

Prof. Preet Rustagi
Institute for Human Development, Delhi

Prof. Gopal Iyer (Rtd)
Panjab University, Chandigarh

Dr. S. Srinivasa Rao
Jawaharlal Nehru University, New Delhi

Dr. S. Rubina Naqvi
Hindu College, University of Delhi, Delhi

Prof. Nadeem Mohsin (Rtd)
A.N.Sinha Institute of Social Sciences, Patna

Prof. Rajesh
University of Delhi, New Delhi

Prof. B. K. Pattanaik
IGNOU, New Delhi

Prof. Nehal A. Farooquee
IGNOU, New Delhi

Prof. P.V.K. Sasidhar
IGNOU, New Delhi

Dr. Pradeep Kumar
IGNOU, New Delhi

Dr. Nisha Varghese
IGNOU, New Delhi

Dr. Grace Don Nemching
IGNOU, New Delhi


## COURSE PREPARATION TEAM


**Units Writers:**

Prof. V. K. Tiwari
National Institute of Health and Family Welfare
New Delhi (Unit 1, 3 and 4)

Dr. Nisha Varghese
SOEDS, IGNOU (Unit 2)

**Editors:**

Prof. V.K.Jain (Rtd)
(Content Editor) NCERT, New Delhi

Mr. Praveer Shukla
(Language Editor), New Delhi

Dr. Nisha Varghese, IGNOU

Prof. B. K. Pattanaik, IGNOU

Prof. Nehal A. Farooquee, IGNOU

Prof. P. V. K. Sasidhar, IGNOU

**Course Coordinator :** Dr. Nisha Varghese, E-mail : nishavarghese@ignou.ac.in

**Programme Coordinators:** Prof. P.V.K. Sasidhar, Prof. B.K. Pattanaik, Prof. Nehal A. Farooquee,


## PRINT PRODUCTION


Mr. S. Burman
Deputy Registrar (Publication)
MPDD, IGNOU, New Delhi

Mr. KN Mohanan
Asst. Registrar (Publication)
MPDD, IGNOU, New Delhi

Mr. Babu Lal Rewadia
Section Officer (Publication)
MPDD, IGNOU, New Delhi

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# BLOCK 5 DATA ANALYSIS

Block 5 on **'Data Analysis'** with four units gives an overview of various tools and techniques of data analysis needed for conducting development research.

Unit 1 on '**Overview of Statistical Tools**' provides information about various measures of central tendency and dispersion. It also discusses correlation, regression, as well as hypothesis testing.

Unit 2 on '**Use of Computer in Data Analysis**' discusses the use of MS Excel and SPSS in data analysis. Use of these software for working out mean, standard deviation, correlation, regression and testing of hypothesis has been discussed.

Unit 3 on '**Data Processing and Analysis**' discusses about data processing particularly tabulation and graphical presentation. It also briefs about data coding, editing and feeding.

Units 4 on '**Report Writing**' discuss about various types of research reports and details about the various components of a research report.

# UNIT 1 OVERVIEW OF STATISTICAL TOOLS

## Structure

1.1 Introduction

1.2 The Data: Meaning and Types

1.3 Frequency Distributions

1.4 Measures of Central Tendency

1.5 Measures of Dispersion

1.6 Hypothesis Testing and Inferential Statistics

1.7 Statistical Tests

1.8 Chi-Square Test

1.9 F-Test

1.10 Z-Test

1.11 t-Test

1.12 Correlation Analysis

1.13 Regression Analysis

1.14 Let Us Sum Up

1.15 Keywords

1.16 References and Selected Readings

1.17 Check Your Progress – Possible Answers

## 1.1 INTRODUCTION

Statistical tools are the pillars of the research study on which data analysis for all types of developmental programmes stand. Those who are researchers also need some understanding of statistical analysis to be able to produce a meaningful research report. With the availability of several user friendly software, the performance of statistical analysis has now become a reality, even for non-statisticians, provided they are computer literate, and understand the basic principles of statistical analysis.

There are two types of statistics:

(i) Descriptive statistics which include techniques for organizing, summarizing, and presenting data using tables, graphs, or single numbers

(ii) Inferential statistics which consist of statistical methods for making inferences about a population based on information obtained from a sample.

This unit aims to make you conversant with the basic statistical tools applicable in developmental research.

After studying this unit, you should be able to

describe various measures of central tendencies and dispersion;

discuss the applicability of various tests involved in hypothesis testing;

explain the use of correlation in data analysis; and

describe the use of regression in data analysis.

## 1.2 THE DATA: MEANING AND TYPES

Statistics is a science that deals with the collection, organization, analysis, interpretation and presentation of information that can be presented numerically and/or graphically to help us answer a question of interest. This helps us, in many ways, to

(i) establish the problem and its effect

(ii) approve or disapprove a hypothesis

(iii) establish association and relationship, etc.

### 1.2.1 Data: Meaning and Types

In order to conduct a study, we collect raw data using one of the sampling techniques/ methods. This raw data does not provide any meaningful conclusion for the program or in policy-making unless; it is presented in some meaningful format. In order to have meaningful information from a study, we need to analyze the data using appropriate statistical tests and techniques. Before applying any statistical test, it is important to identify the type of data, as the choice of statistical tests depends on the type of data. The theory of measurement consists of a set of separate or distinct theories, each concerning a distinct level of measurement. We have already discussed four levels of measurement: Nominal, Ordinal, Interval, and Ratio and here we will discuss the statistics and statistical tests that are permitted with each level.

**Types of Data**

There are two types of data (i) Qualitative data, viz., occupation, sex, marital status, religion and (ii) Quantitative data, viz., age, weight, height, income, etc. These may be further categorized in the following two types.

**Discrete:** data that can be divided into categories or groups, such as male and female, and can take only discrete values, as explained - nominal and ordinal scale.

**Continuous:** data that can take any value including decimal are called continuous data. A continuous data is, at least in interval or ratio scale, as defined in types of measurement. Measurements in ordinal scale can also be considered under this category though it does not fulfill all conditions of the continuous scale. In social sciences, it is difficult to measure variables in interval or ratio scale and one has to depend on measurements taken in the ordinal scale. It is further emphasized that the statistics based on such measurement may provide ‘under’ or ‘over’ estimates of the population parameter.

**1.2.2 Variable Types :** two types of variables are used in analysis of data.

**Independent Variable:** the characteristic being observed or measured which is hypothesized to influence an event or outcome (dependent variable) is called independent variable. It is not influenced by the event or outcome, but may cause it, or contribute to its variation.

**Dependent variable:** a variable, whose value is dependent on the effect of other variables (independent variables) in the relationship, being studied. It is also called a Criterion, Outcome or Response variable.

## 1.3 FREQUENCY DISTRIBUTIONS

Consider a situation, when a test is administered to a group of 60 students. The marks obtained by each student can be listed against the names of students in a register or mark list. The data in the original form are called ungrouped data. When this is arranged in an ascending or descending order of magnitude, the data are said to be arranged in an array. Counting the number of times each value occurs, we get the frequency table of 'number of marks' and 'number of students'.

Consider an example in which 82 clinics in one district were asked to submit the number of patients treated for malaria in one month. 80 clinics out of the 82 responded to the call. The researchers presented both the frequency distribution and percentages (or relative frequencies).

**Table 1.1: Distribution of clinics according to number of patients treated for malaria in one month**

| Number of patients | Number of clinics | Cumulative frequency | Cumulative Percentages | Range of cumulative frequency |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 0 - 19 | 5 | 5 | 6.25 | 0 - 5 |
| 20 - 39 | 8 | 13 | 16.25 | 6 - 13 |
| 40 - 59 | 10 | 23 | 28.75 | 14 - 23 |
| 60 - 79 | 11 | 34 | 42.5 | 24 - 34 |
| 80 - 99 | 19 | 53 | 66.25 | 35 - 53 |
| 100 - 119 | 10 | 63 | 78.75 | 54 - 63 |
| 120 - 139 | 9 | 72 | 90.00 | 64 - 72 |
| 140 - 159 | 8 | 80 | 100.00 | 73 - 80 |
| Total | 80 | | | |
| Missing value (No response) | 2 | 82 | | |

The frequency table given above is an improvement over the arrangement of figures, which were just listed or entered in a register, or kept in a file, or listed in an array form for each respondent, as it presents a clear idea of the data. This type of representation of frequencies is called a grouped frequency distribution. In the above example, 80 observations were divided into eight groups. The groups are known as class limits or class intervals. The difference between upper and lower limit is called the width of the class. The cumulative frequency corresponding to a class is the total number of observations less than or equal to the upper limit of that class, i.e., it is a total of all frequencies up to and including that class.

Instead of presenting data in frequency tables using absolute numbers it is often better to calculate percentages. Percentages may also be called Relative

Frequencies. Percentages *standardize* the data, which means that they make it easier to compare them with similar data obtained in another sample of different size or origin.

**Note**

One should be cautious when calculating and interpreting percentages where the total number is small because one unit more or less would make a big difference in terms of percentages. As a general rule, percentages should not be used when the total is less than 30. Therefore, it is recommended that the number of observations, or total cases studied, should always be given together with the percentage.

After having gone through the concept of data, answer the following questions given in *Check Your Progress-1*.

**Check Your Progress - 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are the different types of data?

.....

.....

.....

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2. What are the two types of variables?

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.....

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## 1.4 MEASURES OF CENTRAL TENDENCY

Frequency distributions and histograms provide useful ways of looking at a set of observations of a variable. In many circumstances, it is essential to present them to understand the pattern or trend in the data. However, if one wants to further summarize a set of observations, it is often helpful to use a measure which can be expressed in a single number. First of all, one would like to have the measures of location or measures of central tendency of the distribution. The three measures used for this purpose are the mean, median, and mode.

### 1.4.1 Mean

The mean (or arithmetic mean) is also known as the average. It is calculated by adding the values of all the observations and dividing by the total number of observations. Note that the mean can only be calculated for numerical data.

$$\bar{X} = \frac{\Sigma X}{N}$$

**Example 1:** The measurements of the heights in centimetres of seven girls are given below.

| S.No. | Height (cm) |
|---|---|
| 1 | 141 |
| 2 | 141 |
| 3 | 143 |
| 4 | 144 |
| 5 | 145 |
| 6 | 146 |
| 7 | 155 |

A total of seven measurements = 1015 cm. The mean = (1015/ 7), which is 145 cm.

In case of frequency, or grouped data, and in this situation it is bit difficult mean is calculated as follows:

**Example 2:** Measurements of the heights in centimetres of 15 girls are given below

| **S.No.** | **Height** $X_i$ | **Frequency** $f_i$ | $f_i \times X_i$ |
|---|---|---|---|
| 1 | 141 | 2 | 282 |
| 2 | 143 | 3 | 429 |
| 3 | 144 | 4 | 576 |
| 4 | 145 | 3 | 435 |
| 5 | 146 | 2 | 292 |
| 6 | 155 | 1 | 155 |
| **Total** | | **15** | **2169** |

*Formula for calculating mean:* $X = \frac{\Sigma f_i \times X_i}{\Sigma f_i} = 2169/15 = 144.6$

***Note***

***Note 1*:** In the case of the grouped frequency data given in table 1.1, the midpoint of the interval will become $X_i$ and a similar procedure for computing the mean can be followed as shown above.

**Note 2:** However, in the case of open interval data, such as 'less than 19' (denoted as <19) or 'more than 159' (denoted as > 159), it is not possible to fix a midpoint, and, therefore, the mean cannot be calculated. As a consequence, we use the median in place of the mean, which is explained in the next section.

### 1.4.2 Median

The median is a value that divides a distribution into two equal halves. The median is useful when the data is in ordinal scale, i.e., some measurements are much bigger or much smaller than the other measurement values. The mean of such data will be biased toward these extreme values. Thus, the mean is not a good measure of distribution, in this case. The median is not influenced by extreme values. The median value, also called the central or halfway value, is obtained in the following way:

List the observations in order of magnitude (from the lowest to the highest value, or vice versa).

Count the number of observations = *n*.

The median value is the middle value, if *n* is odd, it will be the (n+1)/ $2^{th}$ term and if n is even, it will be equal to the mean of two middle values, {i.e., (n/2) and the next value}

**Example 3:**

**Case 1:** The weights of 7 women are:

| S.No. | Weight of women (kg) |
|---|---|
| 1 | 40 |
| 2 | 41 |
| 3 | 42 |
| 4 | 43 |
| 5 | 44 |
| 6 | 47 |
| 7 | 72 |

The median value is the value belonging to observation number (7 + 1)/ 2, which is the fourth one value: 43 kg.

**Case 2:** If there are 8 observations:

| S.No. | Weight of women (kg) |
|---|---|
| 1 | 40 |
| 2 | 41 |
| 3 | 42 |
| 4 | 43 |
| 5 | 44 |
| 6 | 47 |
| 7 | 49 |
| 8 | 72 |

The median would be the average of '$(n/2)^{th}$ or the $4^{th}$ value i.e. 43' and 'next value, i.e., 44'}; the median in this case would be (43+44)/2 = 43.5 kg}.

**Calculation of Median for Grouped Data**

We can use the **grouped data** of the table 1.1 of section 1.3.1, 'Distribution of clinics according to number of patients treated for malaria in one month' for **calculation of median**, which is given below

**Table 1.2: Distribution of clinics according to number of patients treated for malaria in one month**

| Number of patients | Number of clinics | Cumulative frequency |
|---|---|---|
| 0 - 19 | 5 | 5 |
| 20 - 39 | 8 | 13 |
| 40 - 59 | 10 | 23 |
| 60 - 79 | 11 | 34 |
| 80 - 99 | 19 | 53 |
| 100 - 119 | 10 | 63 |
| 120 - 139 | 9 | 72 |
| 140 - 159 | 8 | 80 |
| Total | 80 | |

Step1: The total of frequency is first divided by 2, i.e., 80/2 (=40). The cumulative frequency 40 will correspond to the class interval (80-99). This is called the median interval.

Step2: The formula is $\text{Median} = L + \left[\left(\frac{N}{2} - F\right) \times d\right] / f$

Step3: Record all values of symbol variables from the table as given below:

L (=80) is the lower limit of the median interval,

F (=34) is the cumulative frequency of the class, preceding to median class,

d (=20) is the width of class interval,

f (=19) is the frequency of median class.

Step4: Replace the symbol values with numeric values as noted in step3 in the formula,

Therefore, Median = 80+ [(40-34) x 20] / 19 = 80 + 6.32 = 86.32 patients.

## 1.4.3 Mode

The mode is the most frequently occurring value in a set of observations. The mode is not very useful for numerical data that are continuous. It is most useful for numerical data that have been grouped. The mode is usually used to find the norm among populations and is calculated when the calculation of mean and median is inappropriate, viz., the average shoe size of the Indian population, standard birth weight, etc. The mode can also be used for categorical data, whether they are nominal or ordinal.

In **Example 1** (height of 7 girls) the mode is 141.

In **Example 2** the mode is 144 as 4 persons are with this observation.

**Calculation of Mode for Grouped Data**

We will again use the grouped data given in table 1.1 to calculate the mode. The steps for computing the mode are

Step1: Formula for calculating mode, $\text{Mode} = L + \left( \frac{f_m - f_1}{2f_m - f_1 - f_2} \right) \times h$

Step2: Find the class interval with the largest frequency, which is also called the modal class. In this case, the class interval '80-99' has the maximum frequency, equal to 19.

Step3: Record all values of the symbol variables used in the formula.

$L =$ (80) is the lower limit of the modal class,

$f_m =$ (19) is the modal class frequency (i.e. interval having maximum frequency),

$f_1 =$ (11) is the frequency of the class interval preceding the modal class,

$f_2 =$ (10) is the frequency of the class succeeding the modal class, and

$h =$ (20) is the width of the interval.

Step4: Replace the symbol values with the numeric values as noted in step3 in the formula.

The calculated value of mode is:

$$= \text{Mode} = 80 + \left( \frac{19 - 11}{2 \times 19 - 11 - 10} \right) \times 20$$

=80+9.41 = 89.41 patients

### 1.4.4 Relationship between Mean, Median, and Mode

In normal data, mean, median, and mode are same. However, in a moderately skewed (non normal) distribution, Mode = 3 Median - 2 Mean.

In summary, the mean, the median, and the mode are all measures of central tendency or measures of location. The mean is most widely used. It contains more information because the value of each observation is taken into account in its calculation. However, the mean is strongly affected by values far from the centre of the distribution, while the median and the mode are not. The calculation of the mean forms the beginning of more complex statistical procedures, like, correlation and regression, etc., to describe and analyze data. In general, as the skewness increases, the mean and median move away from the mode. If the mean is less than the median, the data is skewed to the left; and if it is greater than median, the data is skewed to right. The choice of central tendency, therefore, depends upon the type and distribution of data. Nowadays, with the easy availability of scientific

calculators and computers (Excel and other statistical software), the calculation of mean, median, mode, etc., has become very simple.

## 1.5 MEASURES OF DISPERSION

The mean, median, and mode are measures of the central tendency of a variable, but they do not provide any information of how much the measurements vary or are spread. This section will describe some common measures of variation (or variability), which in statistical text books are often referred to as measures of dispersion. Measures of dispersion or variability of a data give an idea up to which extent the values are clustered or spread out. In other words, it gives an idea of the homogeneity and heterogeneity of data. Two sets of data can have similar measures of central tendency but different measures of dispersion. Therefore, measures of central tendency should be reported along with measures of dispersion. There are various measures of dispersion. They are discussed below:

### 1.5.1 Range

It is the simplest measure of dispersion. This can be represented as the difference between maximum and minimum values, or simply, as the maximum and minimum values for all observations.

**Example 4:** If the weights of 7 women were

| S.No. | Weight of women (kg) |
|---|---|
| 1 | 40 |
| 2 | 41 |
| 3 | 42 |
| 4 | 43 |
| 5 | 44 |
| 6 | 47 |
| 7 | 72 |

The range would be 72 – 40 = 32 kg.

Although simple to calculate, the range does not tell us anything about the distribution of the values between the two extreme ones.

**Example 5:** If the weights of 7 other women were

| S.No. | Weight of women (kg) |
|---|---|
| 1 | 40 |
| 2 | 46 |
| 3 | 50 |
| 4 | 55 |
| 5 | 60 |
| 6 | 65 |
| 7 | 72 |

The range would also be 72 – 40 = 32 kg, although the values are very much different from those of the previous example.

### 1.5.2 Percentiles

A second way of describing the variation or dispersion of a set of measurements is to divide the distribution into percentiles (100 parts). As a matter of fact, the concept of percentiles is just an extension of the concept of the median, which may also be called the 50th percentile. Percentiles are points that divide all the measurements into 100 equal parts. The 30th percentile (P30) is the value below which 30% of the measurements lie. The 50th percentile (P50), or the median, is the value below which 50% of the measurements lie. To determine percentiles, the observations should be first listed from the lowest to the highest just like when finding the median. However, in case of grouped data, percentile can be calculated on similar lines of calculating the median.

The concept of percentiles is used by nutritionists to develop standard growth charts for specific countries from a representative sample of children whose weight and height are measured according to their age in months.

### 1.5.3 Mean Deviation

It is the average of deviation from arithmetic mean.

Mean Deviation = $\frac{\Sigma |x - \bar{x}|}{N}$ where | | denotes Mod, considering all differences 'as positive' or 'in absolute value'.

### 1.5.4 Standard Deviation

Standard deviation (sd) is always reported with mean. It denotes (approximately) the extent of variation of values from the mean. Mathematically, it is square root of variance ($sd = \sqrt{Variance}$). All the deviation values $\left(X_i - \bar{X}\right)$ in a data set are calculated by subtracting the mean, $\bar{X}$, of the data from each observation $X_i$. Variance is the mean of the sum of squares of all the deviation scores of a data. Mathematically this is written as follows.

Variance = $s^2 = \frac{\Sigma(X_i - \bar{X})^2}{n-1}$,

An easy to calculate formula is: $s^2 = \frac{1}{n-1}\sum X_i^2 - \left(\frac{\sum X_i}{n}\right)^2$

$sd = \sqrt{Variance}$

X = Mean

n = Number of observations

Large values of variance and standard deviation represent higher variability in the data and vice versa. If the value of variance is equal to 'zero', it represents no variability in the data. To obtain the standard deviation of a set of measurements one has to carry out the following steps:

i) Calculate the mean of all the measurements.

ii) Calculate the difference between each individual measurement and the mean.

iii) Square all these differences.

iv) Take the sum of all squared differences.

v) Divide this sum by the number of measurements minus one.

vi) Finally take the square root of the value obtained (in order to get back to the same unit of measurement).

**Example 6:** Suppose you need to calculate the standard deviation of 2, 4, 6, 8, 10 and 12.

| S. No. | X | $X_i - \bar{X}$ | $(X_i - \bar{X})^2$ |
|---|---|---|---|
| 1 | 2 | -5 | 25 |
| 2 | 4 | -3 | 9 |
| 3 | 6 | -1 | 1 |
| 4 | 8 | 1 | 1 |
| 5 | 10 | 3 | 9 |
| 6 | 12 | 5 | 25 |
| Sum | 42 | | 70 |
| $\bar{X}$ | 7 | | |

Variance = $s^2 = \frac{\Sigma(X_i - \bar{X})^2}{n-1} = \frac{70}{5} = 14$

(sd): $\sqrt{14} = 3.74$.

Fortunately many pocket calculators can do this calculation for us, but it is still important to understand what it means. In the case of grouped data, the mid value of the interval may be taken as observation value and the above procedure can be followed.

In the above sections you studied about the measures of central tendency and the measures of dispersion. Now try and answer the questions in *Check Your Progress-2*.

**Check Your Progress - 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are the different measures of central tendency?

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2. What are the different measures of dispersion?

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## 1.6 HYPOTHESIS TESTING AND INFERENCIAL STATISTICS

### 1.6.1 Understanding True Difference

The analysis and interpretation of the results of our study must be related to the objectives of study. It is important to tabulate the data in univariate and/ or bi-variate or multivariate tables appropriate to the research objectives. We may find some interesting results. For example, in a study on nutrition, we find that 30% of the women included in the sample are anaemic as compared to only 20% of the men. How should we interpret this result?

The observed difference of 10% might be a true difference, which also exists in the total population from which the sample was drawn.

The difference might also be due to the chance; in reality there is no difference between men and women, but the sample of men just happened to differ from the sample of women. One can also say that the observed difference is due to sampling variation.

A third possibility is that the observed difference of 10% is due to defects in the study design (also referred to as Bias). For example, we only used male interviewers, or omitted a pre-test, so we did not discover that anemia is a very important topic for women which require a female investigator.

If we feel confident that an observed difference between two groups cannot be explained by bias, we would like to find out whether this difference can be considered as a true difference. We can only conclude this only if we can rule out chance (sampling variation) as an explanation. We accomplish this by applying a test of significance. A test of significance estimates the likelihood that the observed result (e.g., a difference between two groups) is due to chance or real. In other words, a significance test is used to find out whether a study result, which is observed in a sample, can be considered as a result which indeed exists in the study population from which the sample was drawn.

### 1.6.2 Tests of Significance

Different sets of data require different tests of significance. Throughout this section, two major sets of data will be distinguished.

Two (or more) groups, which will be compared to detect differences. (e.g., men and women, compared to detect differences in anemia.)

Two (or more) variables, which will be measured in order to detect if there is an association between them. (e.g., between anemia and income.)

#### (i) How Tests of Significance Work

The reasoning behind significance tests is the same, no matter whether a researcher is comparing two groups for differences or whether s/he is measuring two variables to detect possible associations.

We will first concentrate on the **comparison of groups**.

Suppose you observed a difference between two groups in your sample.

You want to know whether this observed difference between the two groups represents a *real* difference in the study population from which the sample was drawn, or whether it just *occurred by chance* (due to sampling variation).

To find out, you determine how likely this difference could have occurred by chance, if in the population no difference exists between the two groups.

In any study that is looking for differences between groups or associations between variables, the likelihood or probability (p) of observing a certain result by chance has to be calculated by statistical tests.

**(ii) How to state Null ($H_o$) and Alternative ($H_1$) Hypothesis:**

In statistical terms the assumption that no real difference exists between groups in the total study (target) population (or, that no real association exists between variables) is called the Null Hypothesis ($H_o$). The Alternative Hypothesis ($H_1$) is that there exists a difference between groups or that a real association exists between variables.

Null Hypothesis is also known as the hypothesis of no difference. Examples of null hypotheses are

There is no difference in the incidence of measles between vaccinated and non-vaccinated children.

There is no difference between the alcohol consumption of male and female.

There is no association between families' income and malnutrition in their children.

However, if by testing the hypothesis we find that the result is statistically significant, we reject the Null Hypothesis ($H_o$) and accept the Alternative Hypothesis ($H_1$) that there is real difference between two groups, or a real association between two variables. Examples of alternative hypotheses ($H_1$) are:

There is a difference in the incidence of measles between vaccinated and non-vaccinated children.

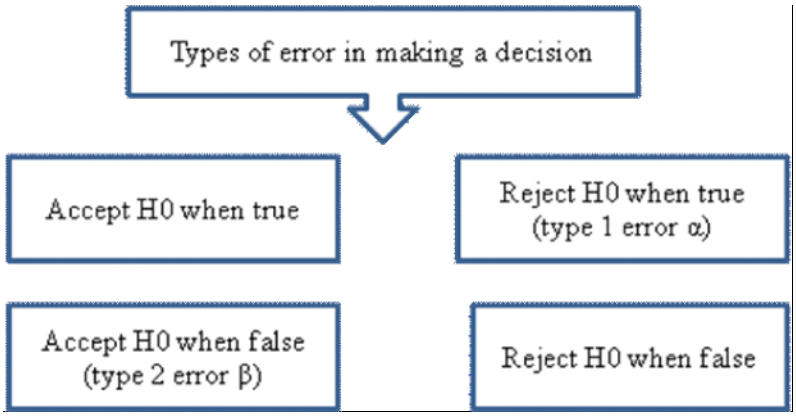
Males drink more alcohol than females.

There is an association between families' income and malnutrition in their children.

Be aware that 'statistically significant' does not mean that a difference or an association is *of practical importance.* The tiniest and most irrelevant difference will turn out to be statistically significant if a large enough sample is taken. On the other hand, a large and important difference may fail to reach statistical significance if too small a sample is used.

**(iii) The Concept of Type I and Type II Error**

The testing of hypothesis will lead the investigator to take one of the following decisions:




Of these, two decisions (Accepting $H_0$ when it is true and Rejecting $H_0$ when it is false) are the right decisions to make whereas the other two lead to error.

**Type I error (α):** We reject the null hypothesis when it is true, or false positive error, or type I error '**α' (**called alpha or the level of significance). Eg. A Pharma company introduces a new drug in the market claiming that it is more effective in treating diabetics than the drug already existing in the market.

In the above example, type I error would mean that the effects of two drugs were found to be different by statistical analysis, when, in fact, there was no difference between them.

**Type II error (β)**: We accept the null hypothesis when it is false or false negative error; or simply, type II error '**β'** (called beta**)**. In the above example, type II error would mean that the effects of two drugs were not found different by statistical analysis, when in fact there was difference.

We would like to carry our test, so as to minimize both types of errors simultaneously, but this not possible in a given fixed sample size. In fact decreasing one type of error may very likely increase the other type. In practice, we keep type I error (α) fixed at a specified value (i.e., at 1% or 5%).

Till now you have read about the various concepts of hypothesis testing. Now try and answer the following questions in *Check Your Progress-3.*

**Check Your Progress - 3**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What do you understand by a null and an alternative hypothesis?

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   .....

   .....

2. What are type I and type II errors?

   .....

   .....

   .....

## 1.7 STATISTICAL TESTS

Depending on the aim of your study and the type of data collected, you have to choose appropriate tests of significance. Before applying any statistical test, state the null hypothesis in relation to the data to which the test is being applied. This will enable you to interpret the results of the test. The following sections will explain how you will choose an appropriate statistical test to determine differences between groups or associations between variables.

### 1.7.1 Determining Significant Difference between Groups

There are several issues one should consider, while deciding, which test to use to determine differences between groups. It is necessary to determine whether the data are categorical (nominal and ordinal) or continuous (numerical).

Under both of these categories, you also need to decide whether you have paired or unpaired observations. In paired observations, individual observations in one data set (e.g., experimental) are matched with individual observations in another data set (e.g., controls).

**For continuous data** (in interval, or, ratio scale), the choice of an appropriate significance test depends on whether you are comparing two groups or more than two groups. The z-test, referred to as the standard normal variate, and the t-test, also referred to as the Student's t-test, are used for numerical data of continuous nature, when comparing the means of two groups. The chi-square test is used for categorical data, when comparing proportions of events occurring in two or more groups.

**Steps to Follow for testing a Hypothesis**

Step1: Formulate the null hypothesis

Step 2: Formulate the alternative hypothesis

Step 3: Choose the level of significance of the test

Step 4: Choose an appropriate test statistic

Step 5: Compute the observed value of the test statistic

Step 6: Compare the calculated value of the statistic with the tabled value

Step 7: Accept or Reject the null hypothesis

Here we will confine our discussion to four types of tests:

(i) $\chi^2$ test

(ii) Z- test

(iii) t-test

(iv) f-test

## 1.8 CHI-SQUARE TEST

Suppose that in a cross-sectional study of the factors affecting the utilisation of health care centres, you found that 64% of the women who lived within 10 kilometres of the centres came for health checkups, compared to only

47% of those who lived more than 10 kilometres away. This suggests that health care centre is used more often by women who live close to the centres. The complete results are presented in Table 1.3.

**Table 1.3: Utilization of health care centre by women living far from, and near the clinic**

| Distance from health care centre | Used health care centre | Did not Use health care centre | Total |
|---|---|---|---|
| Less than 10km | 51 (64%) | 29 (36%) | 80 (100%) |
| 10km or more | 35 (47%) | 40 (53%) | 75 (100%) |
| Total | 86 | 69 | 155 |

From the table we conclude that there seems to be a difference in the use of health care centre between those who live close to, and those who live far from, the centre (64% versus 47%). We now want to know if this observed difference is statistically significant or not. The chi-square $(\chi^2)$ test, used to test the statistical significance, is given below.

Chi-square= $\chi^2_{df} = \sum \frac{(O_i - E_i)^2}{E_i}$ $\sum$ (the summation sign, also called sigma) directs you to add together each value of $(O_i - E_i)^2 / E_i$ for all the 'k' cells of the table. Where, $O_i$ and $E_i$ are the observed and expected frequency of each cell and 'df' is the degree of freedom.

The alternative simplified formula for calculating chi-square is: $\chi^2 = \sum \frac{O_i^2}{E_i} - N$, where N is the total of observed frequency.

These are the steps to follow:

**Formulating the Hypothesis:**

**$H_0$:** There is no difference in the utilization of health care centre among women living within distance of less than and more than 10 kms

**$H_1$:** There is difference in the utilization of health care centre among women living within distance of less than and more than 10 kms

**Test Statistic:** chi-square $(\chi^2)$ Test

***Calculating the Chi-square $\chi^2$ value***

(1) Calculate the expected frequency ($E_i$) for each cell. To find the expected frequency $E_i$ of a cell, you multiply the row total by the column total of the cell and divide by the grand total: $E = \frac{\text{Row total} \times \text{Column total}}{\text{Grand total}}$.

(2) For each cell, subtract the expected frequency $E_i$ from the observed frequency $O_i$, $(O_i - E_i)$, square the difference of $(O_i - E_i)$ and divide it by the corresponding expected frequency $E_i$. (You may skip this step and follow the next step 3 as an alternative step).

(3) Alternatively, for each cell, simply square the observed frequency $O_i$ and divide it by the corresponding expected frequency, $E_i$.

(4) Find the sum by adding the values calculated in step (3) for all the cells and subtract *N* (total of observed frequency) from the sum.

For a 2×2 table the formula is: $\chi^2 = \frac{(O_1 - E_1)^2}{E_1} + \frac{(O_2 - E_2)^2}{E_2} + \frac{(O_3 - E_3)^2}{E_3} + \frac{(O_4 - E_4)^2}{E_4}$,

The alternative formula $\chi_1^2 = \left( \frac{O_1^2}{E_1} + \frac{O_2^2}{E_2} + \frac{O_3^2}{E_3} + \frac{O_4^2}{E_4} \right) - N$

***Using a Chi-square table***

The calculated chi-square value has to be compared with a theoretical chi-square value in order to determine whether the null hypothesis is rejected or not. **Annex I** contains a table of theoretical chi-square values.

(1) First you must decide what significance, or alpha, level you want to use ($\alpha$ value). We usually take 0.05.

(2) Then, the degrees of freedom have to be calculated. With the chi-square test the number of degrees of freedom is related to the number of cells, i.e., the number of groups you are comparing. The number of degrees of freedom is found as:

$$\text{degrees of freedom} = (\text{Number of rows} - 1) \times (\text{Number of colmuns} - 1) = (r - 1) \times (c - 1)$$

For a simple 2 x 2 table, the number of degrees of freedom is 1: d.f. = (2-1) × (2-1) = 1

(3) Then the chi-square value belonging to the $\alpha$-value and the number of degrees of freedom are located in the table.

***Interpreting the results***

If the calculated chi-square value is equal to or larger than the chi-square value from the table then we reject the null hypothesis and conclude that there is a statistically significant difference between the groups.

If the calculated chi-square value is smaller than the chi-square value from the table, then we accept the null hypothesis and conclude that the observed difference is not statistically significant (do not differ significantly).

Let us now apply the chi-square test to the data given in table 1.5 (utilization of health care centre). This gives the following result:

### *Calculating the Chi-square $\chi^2$ value*

First the expected frequencies for each cell are computed for calculating the Chi-square value as follows:

| Distance from health care centre | Used health care centre | Did not Use health care centre | Total |
|---|---|---|---|
| Less than 10km | $E_1 = \frac{86 \times 80}{155} = 44.4$ | $E_2 = \frac{69 \times 80}{155} = 35.6$ | 80 |
| 10km or more | $E_3 = \frac{86 \times 75}{155} = 41.6$ | $E_4 = \frac{69 \times 75}{155} = 33.4$ | 75 |
| Total | 86 | 69 | 155 |

Note that the expected frequencies refer to the values we would have expected, given the total numbers of 80 and 75 women in the two groups, if the null hypothesis, there is **no** difference between the two groups, were true. Now the chi-square value can be calculated:

$$\text{Chi-square} = \frac{(51-44.4)^2}{44.4} + \frac{(29-35.6)^2}{35.6} + \frac{(35-41.6)^2}{41.6} + \frac{(40-33.4)^2}{33.4}$$

$$(\chi^2) = 0.98 + 1.22 + 1.05 + 1.30 = 4.55$$

With the alternative formula, the value of chi-square is same and is given below.

$$\chi_1^2 = \left( \frac{51^2}{44.4} + \frac{29^2}{35.6} + \frac{35^2}{41.6} + \frac{40^2}{33.4} \right) - 155 = 4.56$$

### *Using a Chi-square table*

The number of degrees of freedom (d.f.) for 2×2 table is 1. Use the table of chi-square values in Annex 1. We decided, beforehand, on a level of significance of 5% ($\alpha$-value = 0.05).

As the number of d.f. is 1, we look along that row in the column where p = 0.05. This gives us the tabulated value of 3.84.

### *Interpreting the result*

Our calculated value of chi-square 4.55 is larger than 3.84. Hence we reject the null hypothesis.

We can now conclude that the women living within a distance of 10 km from the clinic utilise antenatal care significantly more often than the women living more than 10 km away.

Table 1.5 indicates that 64% of the women living within a distance of 10 km from the clinic used antenatal care during pregnancy, compared to only 47% of women living 10 km or further away from the nearest clinic. This difference is statistically significant (chi-square = 4.55; $p < 0.05$).

## 1.9 F-test

The F-test is used either for testing the hypothesis about the equality of two population variances or the equality of two or more population means. The ratio of two sample variances follows F distribution.

### i. Test of Equality of Two Population Variances

Let there be two normal populations N ($\mu_1$, $\sigma_1^2$) and N ($\mu_2$, $\sigma_2^2$).

Where $\mu_1$ and $\mu_2$ are the population means and $I_1^2$ and $\sigma_2^2$ are the population variances.

We use F test to test the hypothesis

**$H_0$:** $\sigma_1^{2\ =}\ \sigma_2^2$

**$H_1$:** $\sigma_1^{2\ \#}\ \sigma_2^2$

Let an independent sample of size $n_1$ be selected from population N ($\mu_1$, $\sigma_1^2$), and of size $n_2$ from population N ($\mu_2$, $\sigma_2^2$).

**The test statistic**:

$$F_{k1,k2} = \frac{S_1^2}{S_2^2}$$

Where k1 = ($n_1$- 1) and K2 = ($n_2$ - 1).

As a norm, the larger variance is taken in the numerator and the degrees of freedom corresponding to it is denoted as $k_1$.

**Interpreting the results:**

If the calculated value of F is greater than the tabled value, reject $H_{0,}$ if not, accept $H_{0.}$

**Example 7:** Life expectancy in 9 regions of Brazil in 1900, and in 11 regions of Brazil in 1970 was as given in the table below:

| Regions | Life Expectancy (Years) | |
|---|---|---|
| | **1900** | **1970** |
| 1 | 42.7 | 54.2 |
| 2 | 43.7 | 50.4 |
| 3 | 34.0 | 44.2 |
| 4 | 39.2 | 49.7 |
| 5 | 46.1 | 55.4 |
| 6 | 48.7 | 57.0 |
| 7 | 49.4 | 58.2 |
| 8 | 45.9 | 56.6 |
| 9 | 55.3 | 61.9 |
| 10 | | 57.5 |
| 11 | | 53.4 |

We want to confirm whether the variation in life expectancy in various regions in 1900 and in 1970 is the same or not. Let the populations in 1900 and 1970 be considered N ($\mu_1$, $\sigma_1^2$) and N($\mu_2$,$\sigma_2^2$) respectively.

We use F test to test the hypothesis

**$H_0$:** $\sigma_1^2 = \sigma_2^2$

**$H_1$:** $\sigma_1^2 \# \sigma_2^2$

**Calculating the test statistic**

First we calculate $S_1^2$ and $S_2^2$.

$$S_1^2 = \frac{1}{8}\{\Sigma X_{1i}^2 - \frac{(\Sigma X_{1i})^2}{9}\}$$

$$= 37.848$$

$$S_2^2 = \frac{1}{10}\{\Sigma X_{2i}^2 - \frac{(\Sigma X_{2i})^2}{11}\}$$

$$= 26.606$$

$$F = \frac{37.848}{26.606}$$

$$=1.603$$

**Tabled value**

$F_{tab}$=3.07

**Interpreting the results**

The tabled value of F is 3.07. Since $F_{cal} < F_{tab}$, we accept the null hypothesis. It means that the variation in life expectancy in various regions of Brazil in 1900 and in 1970 is the same.

## 1.10 Z -TEST

To test the hypothesis about a population mean or two population means when the sample size is large (>30) and population variances are known, we use the Z-test.

### 1.10.1 Testing of Significance of Difference between Two Proportions (Two Large Samples)

Let there be two large samples drawn from one population or from two populations, having same variance. The populations are distributed normally. The proportions, $p_1$ and $p_2$ are the two proportions of an event from the two samples ( >30), which are compared for their difference. We may apply the formula: $z = \frac{(p_1 - p_2)}{\sqrt{P \times Q \times \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$, where, $P = \frac{n_1 \times p_1 + n_2 \times p_2}{n_1 + n_2}$, Q = 1 - P

The *P* is the mean proportion of success of the two proportions, $p_1$ and $p_2$, and n1 and n2 are the respective sample sizes.

The above calculated value of 'z' is compared with the tabulated value of 'z-normal variate' for '$\alpha$ = 0.05', i.e., at 5% level of significance, which is 1.96 and the value of z for '$\alpha$ =0.01', i.e., at 1% level significance is 2.58.

**Example 8:** To test the conjecture of the management that 60 % of employees prefer the new bonus scheme, a sample of 150 employees was drawn, and their opinion was taken, whether they favoured it or not. Only 55 employees out of 150 favoured the new bonus scheme.

Thus, we test the hypothesis, $\mathbf{H_0}$: $P = 0.60$

$\mathbf{H_1}$: $P \neq 0.60$

**Calculating the test statistic:**

$$Z = \frac{0.367-0.60}{\sqrt{\frac{0.60*0.40}{150}}} \qquad \text{Since } p = 55/150 = 0.367$$

$Z = -11.65$

$|Z| = 11.65$

**The Table value**

At $\alpha = 0.01$, $z_{tab} = 2.58$.

**Interpreting the results**

As $Z_{cal} > Z_{tab}$, hence $H_0$ is rejected. It means that 60 percent of the employees do not favour the new bonus scheme.

### 1.10.2 Testing of Significance of Difference between Means of Two Large Samples (Continuous Data)

In case of large samples where population variances are known, we test the equality of two population means using z – test.

Hypothesis:

$\mathbf{H_0}$: $\mu = \mu_0$

$\mathbf{H_1}$: $\mu \neq \mu_0$

**Calculating the test statistic**:

$$Z = \frac{x - \mu_0}{\sigma/\sqrt{n}}$$

where, x is the sample mean and $\sigma$ is the standard deviation.

**The Table value**

The value of $z_{(\alpha)}$ for comparing the calculated test statistics is taken as 1.96 at 5% level of significance ($\alpha$); and it is 2.58 at 1% level of significance ($\alpha$). Here, the sample size is treated as large and, therefore, the degree of freedom plays no role, unlike in the t-test.

**Example 9:** The table below gives the total income in thousand rupees per year of 36 persons selected randomly from a particular class of people.

| Income (thousand Rs) | | | | | |
|---|---|---|---|---|---|
| 6.5 | 10.5 | 12.7 | 13.8 | 13.2 | 11.4 |
| 5.5 | 8.0 | 9.6 | 9.1 | 9.0 | 8.5 |
| 4.8 | 7.3 | 8.4 | 8.7 | 7.3 | 7.4 |
| 5.6 | 6.8 | 6.9 | 6.8 | 6.1 | 6.5 |
| 4.0 | 6.4 | 6.4 | 8.0 | 6.6 | 6.2 |
| 4.7 | 7.4 | 8.0 | 8.3 | 7.6 | 6.7 |

On the basis of the sample data, can it be concluded that the mean income of a person in this class of people is Rs. 10,000 per year?

We have to test the hypothesis $\mathbf{H_0}$ **:** $\mu = 10{,}000$

$\mathbf{H_0}$ **:** $\mu_1 \neq 10{,}000$

**Calculating the test statistic**:

Since the sample size is 36, we will use a normal test for which the test statistic is

$$Z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$$

Now we compute $\bar{x}$ and $\sigma$.

$x = 280.7/36 = 7.80$

$\sigma^2 = 1/35\{2368.75 - (2368.75 - (280.7)^2/36\}$

$= 5.14$

$\sigma = 2.27$

$$Z = \frac{(7.80 - 10)}{2.27/\sqrt{36}}$$

$= -5.81$

$|Z| = 5.81$

**The Table value:** $Z_{tab} = 1.96$

**Interpretation:** Since $Z_{cal} > Z_{tab}$, reject $H_{0.}$ It means that the average annual income is less than ten thousand rupees.

**Assumption for use of z statistics:** The assumption for using the z statistics is that the parent population, from where samples have been drawn, should be normal. The z statistics presumes that the population variances ($\sigma_1^2$ and $\sigma_2^2$) of the parent populations are known and, therefore, the z statistics for testing significance of difference between means is defined as $z = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$.

Since the population variances are presumed to be known, therefore the samples drawn from a population should also be normally distributed. It

is, therefore, pertinent to verify whether the samples satisfy the criteria of normality or not. If the samples drawn from the population are sufficiently large, then, one can estimate the population variances from the samples itself. As in practice population variances are not known, the researcher has to estimate the population variances from the samples $\left(sd_1^2 \text{ and } sd_2^2\right)$ itself and use the z statistics $\frac{\left(\overline{X_1}-\overline{X_2}\right)}{\sqrt{\frac{sd_1^2}{n_1}+\frac{sd_2^2}{n_2}}}$. In z statistics, we refer to the tables of normal area curve, where degrees of freedom do not play any role. The computation of z statistics is almost same except for computing of standard error (SE), which is given as $\sqrt{\frac{sd_1^2}{n_1}+\frac{sd_2^2}{n_2}}$.

## 1.11 t-Test

### 1.11.1 Testing the Significance of Independent Samples from Two Groups for Continuous Data

**Example 10:** It has been observed that in a certain province the proportion of women, joining the army, is very high. A study is, therefore, conducted to discover why this is the case. The height of women is supposed to be the contributory factor; the researcher may want to find out if there is a difference between the mean height of women in this province who preferred joining army and of those who opted for other services. The null hypothesis would be that there is no difference between the mean heights of the two groups of women. Suppose the following results were found:

**Table 1.4: Mean heights of women as per type of service**

| Type of Service | Sample size | Mean height in cm | Standard deviation |
|---|---|---|---|
| Joined army (Group1) | $n_1 = 60$ | $\overline{X_1} = 156$ | $sd_1 = 3.1$ |
| Other Services (Group2) | $n_2 = 52$ | $\overline{X_2} = 154$ | $sd_2 = 2.8$ |

The mean height for each of the two samples was calculated and compared, using the t-test, to determine whether there was a difference.

These are the steps to follow, in determining whether the difference is statistically significant:

**Hypothesis:**

**$H_0$:** There is no significant difference between the heights of the women joining army and other services.

**$H_1$:** There is difference between the heights of the women joining army and other services.

**Test Statistic:** A t-test would be the appropriate way to determine whether the observed difference of 2 cm can be considered statistically significant.

$$t_{df} = \frac{\left(\overline{X_1} - \overline{X_2}\right)}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \qquad \text{degrees of freedom, } df = n_1 + n_2 - 2$$

$$\text{Pooled Variance} \quad s^2 = \frac{(n_1 - 1)sd_1^2 + (n_2 - 1)sd_2^2}{n_1 + n_2 - 2}$$

***To calculate the t-value, you need to follow these steps:***

**(1) Difference between the means.** In the above example the difference is (156-154 = 2 cm).

$$\overline{X}_1 - \overline{X}_2 = 2$$

(2) **Calculate the standard deviation (square root of variance $S^2$)** of all observations pooled together for both the samples.

In case the standard deviations for each of the study groups are given or have been calculated, then compute the pooled variance of samples ($S^2$) as given:

$$S^2 = \frac{59 \times 9.61 + 51 \times 7.84}{59 + 51} = \frac{966.83}{110} = 8.80$$

Standard deviation (of pooled sample) S = 2.96

(3) **Calculate the standard error of the difference between the two means**

$$S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \qquad SE = 2.96 \times 0.01895 = 0.5608$$

(4) Finally, divide the difference between the means by the standard error of the difference. The value now obtained is called t-value. $t = \frac{2}{0.5608} = 3.57$

**The Table value**

Once the t-value has been calculated, you will have to refer to a t-table, from which you can determine whether the null hypothesis is rejected or not. Annex II contains a t-table.

(1) First, decide which significance level ($\alpha$ value) you want to use. Usually we choose a significance level of 0.05.

(2) Second, determine the number of degrees of freedom for the test being performed. For student's t-test the number of degrees of freedom is calculated as the sum of the two sample sizes minus 2. Thus, for Example 1.6, it is calculated as follows:

The number of degrees of freedom is: d.f. = 60 + 52 - 2 = 110

(3) Third, the t-value belonging to the '$\alpha$' value (the significance level we chose) and the degrees of freedom are located in the table.

In our example we look up the t-value belonging to $\sigma = 0.05$ and d.f. = 120 (nearest to 110 in the table) and we find it is 1.98.

***Interpreting the result***

In our example the t-value calculated is 3.6, which is larger than the t-value derived from the table (1.98). We, therefore, reject the null hypothesis and conclude that the observed difference of 2 cm between the mean heights of women who joined army and women who opted for other services is a statistically significant difference.

### 1.11.2 Paired t Test

This section describes the most commonly used tests for paired observations pertaining to numerical and to nominal data. The concept of pairing or matching subjects is illustrated by the examples that follow.

**Example 11:** A researcher wanted to find out whether a class of students taught with audio-visual aids (AV) receives on average better grades than those who are taught without audio-visual aids. In other words, whether there is any gain in achievement or not due to use of two teaching methods. To minimize the effect of confounding variables such as *social status* and *previous knowledge of the subjects*, each student in the AV class was paired with another in the non-AV class of similar social status and knowledge level. Paired or matched observations are carried out if researcher wants to ensure through their study design that the relationship between two variables they are interested in is not confounded by another variable. They, therefore, have to sample their cases and controls in such a way that these are similar

**Example 12:** During a nutritional survey, a quality control exercise was carried out to check the agreement between two observers in measuring the children's weight. In this instance we have paired observations as we have a *set of two observations on the same child*.

When dealing with paired (matched) observations, comparison of sample means is performed by using a modified t-test known as the paired t-test. In the paired t-test, differences between the paired observations (say, Post-test minus Pre-test, or matched observations of 2nd group minus 1st group) are used instead of the observations of two sets of independent samples. The paired t-test calculates the value of 't' as

$$t_{df} = \frac{\text{mean of differences}}{\text{standard error of differences}} \quad , \quad t_{df} = \frac{\bar{d}}{sd(d)/\sqrt{n}}$$

Where, $\bar{d}$ is the mean difference of values obtained from subtracting two sets of paired observation; sd(d) is the standard deviation of values obtained from difference of two sets of paired observations; n is the sample size of paired observations; the degrees of freedom (df = n - 1) is the number of paired observations (sample size) minus 1.

The same table of t value is used, as for the t-test for unpaired observations (see Annex II) to interpret result of the study. The use of the paired t-test is illustrated on the results of the nutritional survey referred to in previous example above. The results are given table 1.5.

**Table 1.5: Results of quality control exercise during a nutritional survey**

| Child No. | Weight Measurement (Kg) | | Difference A-B (Kg) |
|---|---|---|---|
| | Observer A | Observer B | |
| 1 | 18.6 | 17.7 | 0.9 |
| 2 | 17.1 | 14.5 | 2.6 |
| 3 | 14.3 | 12.4 | 1.9 |
| 4 | 23.2 | 20.7 | 2..5 |
| 5 | 18.4 | 16.8 | 1.6 |
| 6 | 14.9 | 14.4 | 0.5 |
| 7 | 16.6 | 14.1 | 2.5 |
| 8 | 14.8 | 17.1 | -2.3 |
| 9 | 21.5 | 21.2 | 0.3 |
| 10 | 24.6 | 21.9 | 2.7 |
| 11 | 17.4 | 16.6 | 0.8 |
| 12 | 15.7 | 13.6 | 2.1 |
| 13 | 16.1 | 14.5 | 1.6 |
| 14 | 12.9 | 11.2 | 1.7 |
| 15 | 12.3 | 16.0 | -3.7 |
| 16 | 19.4 | 20.4 | -1.0 |
| 17 | 19.3 | 17.5 | 1.8 |
| 18 | 24.8 | 22.2 | 2.6 |
| 19 | 14.3 | 15.1 | -0.8 |
| 20 | 13.4 | 10.9 | 2.5 |

The null hypothesis in this study is

**H :** The mean difference of measurements between observers A and B would be zero

**$H_1$:** The mean difference of measurements between observers A and B would not be zero

**Calculating the test statistic**

The paired t-test (significance test) is calculated as follows:

i) Calculate the mean difference of the measurements between A and B in the sample. This is the sum of the differences divided by the number of measurements:

$$\text{Mean difference} = \frac{21.1}{20} = 1.05$$

ii) Calculate the standard deviation of the differences and Standard Error,

Standard deviation = 1.77, and the standard error: $SE = \frac{1.77}{\sqrt{20}} = 0.40$

iii) The value of 't' is the mean difference divided by the standard error:

$$t = \frac{1.05}{0.40} = 2.62$$

**The Table Value**

The degrees of freedom are the sample size (the number of pairs of observations) minus 1, which in this case is (20 – 1 = 19). The tabled t-value at 19 degrees of freedom is 2.09

**The Interpretation**

$t_{cal} > t_{tab}$

If the calculated t-value (ignoring the sign) is larger than the value indicated in the table, the null hypothesis, stating that there is no difference, is rejected, and it can be concluded that there is a significant difference in the result of your study.

**Note:** Computers are helpful when dealing with large data sets. A variety of software including Excel and SPSS provides options for various statistical tests.

In this section you have read about the various tests of significance. Now try and answer the questions given in *Check Your Progress-4.*

**Check Your Progress - 4**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What are the important considerations that one should keep in mind while applying the chi-square test?

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2. What is a paired t-test and when is it used?

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## 1.12 CORRELATION ANALYSIS

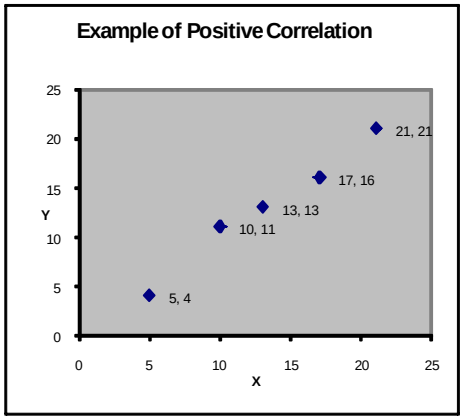
When exploring associations between variables we have to distinguish between nominal, ordinal, and continuous data. In this unit, we will examine associations between continuous data where a linear relationship is suspected.

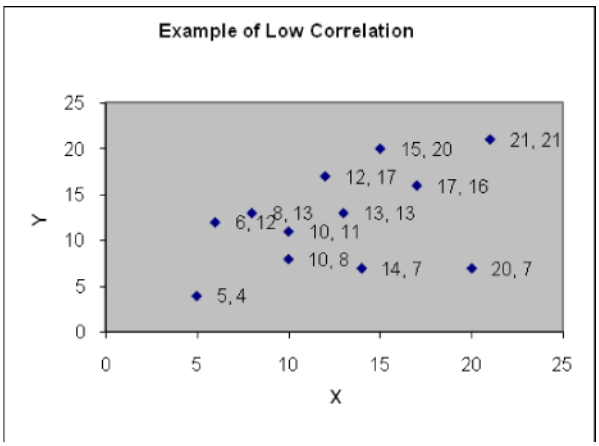
### 1.12.1 Understanding Correlation

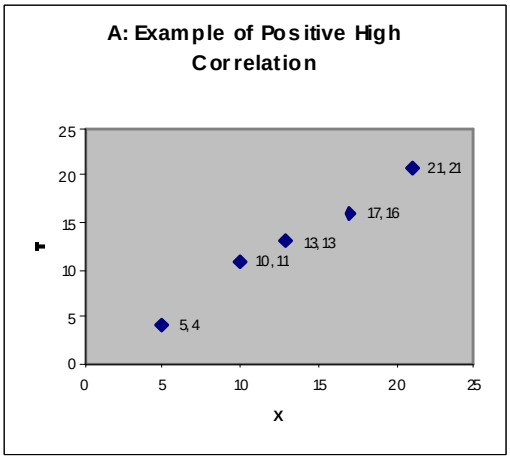
Correlation is relationship between the two sets of continuous data; for example the relationship between height and body weight. Correlation statistics are used to determine the extent to which two independent variables are related and can be expressed by a measure called 'coefficient of correlation'. The correlation coefficient may be positive or negative and therefore it may vary from '-1' to '+1'. Positive correlation means that values of two different variables increase and decrease together. For example, height and weight correlate positively. Negative correlation means that if the value of one variable decreases then the value of the other variable increases (inverse relationship). For example, literacy and number of children in family may correlate negatively.

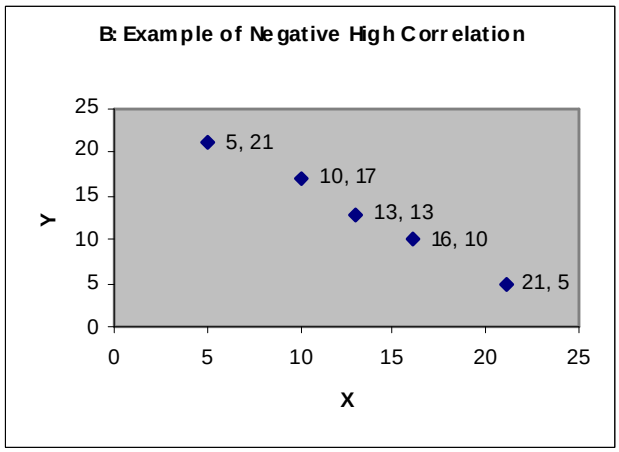
The strength of a correlation is determined by the absolute value of the correlation coefficient; the closer the value to 1, the stronger the correlation. For example, a correlation of -0.9 indicates an inverse relationship between two variables and shows a stronger relationship than that associated with a correlation of +0.2 or -0.5. Correlation between two variables is shown by scatter plot (Fig. 1.1).

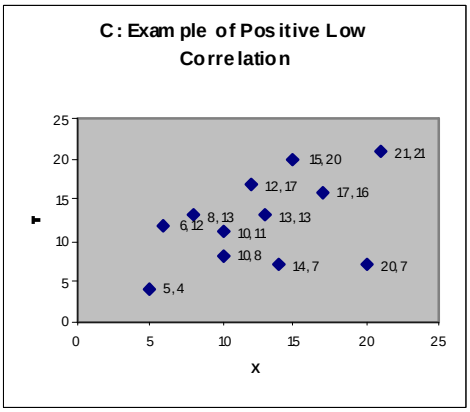
**Figure 1.1: Scatter Diagram showing relation between two variables**

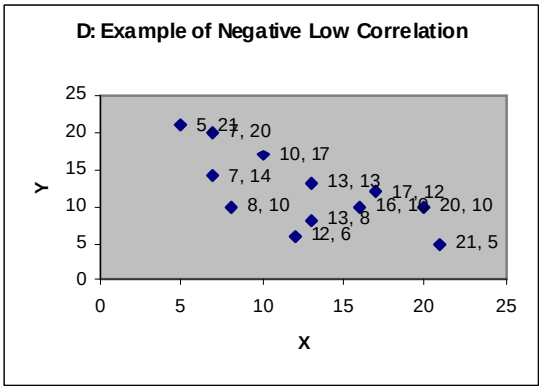


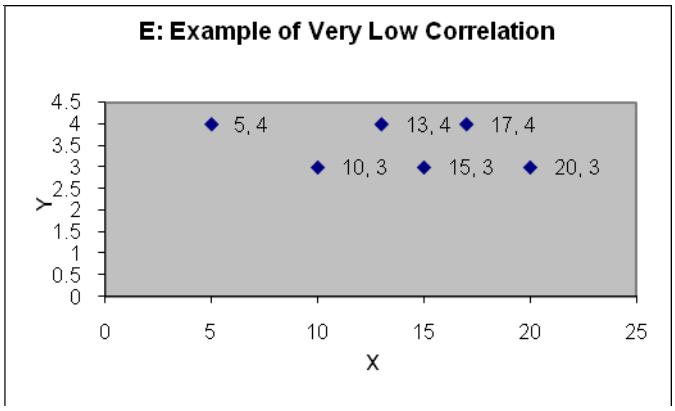






The slopes of both the lines are identical in these two examples, but the scatter around the line is much greater in the second. Clearly the relationship between variables y and x is much closer in the first diagram.

If we are interested only in measuring the association between the two variables, then Pearson's Correlation Coefficient (r) gives us an estimate of the strength of the linear association between two numerical variables. Pearson's Correlation Coefficient can either be calculated using a calculator or on computer using various analytical software. Note that in case there is curvilinear relationship, the value of r will be shown to be zero. The correlation coefficient has the following properties:

1. For any data set, r lies between '-1' and '+1'.
2. If r = +1, or -1, the linear relationship is perfect, that is, all the points lie exactly on a straight line. If most of the points lie on the line, then it is very strong relationship and r is near to 1. If r = +1, variable y increases as x increases (i.e., the line slopes upwards). (See Diagram A.) If r = -1, variable y decreases as x increases (i.e., the line slopes downward). (See Diagram B.)
3. If r lies between 0 and +1, the line slopes upwards, but the points are scattered about the line. (See Diagram C.) The same is true of negative values of r, between 0 and -1, but in this case the line slopes downward. (See Diagram D.)
4. If r = 0, there is very low linear relationship between y and x. This may mean that there is no relationship at all between the two variables (i.e., knowing x tells us nothing about the value of y). (See Diagram E.).

### 1.12.2 Calculation of the Pearson's Correlation Coefficient

In a nutrition study in a large rural district, a sample of 20 children 5 years of age were weighed and their family incomes estimated. The results were as follows:

**Table 1.6: Weights and family incomes of 20 children 5 years of age**

| Serial Number | Family Income in $ Per year | Weight in kg | Serial Number | Family Income in | Weight in kg $ Per year |
|---|---|---|---|---|---|
| 1. | 130 | 15.5 | 11. | 225 | 18.1 |
| 2. | 200 | 19.8 | 12. | 95 | 17.4 |
| 3. | 345 | 21.5 | 13. | 130 | 17.9 |
| 4. | 245 | 18.8 | 14. | 330 | 17.0 |
| 5. | 155 | 12.8 | 15. | 295 | 18.7 |
| 6. | 300 | 18.8 | 16. | 170 | 16.0 |
| 7. | 360 | 18.1 | 17. | 250 | 18.2 |
| 8. | 105 | 18.7 | 18. | 355 | 16.4 |
| 9. | 80 | 13.1 | 19. | 220 | 15.4 |
| 10. | 275 | 20.1 | 20. | 175 | 17.6 |

The formula for calculating of the correlation coefficient is as follows:

$$r = \frac{\sum_{i=1}^{n}(X_i - \overline{X})\left(Y_i - \overline{Y}\right)}{\sqrt{\sum_{i=1}^{n}(X_i - \overline{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \overline{Y})^2}}$$

$$r = \frac{\sum_{i=1}^{n}(X_i - \overline{X})\left(Y_i - \overline{Y}\right)}{\sqrt{\sum_{i=1}^{n}(X_i - \overline{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \overline{Y})^2}}$$

$$r = \frac{\sum X_i Y_i - (\sum X_i \sum Y_i)/n}{\sqrt{\sum_{i=1}^{n} X_i^2 - \frac{\left(\sum_{i=1}^{n} X_i\right)^2}{n}}\sqrt{\sum_{i=1}^{n} Y_i^2 - \frac{\left(\sum_{i=1}^{n} Y_i\right)^2}{n}}}$$

It would be more informative to investigate whether the two variables 'family income' and 'weight of five-year-olds' are associated.

In our example of weight and family income, this would mean:

$$r = \frac{79416.5 - \frac{4440 \times 349.9}{20}}{\sqrt{1141550 - \frac{19713600}{20}}\sqrt{6210.77 - \frac{122430}{20}}}$$

r = 0.466

which is positive (indicating an upward sloping line), but away from 1 (indicating that there is plenty of scatter around the line) showing that there is a positive relation between 'family income' and 'weight of five-year-olds', however the relationship is not strong.

### 1.12.3 The Significance of the Correlation Coefficient

The value of r was calculated from a sample of just 20 children. The result is, therefore, subject to sampling error, and is unlikely to be equal to the true value of r, which we would obtain if we measured all 5-year-old children in this district. The question arises as to whether there really is any relationship at all between weight and income. Perhaps, in the entire population of 5-year-old children, the scatter diagram would look like diagram 'E', above, (no relationship between y and x) and the positive relationship in our sample occurred by chance. To assess whether this is the case we do a significance test on r. The null hypothesis is

$H_0$: There is no relationship between X and Y

$H_1$: There is significant relationship between X and Y

To do the test we calculate

$$t_{n-2} = r \times \sqrt{\frac{n-2}{1-r^2}}$$

We compare this value of t to tables of the t distribution with (n - 2) degrees of freedom, where n is the number of observations.

In our example: n = 20, r = 0.466, $t_{18} = 0.466 \times \sqrt{\frac{18}{1-0.466^2}} = 2.23$

Therefore, using $\alpha$ value of 0.05, the t-table value for 18 degrees of freedom ($t_{18}$; $_{0.05}$) = 2.10. Thus the calculated t-value is more than the table value; therefore we reject the null hypothesis and accept the alternative hypothesis that the linear relationship is statistically significant.

## 1.13 REGRESSION ANALYSIS

A simple linear regression involves finding the equation of a line in such a way that if the observations are plotted in a scatter diagram, most of the observed points will lie close to the line and the sum of square of the distance between the line and each of the observed points will be minimum.

### 1.13.1 Fitting the Regression Line

Suppose there are $n$ data points $\{y_i, x_i\}$, where $i = 1, 2, \ldots, n$. The goal is to find the equation of the straight line,

$$y = \alpha + \beta x,$$

Where α = the intercept of the regression line

ß = the slope of the regression line

which would provide a best fit for the data points. Here the best fit will be understood as a line that minimizes the sum of squared residuals of the linear regression model.

By using calculus, it can be shown that the values of α and β that minimize the objective function $Q$ are

$$\hat{\beta} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2} = \frac{\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{j=1}^{n} y_j / n}{\sum_{i=1}^{n}(x_i^2) - (\sum_{i=1}^{n} x_i)^2 / n}$$

$$= \frac{\overline{xy} - \bar{x}\bar{y}}{\overline{x^2} - \bar{x}^2} = \frac{\mathrm{Cov}[x, y]}{\mathrm{Var}[x]} = r_{xy}\frac{s_y}{s_x},$$

$$\hat{\alpha} = \bar{y} - \hat{\beta}\,\bar{x},$$

where $r_{xy}$ is the sample correlation coefficient between $x$ and $y$, $s_x$ is the standard deviation of $x$, and $s_y$ is correspondingly the standard deviation of $y$. $\overline{xy} = \frac{1}{n}\sum_{i=1}^{n} x_i y_i$ .

Sometimes people consider a simple linear regression model without the intercept term: $y = \beta x$. In such a case the OLS estimator for β will be given by the formula.

In the regression without the intercept

$$\hat{\beta} = \frac{\sum_{i=1}^{n} x_i y_i}{\sum_{i=1}^{n} x_i^2}.$$

In simple regression analysis, there is one quantitative dependent variable and one independent variable. In multiple regression analysis, there is one quantitative dependent variable and two or more independent variables. For example, one may derive a formula to predict production of wheat (dependent variable) from the quantity of seed, fertilizer, pesticide, number of irrigation etc., (independent variables). Linear regression statistics finds the best fit line (line of regression) that predicts dependent variable from independent variables. Linear regression statistics is applied to data where dependent variable is continuous, but independent variables are continuous and/or categorical variable. It is beyond the scope this study material to give more detailed information about the regression analysis.

### 1.13.2 How to Find the Regression Equation

In the table below, the xi column shows scores on the aptitude test. Similarly, the yi column shows statistics grades. The last two rows show sums and mean scores that we will use to conduct the regression analysis.

| Student | xi | yi | (xi - x) | (yi - y) | $(xi - x)^2$ | $(yi - y)^2$ | (xi - x) (yi - y) |
|---|---|---|---|---|---|---|---|
| 1 | 95 | 85 | 17 | 8 | 289 | 64 | 136 |
| 2 | 85 | 95 | 7 | 18 | 49 | 324 | 126 |
| 3 | 80 | 70 | 2 | -7 | 4 | 49 | -14 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | 70 | 65 | -8 | -12 | 64 | 144 | 96 |
| 5 | 60 | 70 | -18 | -7 | 324 | 49 | 126 |
| **Sum** | 390 | 385 | | | 730 | 630 | 470 |
| **Mean** | 78 | 77 | | | | | |

The regression equation is a linear equation of the form: $\bar{y} = \alpha + ßx$. To conduct a regression analysis, we need to solve for $\alpha$ and ß. The computations are shown below.

$\beta = 5\ [(xi - \bar{x})\ (yi - \bar{y})]\ /\ \sum\ [\ (xi - x)2]$ $\alpha = \bar{y} - ß^* \bar{x}$

$\beta = 470/730 = 0.644$ $\alpha = 77 - (0.644)(78) = 26.768$

Therefore, the regression equation is: $\bar{y} = 26.768 + 0.644x$.

### 1.13.3 How to Use the Regression Equation

Once you have the regression equation, using it is easy. Choose a value for the independent variable (*x*), perform the computation, and you have an estimated value ( $\bar{y}$ ) for the dependent variable. In our example, the independent variable is the student's score on the aptitude test. The dependent variable is the student's statistics grade. If a student made an 80 on the aptitude test, the estimated statistics grade would be

$\bar{y} = 26.768 + 0.644x = 26.768 + 0.644 * 80 = 26.768 + 51.52 = 78.288$

### 1.13.4 Difference between Regression and Correlation

| S.No. | Correlation | Regression |
|---|---|---|
| **1** | Correlation quantifies the degree to which two variables are related. You simply are computing a correlation coefficient (r) that tells you how much one variable tends to change when the other one does. | Regression finds out the best fit line for a given set of variables. |
| **2** | With correlation you don't have to think about cause and effect. You simply quantify how well two variables relate to each other. With regression, you do have to think about cause and effect as the regression line is determined as the best way to predict Y from X. | |
| **3** | With correlation, it doesn't matter which of the two variables you call "X" and which you call "Y". You'll get the same correlation coefficient if you swap the two. | With linear regression, the decision of which variable you call "X" and which you call "Y" matters a lot, as you'll get a different best-fit line if you swap the two. The line that best predicts Y from X is not the same as the line that predicts X from Y. |

| | | |
|---|---|---|
| **4** | Correlation is almost always used when you measure both variables. It rarely is appropriate when one variable is something you experimentally manipulate. | With linear regression, the X variable is often something you experimentally manipulate (time, concentration...) and the Y variable is something you measure. |
| **5** | In correlation, our focus is on the measurement of the strength of such a relationship. | In regression analysis, we examine the nature of the relationship between the dependent and the independent variables. |
| **6** | In correlation, all the variables are implicitly taken to be random in nature. | In regression, at our level, we take the dependent variable as random, or stochastic, and the independent variables as non-random or fixed |

**Use of Data Reduction Methods in Development Research**

There are also some of the data reduction techniques that are extensively used in development studies but are not within the scope of this unit. One of such technique is the Principal Component Analysis which is very commonly used. This technique is generally used when the number of explanatory variables is very high. In Principal Component Analysis, the variables are compressed to get a lesser number of variables called the principal components. There are statistical softwares which can be used to easily work out the Principal Component Analysis. For example a researcher has identified 20 variables that influence a farmer's adaptation to climate change. He may use principal component analysis which will help in grouping similar variables into one component thus reducing the number of variables. The analysis may thus identify just three or four principal components into which all these variables can be grouped. The first principal component will amount for maximum amount of variation out of the existing variables followed by the second, third and the fourth. This kind of analysis helps the researcher to identify those variables which if worked upon would increase the adaption of the farmers to climate change.

In this section you have read about correlation and regression analysis. Now try and answer the questions given in *Check Your Progress-5.*

**Check Your Progress 5**

N**ote:** a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit

1. Differentiate between correlation and regression.

.....

.....

.....

## 1.14 LET US SUM UP

Statistics is a science that deals with the collection, organization, analysis, interpretation, and presentation data. The information or data collected may be classified as qualitative and quantitative. It may also be classified as discrete or continuous. Frequency distribution is an improved way of presenting a data. For better and more concise presentation of the information contained in a data set, the data is subjected to various calculations. If one wants to further summarize a set of observations, it is often helpful to use a measure which can be expressed in a single number like the measures of location or measures of central tendency of the distribution. The three measures used for this purpose are the mean, median, and mode. Measures of dispersion, on the other hand, give an idea about the extent to which the values are clustered or spread out. In other words, it gives an idea of homogeneity and heterogeneity of data. Two sets of data can have similar measures of central tendency but different measures of dispersion. Therefore, measures of central tendency should be reported along with measures of dispersion. The measures of dispersion include range, percentiles, mean deviation and standard deviation.

The results we obtain by subjecting our data to analysis may actually be true or may be due to chance or sampling variation. In order to rule out chance as an explanation, we use the test of significance. In this unit we have confined our discussion to four tests i.e. $\chi^2$ test, Z- test, t-test and f-test.

Correlation is relationship between the two sets of continuous data; for example relationship between height and body weight. Correlation statistics is used to determine the extent to which two independent variables are related and can be expressed by a measure called the coefficient of correlation. Regression, on the other hand, deals with the cause and effect relation between two sets of data. Simple linear regression fits a straight line through the set of *n* points in such a way that makes the sum of squared *residuals* of the model (that is, vertical distances between the points of the data set and the fitted line) as small as possible. The regression line, thus, obtained helps us to predict the value of dependent variable for a given value of independent variable.

**Annex I: Table of chi-square values**

| Degrees of freedom | $\chi^2$ value if $\alpha = 0.05$ | $\chi^2$ value if $\alpha = 0.01$ |
|---|---|---|
| 1 | 3.84 | 6.63 |
| 2 | 5.99 | 9.21 |
| 3 | 7.81 | 11.34 |
| 4 | 9.49 | 13.28 |
| 5 | 11.07 | 15.09 |
| 6 | 12.59 | 16.81 |
| 7 | 14.07 | 18.48 |
| 8 | 15.51 | 20.09 |
| 9 | 16.92 | 21.67 |
| 10 | 18.31 | 23.21 |
| 11 | 19.68 | 24.72 |
| 12 | 21.03 | 26.22 |

**Annexure-II: Table of the values**

| Degrees of freedom | t-value if chosen p ($\alpha$) = 0.05 | t-value if chosen p ($\alpha$) = 0.01 |
|---|---|---|
| 1 | 12.71 | 63.66 |
| 2 | 4.30 | 9.92 |
| 3 | 3.18 | 5.84 |
| 4 | 2.78 | 4.60 |
| 5 | 2.57 | 4.03 |
| 6 | 2.45 | 3.71 |
| 7 | 2.36 | 3.50 |
| 8 | 2.31 | 3.36 |
| 9 | 2.26 | 3.25 |
| 10 | 2.23 | 3.17 |
| 11 | 2.20 | 3.11 |
| 12 | 2.18 | 3.05 |
| 13 | 2.16 | 3.01 |
| 14 | 2.14 | 2.98 |
| 15 | 2.13 | 2.95 |
| 16 | 2.12 | 2.92 |
| 17 | 2.11 | 2.90 |
| 18 | 2.10 | 2.88 |
| 19 | 2.09 | 2.86 |
| 20 | 2.09 | 2.85 |
| 21 | 2.08 | 2.83 |
| 22 | 2.07 | 2.82 |
| 23 | 2.07 | 2.81 |
| 24 | 2.06 | 2.80 |
| 25 | 2.06 | 2.79 |
| 30 | 2.04 | 2.76 |
| 40 | 2.02 | 2.70 |
| 60 | 2.00 | 2.66 |
| 120 | 1.98 | 2.62 |
| Infinite | 1.96 | 2.58 |

## 1.15 KEYWORDS

**Independent variable:** the characteristic being observed or measured which is hypothesized to influence an event or outcome (dependent variable), and is not influenced by the event or outcome, but may cause it, or contribute to its variation.

**Dependent variable:** a variable whose value is dependent on the effect of other variables (independent variables) in the relationship being studied.

**Mean:** the mean (or, arithmetic mean) is also known as the average. It is calculated by totaling the results of all the observations and dividing by the total number of observations.

**Median:** the median is the value that divides a distribution into two equal halves. The median is useful when some measurements are in ordinal scale, i.e., much bigger or much smaller than the rest.

**Mode:** the mode is the most frequently occurring value in a set of observations. The mode is not very useful for numerical data that are continuous. It is most useful for numerical data that have been grouped. The mode is usually used to find the norm among populations.

**Range:** this can be represented as the difference between maximum and minimum value or, simply, as maximum and minimum values.

**Percentiles:** percentiles are points that divide all the measurements into 100 equal parts. The 30th percentile (P3) is the value below which 30% of the measurements lie. The 50th percentile (P50), or the median, is the value below which 50% of the measurements lie.

**Mean Deviation:** this is the average of deviation from arithmetic mean.

**Standard Deviation:** this denotes (approximately) the extent of variation of values from the mean.

**Parametric statistical test** is a test whose model specifies certain conditions about the parameters of the parent population from which the sample was drawn.

**Non-parametric statistical test** is a test whose model does not specify conditions about the parameters of the parent population from which sample was drawn.

**Normal Distribution:** The normal distribution is symmetrical around the mean. The mean, median, and mode assume the same value if observations (data) follows a normal distribution.

**Sampling Variation:** any value of a variable obtained from the randomly selected sample (e.g., a sample mean) cannot assume the true value in the population. The variation is called a sampling variation.

**Test of Significance:** a test of significance estimates the likelihood that an observed study result (e.g., a difference between two groups) is due to chance or real.

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## 1.17 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress-1**

1) There are two types of data: (i) qualitative data, viz., occupation, sex, marital status, religion, and; (ii) quantitative data viz., age, weight, height, income, etc. These may be further be categorized in two types viz., Discrete and continous datas.

2) The two types of variables are used in analysis of data are (i) independent variables which are not influenced by the event or outcome, but may cause it, or contribute to its variation and (ii) dependent variable whose value is dependent on the effect of other variables (independent variables) in the relationship, being studied.

**Check Your Progress-2**

**1)** The three measures of central tendency are the mean, median, and mode.

**2)** The measures of dispersion are range, percentiles, mean deviation and standard deviation.

**Check Your Progress-3**

**1)** In statistical terms, the assumption that no real difference exists between groups in the total study (target) population (or that no real association exists between variables) is called the Null Hypothesis ($H_o$). The Alternative Hypothesis ($H_1$) is that there exists a difference between groups or that a real association exists between variables.

**2)** Type I error ($\alpha$): We reject the null hypothesis when it is true, or a false positive error or type I error $\alpha$ (called alpha). It is the error in detecting true effect.

Type II error ($\beta$): We accept the null hypothesis when it is false, or a false negative error; or simply, type II error '$\beta$' (called beta) can be stated as failure to detect true effect.

**Check Your Progress-4**

**1)** The chi-square test can only be applied if the sample is large enough. The total sample should be at least 40 and the expected frequencies

in each of the cells should be at least 5. Unlike the t-test, the chi-square test can also be used to compare more than two groups. In that case, a table with three or more rows/columns would be designed, rather than a two-by-two table. The chi-square is always applied on absolute numbers but not on percentage values. The high chi-square value never means high association but it only means high probability of finding such a value and low chance of finding this chi-square value by chance. It may be very misleading to pool dissimilar data.

**2)** When dealing with paired (matched) observations, comparison of sample means is performed by using a modified t-test known as the **paired t-test**. In the **paired t-test,** differences between the paired observations (say, Post-test minus Pre-test, or matched observations of 2nd group minus 1st group) are used instead of the observations of two sets of independent samples.

**Check Your Progress 5**

**1)** Correlation statistics are used to determine the extent to which two independent variables are related and can be expressed by a measure called the coefficient correlation. Correlation coefficient may be positive or negative and may vary from -1 to +1. In simple regression analysis, there is one quantitative dependent variable and one independent variable. In multiple regression analysis, there is one quantitative dependent variable and two or more independent variables.

# UNIT 2 USE OF COMPUTER IN DATA ANALYSIS

**Structure**

2.1 Introduction

2.2 Need for the Use of Computer in Data Analysis

2.3 Working with Excel

2.4 SPSS: An Overview

2.5 Data Management

2.6 Using Descriptive Statistics to Describe Your Data

2.7 Testing of Hypothesis Using SPSS

2.8 Multiple Regression Using SPSS

2.9 Let US Sum Up

2.10 References and Selected Readings

2.11 Check Your Progress – Possible Answers

## 2.1 INTRODUCTION

Data analysis is an integral part of any research and more particularly of development research. It is a process of applying statistical or logical techniques to describe, illustrate, condense or evaluate data. In this unit we will be dealing with data analysis on MS excel and SPSS. MS excel allows the creation, analysis and revision of data. Excel is a spreadsheet programme, used for data analysis, in the Microsoft Office system. Excel offers a variety of functions like tracking data, building models for analyzing data, writing formulas to perform calculations on the data, pivot the data in numerous ways and present the data in a number of chart forms. SPSS or Statistical Package for Social Sciences is a windows based programme that can be used for data entry and analysis and also to create tables and graphs. SPSS is a comprehensive and flexible statistical analysis and data management solution. SPSS can take data from almost any type of file and use them to generate tabulated reports, charts, and plots of distributions and trends, descriptive statistics, and conduct complex statistical analyses. You will find SPSS customers in virtually every industry, including telecommunications, banking, finance, insurance, healthcare, manufacturing, retail, consumer packaged goods, higher education, government, and market research.

After reading this unit you will be able to:

- feed data on MS Excel and work out mean and standard deviation;
- prepare a chart using MS Excel;
- feed your research on SPSS;
- manage and do basic transformations needed for your research on SPSS;
- calculate descriptive for your data on SPSS;
- perform testing of hypothesis on SPSS;
- work out correlation on SPSS; and
- work out regression analysis on SPSS.

## 2.2 NEED FOR THE USE OF COMPUTER IN DATA ANALYSIS

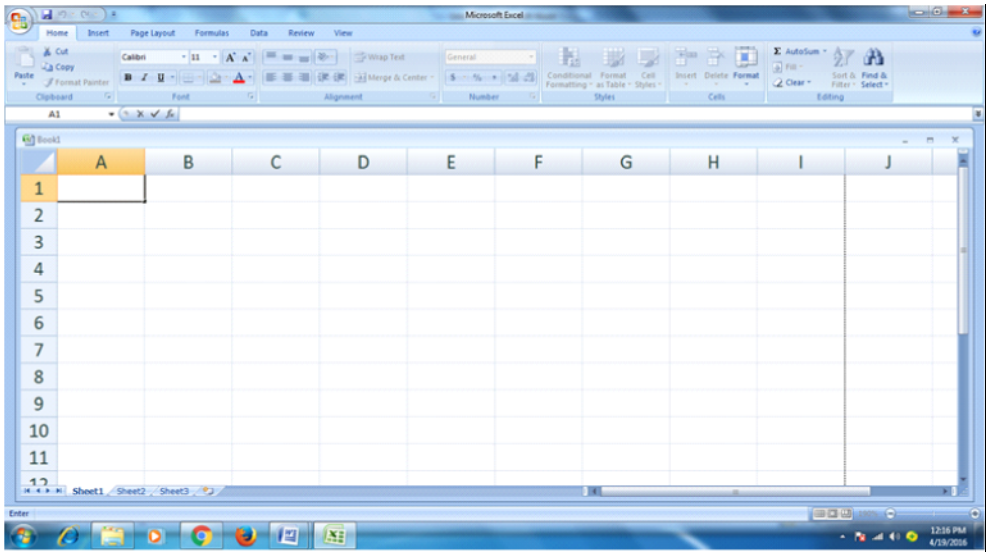
In research, you are required to handle a lot of data. Handing a small data on a piece of paper with the use of a calculator is easy but imagine calculating mean of a variable for 200 or more data. Using a calculator in this case would not just be time consuming but you are also in the danger of making mistakes. You may just punch in a wrong number and not notice it. Such mistakes can lead to erroneous results. Wrong results can render your research meaningless and hence you need to be very cautious in your data analysis and interpretation. Using computer to analyse your data will not just speed up the process of data analysis but also help in reducing the errors. Some of the advantages of use of computers in data analysis is given below:

1. It helps in reducing/eliminating errors in calculation
2. It helps in better data management as you can easily add or delete variables and observations, code and recode values etc.
3. It is very easy to depict the results in graphs and charts
4. Several users can work on the same set of data simultaneously by sharing the data file
5. It is a faster and more efficient way of handling data

## 2.3 WORKING WITH EXCEL

### 2.3.1 Excel Worksheet

An excel worksheet is a two dimensional grid comprising of rows and columns. The columns are named alphabetically and the rows are numbered. The cells in the first row will be referred to as A1, B1, C1, and so on and the cells in the first ***column will be referred to as*** A1, A2, A3, and so on. Each excel file is a workbook which is a collection of worksheets. By default, a workbook contains three worksheets which are named as sheet1, sheet 2 and sheet 3. You can use the arrow key to move up, down, right or left from the current cell. Enter key can be used to move one cell down from the current position and the tab key can be used to move one cell to the right.



In order to select a cell, click in the cell and in order to select a group of cells, click in a corner cell and, with the left mouse button depressed, drag the cursor horizontally and/or vertically until all of the cells you want selected are outlined in black. To select multiple cells that are not contiguous, press and hold the Ctrl key while clicking in the desired cells. To select every cell in the worksheet, click in the upper right corner of the worksheet to the left of "A." .

### 2.3.2 Entering Data in a Worksheet

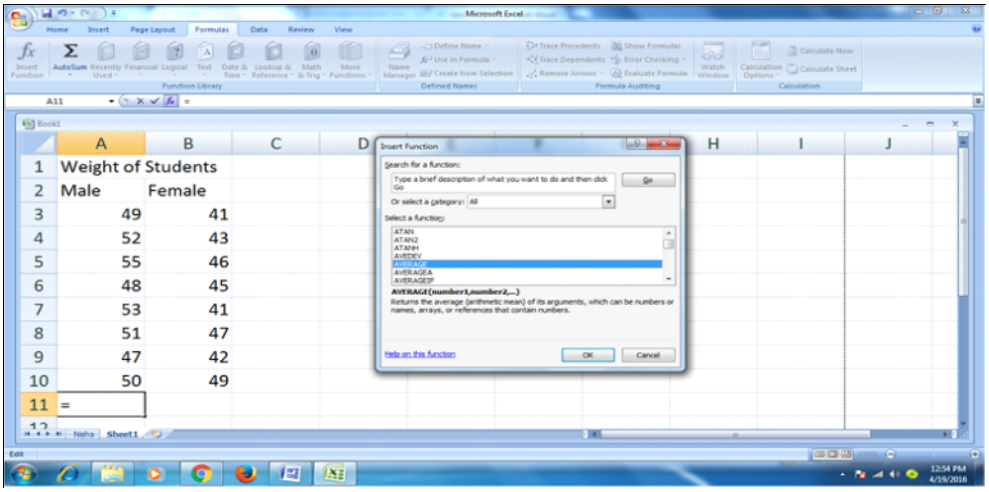
To enter data in a cell, you just need to click in that cell and type. The contents in a cell can be edited by double clicking in the desired cell and then making the needed correction. To insert a new row in a worksheet, right click on the row number and click insert. A new row will be added above the row that was clicked. To delete a row, right click on the row number and click delete. In the same way, to insert a new column, right click on a column head and click insert. A new column will be inserted to the left of the column that was clicked. To delete a column, right click on the column letter and click delete.

Worksheet tabs are found at the bottom of the workbook, towards the left. If you want to open any particular worksheet within a workbook, you just need to click on that particular worksheet tab. It is also possible to rename the worksheet. In order to rename a worksheet, you need to right click on the worksheet tab and click on the rename option. The new name can then be entered. In order to insert an additional worksheet, right click on the worksheet tab and click insert. A new worksheet will be inserted towards the left. Similarly, to delete an existing worksheet, right click on that worksheet tab and click delete. The positions of the worksheet can also be changed by left clicking on the worksheet tab and then dragging it to the desired position.

### 2.3.3 Basic Calculations on Excel

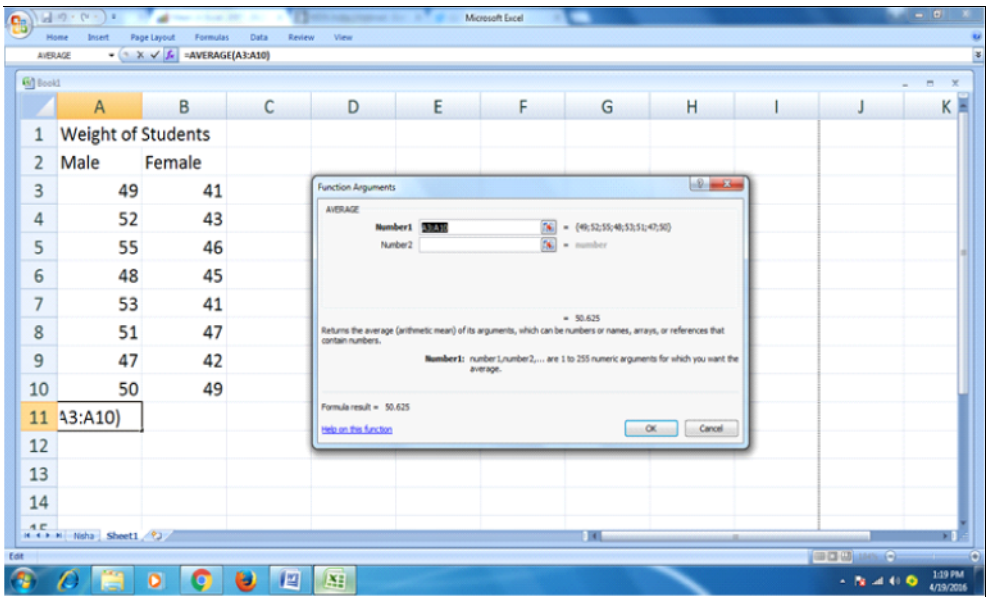
**Calculating Mean in Three Easy Steps**

We take a simple example in which we have the weights of 8 male and 8 female students. We need to calculate the average weight of male and female students.




**Step 1:** Click on the 'formula' tab on the top and then click 'insert function'.

**Step 2:** Select the option 'All' in the *Select a category* option so that all the available functions are displayed in the box under the heading *Select a function.* Select 'AVERAGE' function in the box and click **OK**.




**Step 3:** Another box titled *Function Arguments* opens. Within this box are options 'Number 1' and 'Number 2'. In 'Number 1' you need to select the numbers for which you want the average. This can be done by left clicking on the first number 40 and then dragging it upto the last number which is 50 in case of male students. Then press the **OK** button. It will give the average weight of eight male students as 50.625.

**Calculating Standard Deviation in Three Easy Steps**

**Step 1:** Click on the 'formula' tab on the top and then click 'insert function'.

**Step 2:** Select the option 'All' in the *Select a category* option so that all the available functions are displayed in the box under the heading *Select a function.* Select 'STDEV' function in the box and click **OK**.

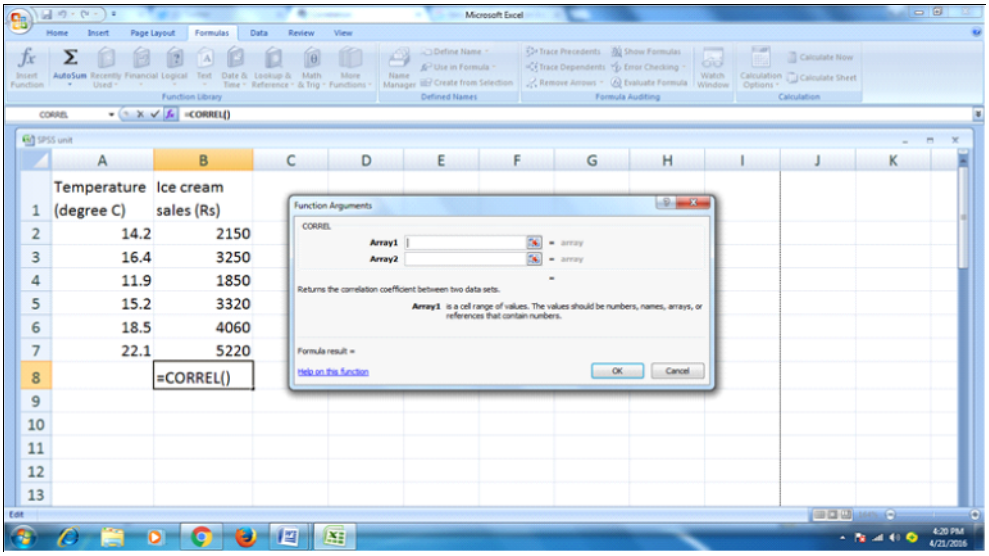
**Step 3:** Step 3: Another box titled *Function Arguments* opens. Within this box are options 'Number 1' and 'Number 2'. In 'Number 1' you need to select the numbers for which you want the average. This can be done by left clicking on the first number 40 and then dragging it upto the last number which is 50 in case of male students. Then press the **OK** button. It will give the standard deviation of the weight of eight male students which is 2.67. Similarly the standard deviation of female students works out to be 2.96.

**Calculating Correlation**

**Step 1:** Click on the 'formula' tab on the top and then click 'insert function'.

**Step 2:** Select the option 'All' in the *Select a category* option so that all the available functions are displayed in the box under the heading *Select a function.* Select 'CORREL' function in the box and click **OK**.

**Step 3:** Another box titled 'Function Arguments' opens which has two boxes 'Array1' and 'Array2'. Select the data on temperature for 'Array1' and the data on ice cream sales for 'Array2'. Then press the **OK** button. It will give the correlation between temperature and the corresponding ice cream sales as .976 indicating that there is a very high correlation between the temperature levels and sale of ice creams.




Similarly, you can do several other statistical and mathematical calculations using excel by selecting the desired function in the formula ⟶ insert function option.

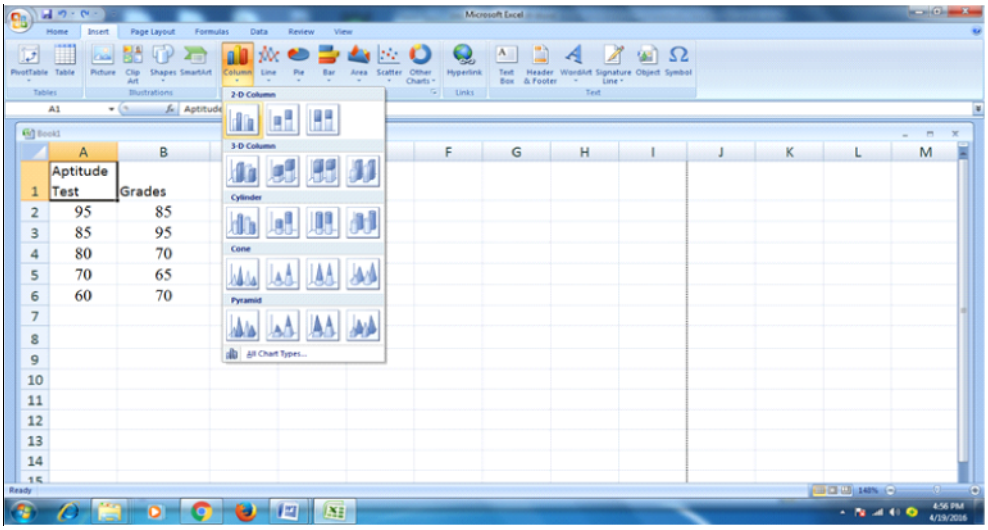
**Activity**

Feed the data of the weight of Female Students in the example shown in the picture above in Excel and work out the mean and standard deviation.

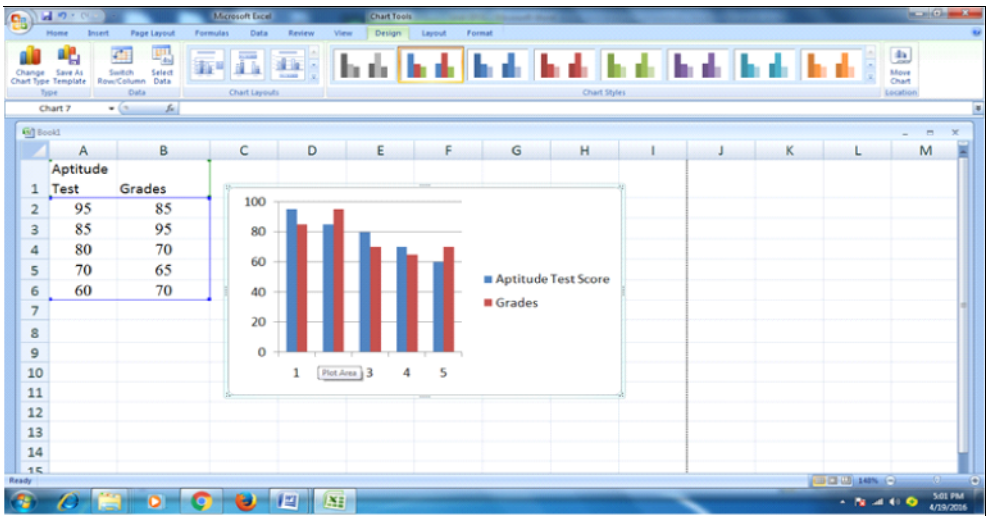
### 2.3.4 Charts in Excel

One of the most important and appealing features of excel is the charts. Charts make data visual. It is easy to present your results in charts using excel. We will see how to construct a simple 2D column chart using excel. You can explore other options like line, pie, bar, scatter and many other options available on excel in similar fashion.

In our example, we take the results of aptitude test scores and grades of five students and plot it in a simple 2D column chart.




**Step 1:** Go to 'Insert' and then on 'column'. A number of chart options within column chart will be displayed and you can click on the chart you wish to construct. We click on the first option shown which is the 2D column chart. We can get a chart at the click of a button.




Note: you can modify this chart as you desire.

1. To remove gridlines, right click on the grid line and click delete.

2. You can include the data labels (value of data on each bar) by selecting the bars by a left click on any of the bar. For example if you left click on any one of the bar representing grades, all the bars will be selected. Then right click and then click on the option 'insert data labels'. By default, the data labels appear on the top of the bar which may be repositioned by first selecting the data labels by a left click and then right click and click on the option 'format data labels'.

3. You can change the colour of the bars by selecting the bars with a left click. Then right click and select 'format data series', 'fill' and then 'solid fill'. Then choose the desired colour and click on the **close** button.

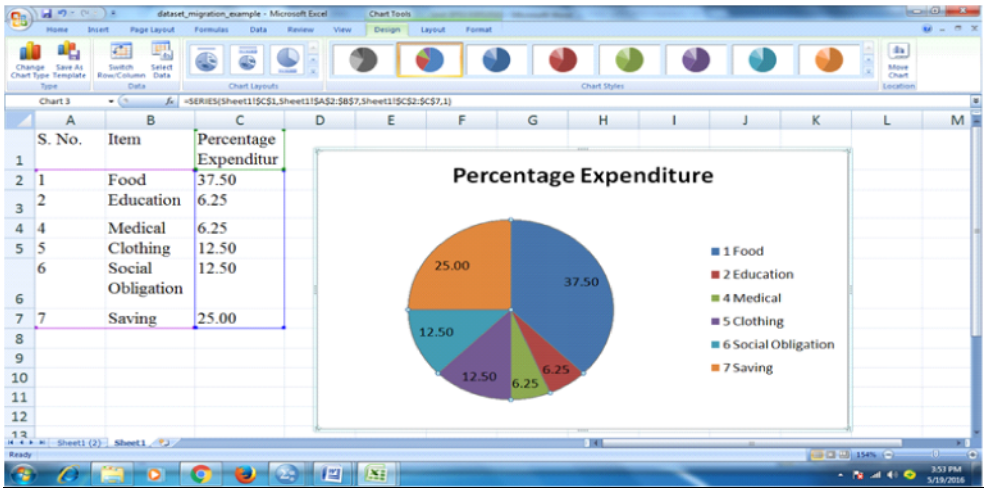
There are several other options available on excel to modify your chart to suit your style and liking.

Let us also see how you can use excel to draw a pie chart. For example, A survey of 100 vegetable vendors showed an average monthly consumption expenditure as follows:

| S. No. | Item | Expenditure | Percentage |
|---|---|---|---|
| 1. | Food | 3000 | 37.50 |
| 2. | Education | 500 | 6.25 |
| 4. | Medical | 500 | 6.25 |
| 5. | Clothing | 1000 | 12.50 |
| 6. | Social Obligation | 1000 | 12.50 |
| 7. | Saving | 2000 | 25.00 |

We can use excel to represent this in a pie chart by following steps.

**Step 1:** Go to 'Insert' and then on 'Pie'. You then have an option to choose a 2D or a 3D pie. Choose your option and click ok. You get a pie chart for the expenditure percentage as shown in the figure below:




Excel can be used to work out correlations, regression, carrying out tests of significance and several other purposes. In this section you have seen how to work out the basic calculations and charts. You can explore all the other options on Excel as the more you use it the more you learn.

## 2.4 SPSS: AN OVERVIEW

**SPSS files:**

SPSS covers a broad range of statistical procedures used in social sciences like data summarization, test of significance, determining relationship between variables, time series analysis and also graphs. SPSS has three main windows which allow you to i) see your data(data editor), ii) see your output (output viewer), and iii) see any programming commands that you have written(syntax editor). Each of these windows have a separate type of SPSS file. Let us look at each of these files and their functions.

1. **Data Editor (.sav files):**

   Data editor is used to enter data in a spreadsheet format. Data editor lets you see and manipulate your data. Data files are saved as a file type .sav. SPSS lets you to open many datasets simultaneously. Creating a data file will be dealt with in subsequent sessions.

2. **Output Viewer (.spv files):**

   As you command SPSS to perform various computations, the statistical results will show up in output viewer. The output viewer shows the tables and graphs that you create. Output viewer files are saved with they file type .spv.

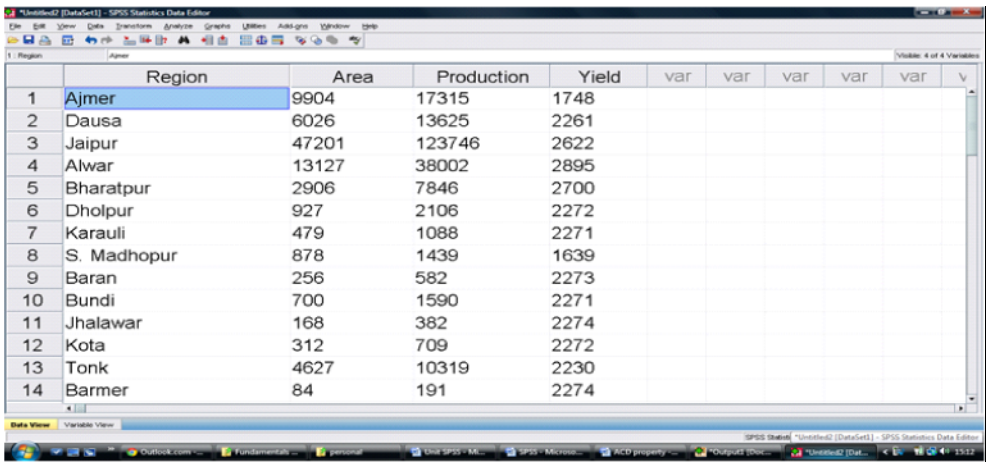
3. **Syntax editor (.spx files):**

   If you want to work on SPSS programming language directly, you will have to open the SPSS syntax editor. The syntax editor can be used to write, edit and run commands. If you are using menus and dialog boxes, the paste button automatically pastes the syntax for the command you have specified in the active syntax editor. The syntax files are saved as plain text and most of the text editors can open them with a file extension of .sps. More than one syntax editor can be opened at a time and in such cases when syntax is pasted from a dialogue box, it gets pasted in the active syntax editor. When all the syntax editors are closed, the paste command leads to opening of a fresh syntax editor.

1. **Working with Data Editor**

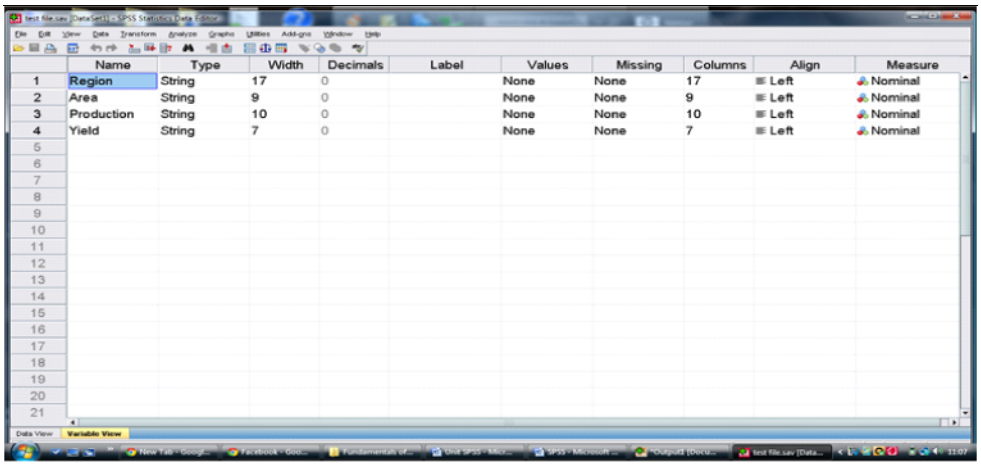
   Data editor is used to define variables, enter data and define or redefine the characteristics of the variables. The data editor gives you two views

of your data: **the data view** and **the variable view**. The relevant view can be selected from the tabs given at the lower left corner of the window.



| | Region | Area | Production | Yield | var | var | var | var | var |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Ajmer | 9904 | 17315 | 1748 | | | | | |
| 2 | Dausa | 6026 | 13625 | 2261 | | | | | |
| 3 | Jaipur | 47201 | 123746 | 2622 | | | | | |
| 4 | Alwar | 13127 | 38002 | 2895 | | | | | |
| 5 | Bharatpur | 2906 | 7846 | 2700 | | | | | |
| 6 | Dholpur | 927 | 2106 | 2272 | | | | | |
| 7 | Karauli | 479 | 1088 | 2271 | | | | | |
| 8 | S. Madhopur | 878 | 1439 | 1639 | | | | | |
| 9 | Baran | 256 | 582 | 2273 | | | | | |
| 10 | Bundi | 700 | 1590 | 2271 | | | | | |
| 11 | Jhalawar | 168 | 382 | 2274 | | | | | |
| 12 | Kota | 312 | 709 | 2272 | | | | | |
| 13 | Tonk | 4627 | 10319 | 2230 | | | | | |
| 14 | Barmer | 84 | 191 | 2274 | | | | | |

i. **The Data View:** In the data view, the data are laid in a rectangular format of rows and columns in which the columns represent the variables and each row represents a unit of observation. The data in a column should be of the same type ie. either numeric (numbers) or string (characters). Data values can be added by typing the values directly in the data view.

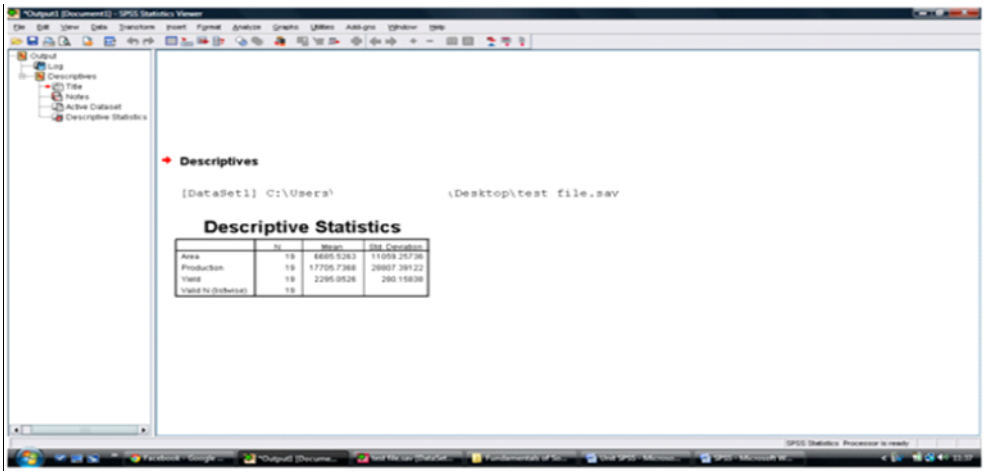


| | Name | Type | Width | Decimals | Label | Values | Missing | Columns | Align | Measure |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Region | String | 17 | 0 | | None | None | 17 | Left | Nominal |
| 2 | Area | String | 9 | 0 | | None | None | 9 | Left | Nominal |
| 3 | Production | String | 10 | 0 | | None | None | 10 | Left | Nominal |
| 4 | Yield | String | 7 | 0 | | None | None | 7 | Left | Nominal |

ii. **The Variable View:** You can easily switch between data view and variable view by clicking on the relevant button on the lower left corner. In the variable view you can edit the information that defines a variable. Each row of the variable view describes a column of the data view. The first attribute or the **Name** is how the data column is named or identified. The Name may contain characters, numerals, punctuation marks etc. However, *space* is considered as an illegal character while naming a variable. The **Type** of data is generally a numeric or a string but SPSS also provides with other options (comma, dot, scientific notation, currency etc.) by which you may define the type of your data. **Label** may be considered as a longer description of the variable name. **Values** allow you to create a list of value labels for example you may use 1 and 2 for male and female gender. If a researcher wants SPSS to designate certain data values as missing values, it can be done conveniently on SPSS using the missing attribute. For instance the researcher may give a number, say ‘8’ to all the responses in which respondent says “I don’t know” in response to a question, the researcher can have SPSS treat all 8s in a variable as missing data.

**2. Working with Output Viewer:**

All the statistical tables and graphs analysed in the data editor can be viewed in the output viewer. The output viewer consists of two sections: the one on the left is the outline pane and the one on the right is the tables pane. Whenever the output for any analysis is generated, it is added on the tables pane as object. Selection of an object can be done by clicking on it in the tables pane or clicking the corresponding entry in the outline pane. It is also possible to edit the objects on the table plane by double clicking on the object. To delete the object, simply select the object and press the **Delete** key. Double clicking an object in the outline pane can be used to hide an object from the tables pane. To rearrange or reposition any object on either pane, you just need to select the object and drag and drop the object at the place where you want it to be. You can also export your output by clicking **File àExport** in the output viewer. A new dialogue box will open and you can select the options regarding the portion of output and the type of file in which you want it to be saved.

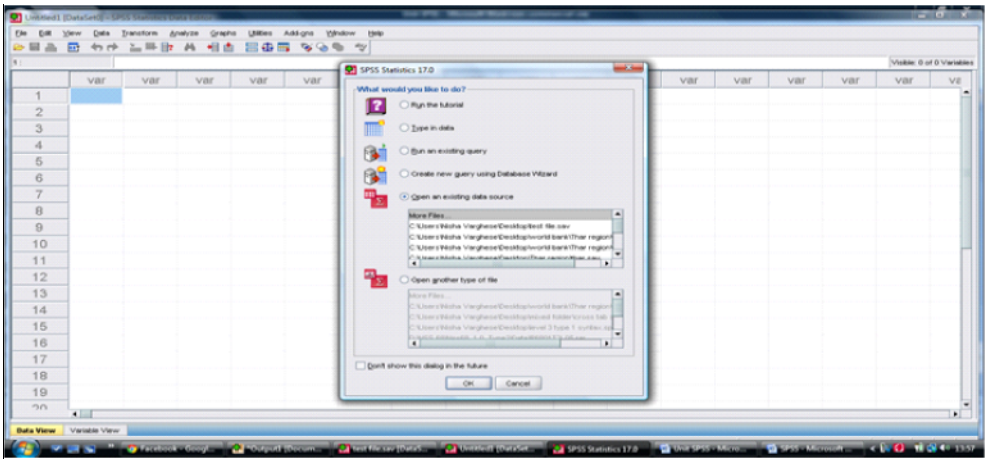



## 2.5 DATA MANAGEMENT

Once you have collected the data for your research, the next step would be to enter the data in appropriate format so as to facilitate statistical analysis. In this section you will read about data management in SPSS.

### 2.5.1 Creating a Data File

The first step is to create a data file. SPSS can also read files created by other programmes such as Microsoft Excel. When you first open the SPSS, you will be prompted to choose to either run a tutorial or type new data or open an existing file.



It is important to note here that the rows are used to enter information on respondents or cases and columns are used to enter variable information. For example you have to enter information on area, production and yield of a particular crop in 19 districts in Rajasthan, 'area, production and yield' will be represented in rows and districts in columns.

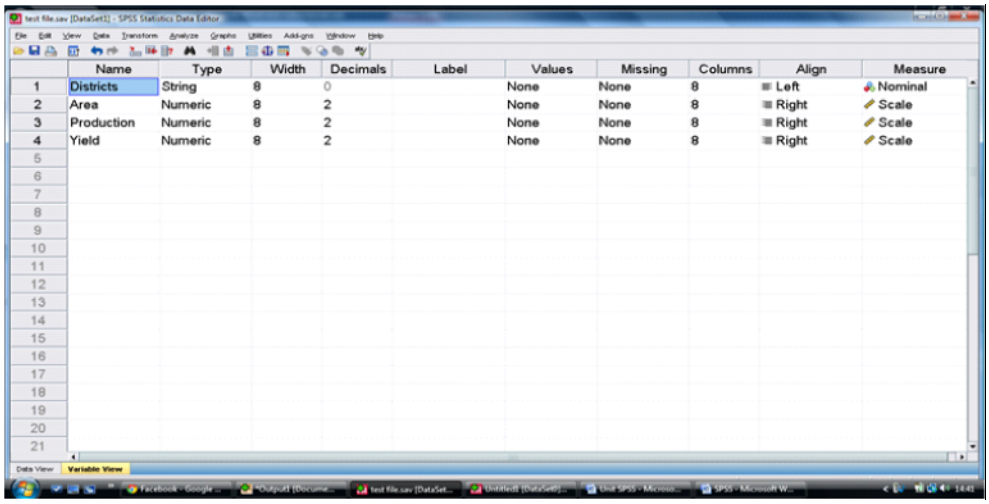
SPSS data editor will have two views: **Data view** and **Variable view** and you can select the relevant view by clicking at either of the option given at the bottom left of the window. To proceed logically, you would first click on the **Variable View**. Here you will define your variables.

Under **Name**, you would be required to type the desired variable name. While naming a variable, you need to take care that the first letter should be a alphabet and no spaces can appear in the variable name. The next is to define the type of the variable under the **Type** option. The functions and corresponding default values of each of these columns are given below:

**Characteristics of Variables and their Default Values:**

| **Characteristics of Variables** | **Explanation** | **Default value taken by SPSS** |
|---|---|---|
| Type | Data type: Numeric, date, string etc. | Numeric |
| Width | Total number of Characters | 8 |
| Decimals | Number of characters after decimal | 2 |
| Label | Description of Variable | None |
| Values | Give labels to different levels of variables | None |
| Missing | Enables you to designate certain data as missing | None |
| Columns | Maximum number of characters in a column | 8 |
| Align | Alignment of values in a given column | Right |
| Measure | Specifies the measurement scale of the variable | Scale |

**The picture below gives the details of the variable view for our dataset.**



| | Name | Type | Width | Decimals | Label | Values | Missing | Columns | Align | Measure |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Districts | String | 8 | 0 | | None | None | 8 | Left | Nominal |
| 2 | Area | Numeric | 8 | 2 | | None | None | 8 | Right | Scale |
| 3 | Production | Numeric | 8 | 2 | | None | None | 8 | Right | Scale |
| 4 | Yield | Numeric | 8 | 2 | | None | None | 8 | Right | Scale |

The next step would be to enter the data. The variable information entered in the variable view can be altered at later stage. Next click the **Data View** at the bottom left of the window. Once the variable information is ent in the variable view, you would be able to see all the variable names that you entered in the **Data View.** Now type the name of the districts and the data pertaining to area production and yield. Once you are done with entering the data, you need to save the data by clicking the **File → Save** option at the top left corner of the window. You can give a relevant name to the file when the dialogue box opens. The SPSS files are saved with **.sav** as suffix.

Some important tips in data management in SPSS:

You can open an existing data file by clicking **File → Open → Data** in sequence.

You can insert an additional variable/column by clicking at the column next to the desired place where you want to insert the variable, go to **edit** option at top and click **insert variable.** A new variable can be inserted by following these steps in both data and variable view.

In order to insert a new row, just above the selected row, click on the row above which you want to insert the additional row. Then click **edit** option at top and click **insert case.** A blank row will appear just above the selected row.

So far you have read about working with excel, an overview of SPSS and data management in SPSS. Now answer the questions given in *Check Your Progress-1*.

**Check Your Progress - 1**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. Eplain about data editor in SPSS?

.....

.....

.....

2. How will you include data lebels in a bar graph in excel?

.....

.....

.....

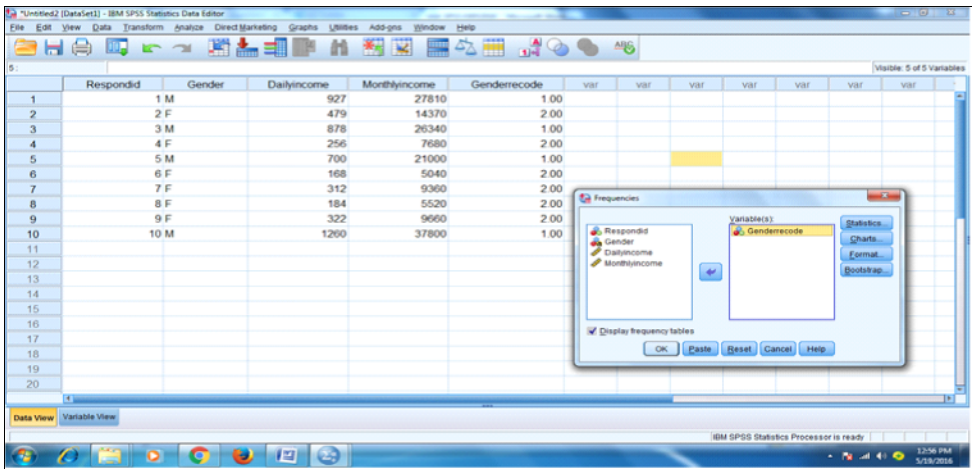
## 2.6 USING DESCRIPTIVE STATISTICS TO DESCRIBE YOUR DATA

Descriptive statistics are used to describe a variable and to study its summary measures life mean, median, mode and standard deviation. SPSS provides you an easy option to calculate all the descriptive simultaneously in one go. The steps for calculating descriptive statistics are as follows:

**1. Frequency**

i. In order to calculate frequencies, the following ste1ps need to be followed. Click on **Analyse** on the main menu and **Descriptive Statistics**

followed by **Frequencies** on the sub menu. A dialogue box will open. Shift the desired variable in the **Variable(s)** text box and click **OK.**




ii. The gender has been recoded as 1 for Males and 2 for Females. The results will be displayed in the output file. The results of working out frequencies of the variable gender using SPSS will be as under

**Genderrecode**

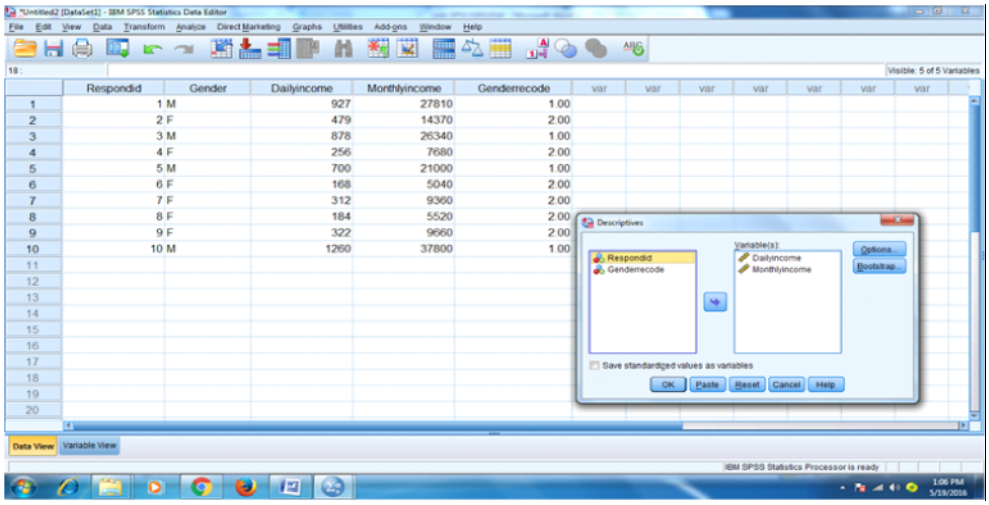
| | Frequency | Percent Percent | Valid Percent | Cumulative |
|---|---|---|---|---|
| 1.00 | 4 | 40.0 | 40.0 | 40.0 |
| Valid 2.00 | 6 | 60.0 | 60.0 | 100.0 |
| Total | 10 | 100.0 | 100.0 | |

iii. This shows that in the given data there are 4 males and 6 females.

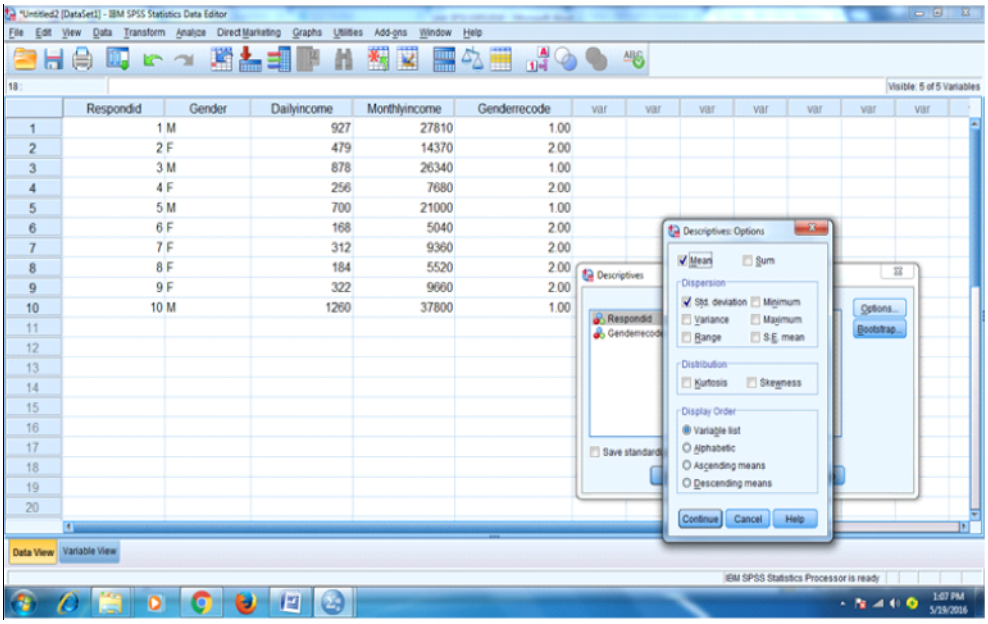
**2. Descriptive Statistics**

Descriptive statistics includes calculation of various measures of central tendency and measures of dispersion. These can be calculated by following the steps given below:

i. Click **Analyze, Descriptive Statistics** and **Descriptives**. This will open a dialogue box in which you move the variables whose descriptives need to be calculated by shifting them to the **Variable(s)** text box. In this example we have shifted the daily income and monthly income to the variable box.



ii. Click on the **Options** button to get another dialogue box. Then select the desired statistics by clicking the appropriate check boxes. In this example we have checked the Mean and Standard Deviation. Click **Continue** to go back to the previous dialogue box and then click **OK**. In this example, we have selected Mean and Standard Deviation.




iii. The results will be displayed in the output file. The Mean and Standard Deviation for daily income and monthly income as calculated using SPSS are as given:

**Descriptive Statistics**

| | N | Mean | Std. Deviation |
|---|---|---|---|
| Dailyincome | 10 | 548.60 | 373.613 |
| Monthlyincome | 10 | 16458.00 | 11208.383 |
| Valid N (listwise) | 10 | | |

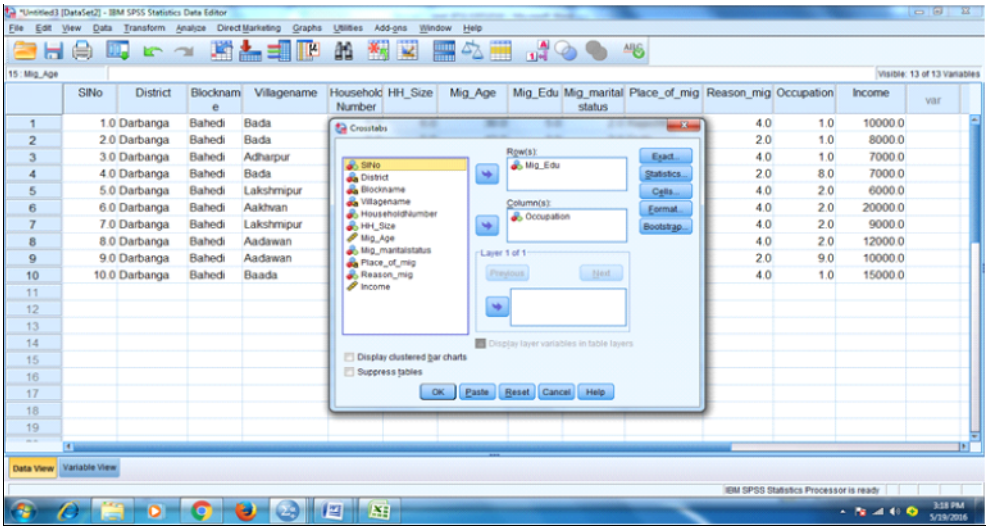
## 3. Crosstabs

The **Crosstabs** command is used to get information on the intersection of two or more categorical variables. While information on each level of one categorical variable can be obtained by working out frequencies but it does not provide information on intersection of two variables. This can be done using the crosstabs command as follows:

i. For example in a given data set we want to cross tabulate migrant education and their occupation.

ii. Click **Analyze, Descriptive Statistics** and **Crosstabs**. A dialogue box opens. Select **Mig_Edu** and move it to the **Rows** list box and select **Occupation** and move it to the **Columns** list box.

iii. Click Cells button which opens another dialogue box. This dialogue box allows you to select additional information you want to compute for the selected variables. Select the relevant information and click **Continue** button to go to the previous dialogue box and then click **OK**.



iv. The result that we get in the output file is as under.

**Migrant Education** was classified into 9 categories viz. 1. Illiterate, 2. Literate with formal education, 3. Primary, 4. Matriculate, 5. Intermediate, 6. Technical Education, 7. Graduate, 8. Post Graduate, 9. Others.

**Migrant occupation** was classified as 1. Unskilled worker, 2. Skilled worker, 3. Shopkeeper, 4. Self Employed, 5. Salesman, 6. Officer/ executive, 7. Software Professional, 8. Others, 9. Unemployed.

Thus in this example, out of a total of 4 literates with formal education, one was employed as unskilled worker, 2 were working as skilled workers and one was engaged in other occupation not listed here.

**Mig_Edu * Occupation Crosstabulation**

Count

| | | Occupation | | | | Total |
|---|---|---|---|---|---|---|
| | | 1.0 | 2.0 | 8.0 | 9.0 | |
| Mig_Edu | 2.0 | 1 | 2 | 1 | 0 | 4 |
| | 3.0 | 2 | 2 | 0 | 0 | 4 |
| | 4.0 | 0 | 0 | 0 | 1 | 1 |
| | 5.0 | 1 | 0 | 0 | 0 | 1 |
| Total | | 4 | 4 | 1 | 1 | 10 |

## 2.7 TESTING OF HYPOTHESIS USING SPSS

SPSS can also be used for testing of hypothesis. A hypothesis is a statement about the population. Testing of hypothesis helps in establishing the truth about the statement made about the population.

### 1. One Sample t Test

One sample t test is used to test if the observed mean is different from the population mean. The hypothesis that is tested for its claim about the population parameter is called the null hypothesis. Another hypothesis which is the opposite of null hypothesis is the alternative hypothesis. This is accepted in case the hull hypothesis is rejected.

T test is used when the sample size is less than 30 and population standard deviation is not known. For example, a CFL tube manufacturing company claims that the average life of tube manufactured by them is 3000 hours. To test this claim, sample data is collected and analysed. Here

$H_0$: $\mu = 3000$

$H_1$: $\mu \neq 3000$

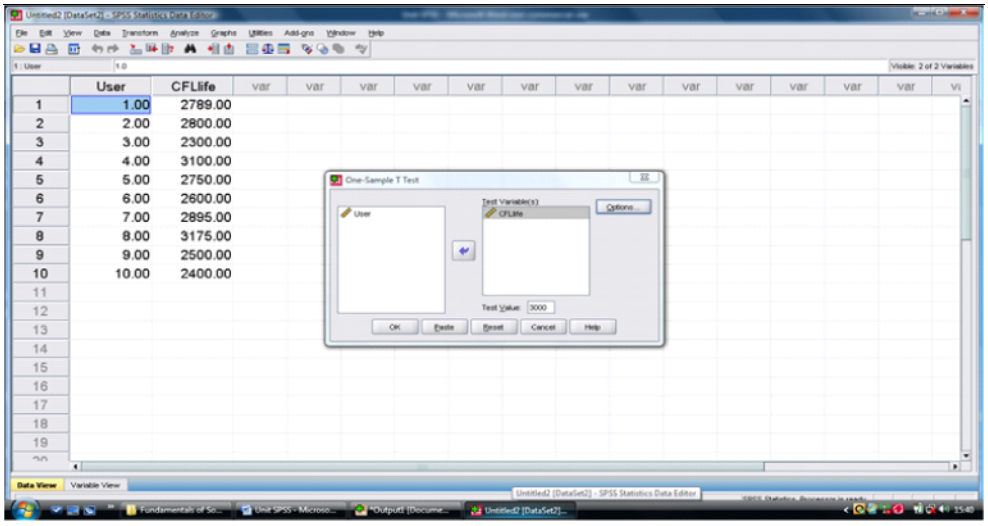
| User | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CFL life | 2789 | 2800 | 2300 | 3100 | 2750 | 2600 | 2895 | 3175 | 2500 | 2400 |

For the given data, one sample t test can be done as follows:

i. Enter the data in SPSS data editor.

ii. Click **Analyze, Compare Means, One Sample T Test.** A dialogue box will open. Move the variable **CFLlife** to the **Test Variable(s)** box.

iii. Click **Options** to set the confidence interval and then press **Continue** and then **OK**.




The test results on SPSS would give the following two sets of tables:

**One-Sample Statistics**

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| CFLlife | 10 | 2730.9000 | 285.68104 | 90.34028 |

**One-Sample Test**

| | Test Value = 3000 | | | | | |
|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | |
| | t | df | Sig. (2-tailed) | Mean Difference | Lower | Upper |
| CFLlife | -2.979 | 9 | .015 | -269.10000 | -473.4639 | -64.7361 |

The first table showing One Sample Statistics gives the summary measures and the second table on One Sample Test gives the test values. The

Significance value or the p value shows the risk of Type-1 error. Here the p value is less than .05 indicating that there is significant difference between the hypothesised mean and sample mean. Hence we reject the null hypothesis and thus the claim of the company that the average life of the CFL tubes manufactured by them is 3000 hours.

## 2. Independent Sample t-Test

This test is employed to study the difference in two groups. Some of the examples where independent sample t-test can be employed are to study the difference in productivity of high yielding varieties (HYV) between irrigated and unirrigated farms, gender differences in IQ levels etc.

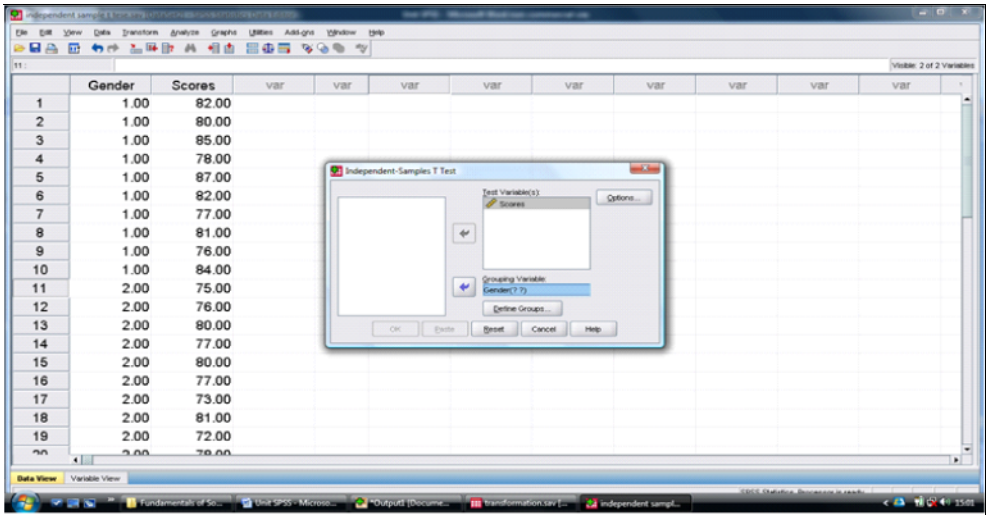
In order to take up an independent sample t test, the following steps need to be followed:

Eg. In a physical education class, the scores of males and females are compared. We need to find out if the mean score of men in class differ significantly from the mean score of women in the class.

| | Scores | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | 82 | 80 | 85 | 78 | 87 | 82 | 77 | 81 | 76 | 84 |
| Female | 75 | 76 | 80 | 77 | 80 | 77 | 73 | 81 | 72 | 78 |

i. Open the data file and click on **Analyze** from the command menu.

ii. Select **Compare Means** and **Independent Sample T-test** from the **Analyze** menu. The **Test Variable** is **Scores** and the grouping variable is **Gender** .




iii. To define groups, click on define groups to get a new dialogue box. Assign code 1 to group 1 (males) and 2 to group 2 (females).

iv. Click **Options** button to set the confidence interval of 95%. Click **Continue** and then **OK** to execute the command.

The output will have the following tables:

**Group Statistics**

| | Gender | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Scores | 1.00 | 10 | 81.2000 | 3.55278 | 1.12349 |
| | 2.00 | 10 | 76.9000 | 2.99815 | .94810 |

The **group statistics** table displays the summary measures of the selected variables. The second table displays the results of the t test. The first step is to look at the Levene's test to decide if you need to assume equal variance or not. The null and alternative hypothesis for Levene's test for equality of variances is as follows:

$H_0$: Variances of two groups are equal

$H_1$: Variances of two groups are unequal.

In this example, since the significance of F value is .571 which is higher than .05, we accept the null hypothesis. Thus in this example we need to interpret the results related to assumption of equal variance. The next step would be to interpret the t test. In this example, the t value is 2.925 and the significance level is .009 which is less than .05. Hence we reject the null hypothesis for equality of means. In other words, there is significant difference between the marks scored by males and females.

### 3. Paired Sample t-Test

This test is employed to test the difference in means of the dependent samples. Here, the observations are recorded on the same subject but at different points of time. For example, comparing the performance of the students before and after vacations, sales of a product before and after advertisement etc. These samples are very closely matched and hence are also called dependent sample t test.

Suppose 20 students were given a test before and after studying a module. We want to find out if in general, reading our module, leads to improvement in student's knowledge levels. This can be done using paired t test. The scores of students before and after reading the module are given:

| Student | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre-module score | 18 | 21 | 16 | 22 | 19 | 24 | 17 | 21 | 23 | 18 | 14 | 16 | 16 | 19 | 18 | 20 | 12 | 22 | 15 | 17 |
| Post-module score | 22 | 25 | 17 | 24 | 16 | 29 | 20 | 23 | 19 | 20 | 15 | 15 | 18 | 26 | 18 | 24 | 18 | 25 | 19 | 16 |

The null and alternative hypothesis for examining the difference in scores of students before and after reading the module is given as:

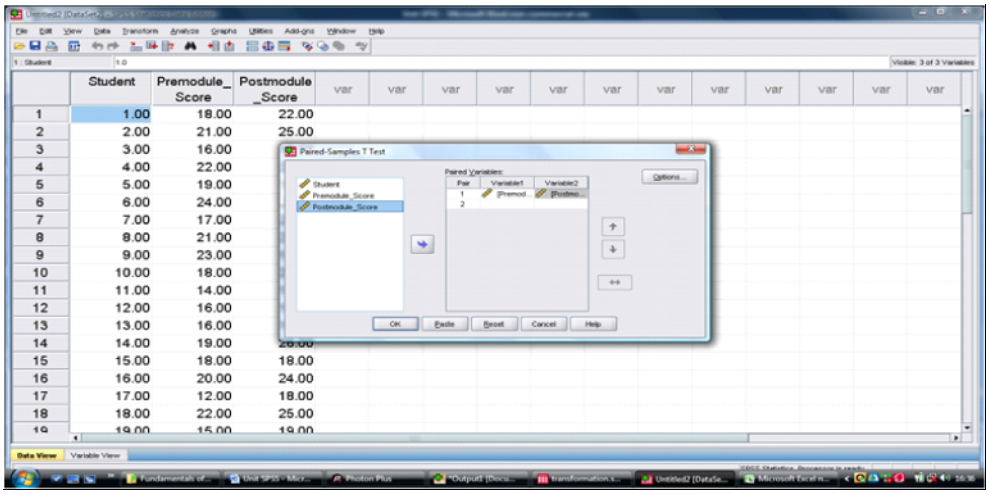
H0: There is no difference in the marks scored before and after reading the module.

H1: There is difference in the marks scored before and after reading the module.

This can be done using SPSS by following these steps:

i. Open the data file. Click on **Analyze**, **Compare Means** and **Paired Samples t-test**. A dialogue box opens.

ii. Select the two variables **Pre-module Score** and **Post-module Score** and shift them to **Paired Variable** list box. Click on **Options** button and set the confidence interval, click **Continue** and then **OK**.




SPSS gives the following output tables:

**Paired Samples Statistics**

| | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| Pair 1 Premodule_Score | 18.4000 | 20 | 3.15228 | .70487 |
| Postmodule_Score | 20.4500 | 20 | 4.05845 | .90750 |

**Paired Samples Correlations**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | Premodule_Score & Postmodule_Score | 20 | .717 | .000 |

**Paired Samples Test**

| | Paired Differences | | | | | t | df | Sig. 2-tailed) |
|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 Premodule_ Score - Postmodule_ Score- | 2.0500 | 2.8372 | .63443 | -3.37787 | -.72213 | -3.231 | 19 | .004 |

**Paired Samples Statistics** table displays the summary measures.

**Paired Samples Correlation** table gives the correlation between the scores before and after reading of the module.

**Paired Sample Test** table gives the t value of -3.231 with associated significance value of .004 which is less than .05. Therefore we reject the null hypothesis and can say that there is improvement in marks scored after reading the module as compared to marks scored before reading the module.

### 4. Chi square Test:

Chi square test measures the association between two or more categorical variables. Chi square tests the hypothesis whether two or more sample drawn from the same population have similar characteristics. Chi square test is used to test statistical significance of results reported in bi-variate tables.

For example, there are 125 children who are three television commercials for breakfast cereals and are asked to pick any one of the three which they liked best. The results are shown in the following table:

| Gender | Cereals | | | Total |
|---|---|---|---|---|
| | A | B | C | |
| Boys | 30 | 29 | 16 | 75 |
| Girls | 12 | 33 | 5 | 50 |
| Total | 42 | 62 | 21 | 125 |

You would like to know if the choice of commercial was related to the gender of the child.

The null and the alternative hypothesis would be defined as follows:

$H_0$: There is no association between gender and choice of commercial

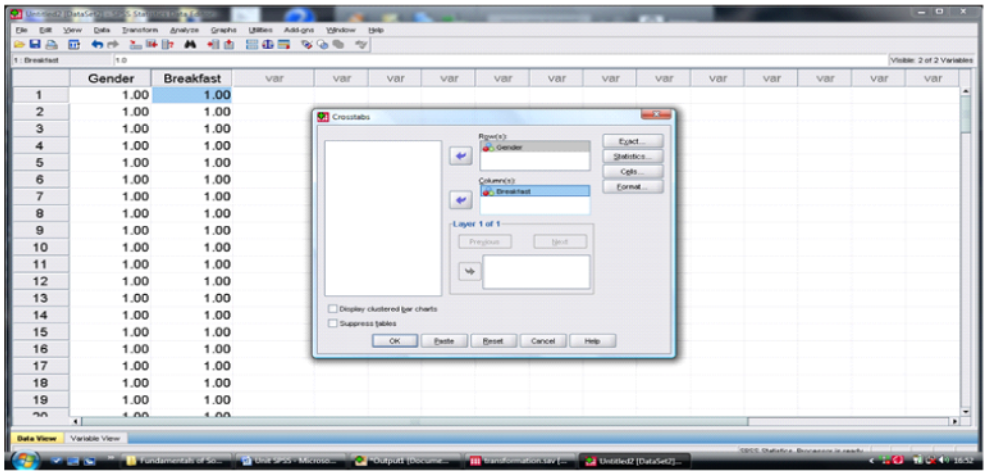
$H_1$: There is association between gender and choice of commercial

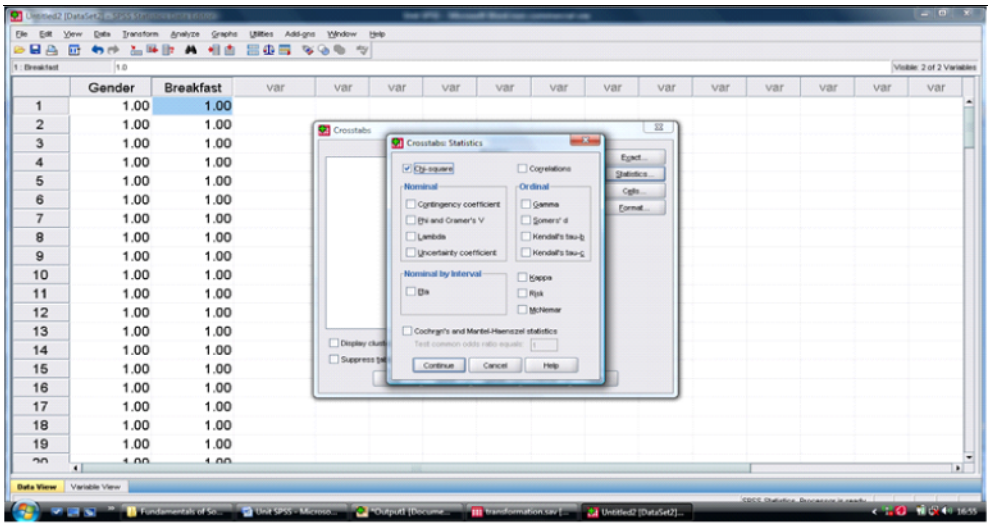
Procedure to conduct Chi square test is as follows:

i. Click **Analyze, Descriptives** and **Crosstabs**. A dialogue box will open.

ii. Select **Gender** and move it into the **Row** list box and **Location** in the **Column** list box.

iii. Click **Statistics** button to get another dialogue box. Select **Chi square** check box and then click **Continue** and then **OK**.





You will get the following output tables:

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Gender * Breakfast | 125 | 98.4% | 2 | 1.6% | 127 | 100.0% |

**Gender * Breakfast Crosstabulation**

Count

| | | Breakfast | | | Total |
|---|---|---|---|---|---|
| | | 1.00 | 2.00 | 3.00 | |
| Gender | 1.00 | 30 | 29 | 16 | 75 |
| | 2.00 | 12 | 33 | 5 | 50 |
| | Total | 42 | 62 | 21 | 125 |

**Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 9.098[a] | 2 | .011 |
| Likelihood Ratio | 9.254 | 2 | .010 |
| Linear-by-Linear Association | .136 | 1 | .712 |
| N of Valid Cases | 125 | | |

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.40.

Case Proceedings Summary table gives the summary information of the variables.

Crosstabulation of gender and breakfast is given in the second table showing 30 boys and 12 girls prefer the first option, 29 boys and 33 girls prefer the second option and 16 boys and 5 girls prefer the third option.

The Chi square test table gives the test results. The value of Pearson Chi Square is 9.098 and the associated significance is .011 which is less than .05. Therefore the null hypothesis is rejected and we can say that there is association between gender and breakfast commercial preference.

## 2.8 MULTIPLE REGRESSION USING SPSS

Regression analysis is one of the most widely used mathematical techniques. Regression is commonly used for prediction of values of the dependent variable based on the values of independent variables. Regression analysis with only one independent variable is called simple regression and one with more than one independent variable is called multiple regression.

A single variable regression line may be specified as

$Y = \alpha + \beta X_1$

A multiple regression model can be specified as

$$Y=\alpha + \beta_1X_1+ \beta_2X_2+ \beta_3X_3 + \beta_4X_4+.....+ \beta_nX_n$$

The null and alternative hypothesis for a regression analysis would be:

$H_0$: $\beta_i = 0$

$H_1$: $\beta_i = 0$

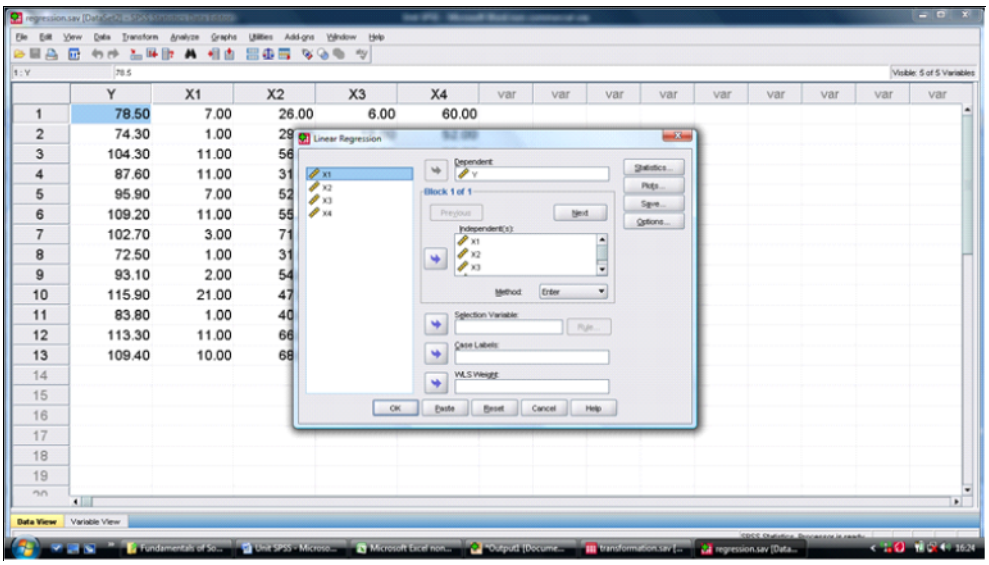
Let us see how multiple regression can be worked out on SPSS taking a hypothetical example in which Y is the dependent variable and X1, X2 and X3 are independent variables.

In order to do multiple regression, you need to follow the steps given below.

i. Click **Analyze, Regression, Linear** to get a dialogue box.

ii. Shift Y to the **Dependent** text box and X1, X2, and X3 to the **Independent(s)** text box. Prior to running the regression, you need to choose the method of regression which is to remove or retain the independent variables in the regression equation. If you are not very familiar with the methods, you can choose the default method **Enter**.

iii. Click **OK** button to execute the command.




The results are given below:

**Variables Entered/Removed**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 X3, X1, X2[a] | . | | Enter |

a. All requested variables entered.

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .600[a] | .360 | .343 | 6.162 |

a. Predictors: (Constant), X3, X1, X2

ANOVA[b]

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2473.601 | 3 | 824.534 | 21.716 | .000[a] |
| | Residual | 4404.365 | 116 | 37.969 | | |
| | Total | 6877.967 | 119 | | | |

a. Predictors: (Constant), X3, X1, X2

b. Dependent Variable: Y

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 60.029 | 2.644 | | 22.702 | .000 |
| | X1 | .005 | .003 | .116 | 1.558 | .122 |
| | X2 | .457 | .264 | .134 | 1.731 | .086 |
| | X3 | -.489 | .071 | -.533 | -6.888 | .000 |

a. Dependent Variable: Y

**Variables Entered/Removed** gives information about the independent variables that were entered and removed in the regression analysis. Since we have chosen the Enter method, all the four independent variables have been entered.

In **Model Summary**, R is the square root of R Square and R Square or coefficient of determination is the percentage of total variation of dependent variable that can be explained by the independent variables included in the model. It shows how well the regression line fits the data. In our example, the independent variables explain only 36 percent of variations in the dependent variable. Adjusted R square gives a more realistic picture of the fit of the regression line. Standard Error of the Estimate is the standard deviation of the error term in the model.

The **ANOVA** table is used to test the overall significance of the model. In this case, when we find that the F value is significant showing that the group of independent variables chosen in this model show a statistically significant relationship with the dependent variable.

In the **Coefficients** table, the first column gives a list of variables in the regression equation. The term **constant** refers to the intercept or the height of regression line when it crosses the Y axis. In other words, it gives the value that the dependent variable will assume when the value of all the independent variables is 0. **B** represents the values of the coefficients. Since the natural units of measurement of variables are taken hence the coefficients are known as unstandardized coefficients. Based on the coefficients, the estimated regression equation will be $Y = 60.029 + 0.457X_1 - 0.489X_2 + 0.005X3$. The standard error is to estimate the t value. The Standardized Beta coefficients are those that would be obtained if you standardized the X and the Y variables which means you arrange them on an identical scale and then execute the regression. The t and Sig. Column have the t value

and 2 tailed p-value which are used to accept or reject the null hypothesis, as the case may be. If you have Sig. Values or p-values less than or equal to .05, then those coefficients are statistically significant and you can reject the null hypothesis and say that the coefficients are significantly different from 0. In our example, the constant and coefficient for X3 are significant at 5 percent and the coefficient for X2 is significant at 10 percent. The coefficient for X1 is not significant.

So far you have read about the use of descriptive statistics in SPSS. You have also learned the usage of testing of hypothesis, correlation and regression using SPSS. Now answer the questions given in *Check Your Progress – 2.*

**Check Your Progress 2**

N**ote:** a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit

1. How will you calculate frequencies using SPSS?

   .....

   .....

   .....

2. Explain the use of crosstabs in SPSS.

   .....

   .....

   .....

## 2.9 LET US SUM UP

SPSS is a widely used and popular statistical package. The use of statistical package has become indispensable in research. In this unit you have read about the basics of SPSS. This unit deals with data feeding, analysis and interpretation of quantitative data. It makes use of elementary statistical techniques that are explained and put into use in SPSS with the help of lucid examples. Besides the data handling and analysis explained in this unit, SPSS has several other interesting and useful features. However, in this unit we have tried to cover the basic topics that are required by research students in performing statistical analysis. Students are however encouraged to explore other options available on SPSS and put them to use.

## 2.10 REFERENCES AND SELECTED READINGS

Pandya, K., Bulsari S. And Sinha S. (2014). SPSS in Simple Steps, Dreamtech Press, Delhi.

## 2.11 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress – 1**

1. Data editor is used to enter data in a spreadsheet format. Data editor lets you see and manipulate your data. Data files are saved as a file

type .sav. SPSS lets you to open many datasets simultaneously. Creating a data file will be dealt with in subsequent sessions.

You can include the data labels by selecting the bars by a left click on any of bar.

**Check Your Progress – 2**

1. In order to calculate frequencies, the following steps need to be followed. Click on **Analyse** on the main menu and **Descriptive Statistics** followed by **Frequencies** on the sub menu. A dialogue box will open. Shift the desired variable in the **Variable(s)** text box and click **OK.**

2. The **Crosstabs** command is used to get information on the intersection of two or more categorical variables. While information on each level of one categorical variable can be obtained by working out frequencies but it does not provide information on intersection of two variables. This can be done using the crosstabs command as follows:

   i) Click **Analyze, Descriptive Statistics** and **Crosstabs**. A dialogue box opens. Select **Gender** and move it to the **Rows** list box and select **Place** and move it to the **Columns** list box.

   ii) Click Cells button which opens another dialogue box. This dialogue box allows you to select additional information you want to compute for the selected variables. Select the relevant information and click **Continue** button to go to the previous dialogue box and then click **OK**.

# UNIT 3 DATA PROCESSING AND ANALYSIS

## Structure

3.1 Introduction

3.2 Data Measurement and Its Types

3.3 Tabulation and Interpretation of Data

3.4 Let Us Sum Up

3.5 Keywords

3.6 References and Selected Readings

3.7 Check Your Progress – Possible Answers

## 3.1 INTRODUCTION

The purpose of data analysis is to identify whether research assumptions were correct or not, and to highlight possible new views on the problem under study. The ultimate purpose of analysis is to answer the research questions outlined in the objectives with the collected data. However, before we look at how variables may be affecting one another, we need to summarize the information obtained on each variable in simple, tabular form, or, in a figure.

Some of the variables may produce numerical (continuous) data, while other variables produce categorical data. In analyzing our data, it is important, first, to determine the type of data that we are dealing with. This is crucial because the type of data used largely determines the type of statistical techniques that should be used to analyze the data. Once the data is processed, tables and graphs are prepared, then the report writing work may be initiated.

After studying this unit, you should be able to:

- define data and describe various types and nature of data.
- describe techniques of data processing, tabulation, and presentation.
- describe and interpret data from tables that have been generated.

## 3.2 DATA MEASUREMENT AND ITS TYPES

### 3.2.1 Data Measurement

Measurement is the process of observing and recording the observations that are collected as part of a research effort and the process of assigning numbers to objects or observations. But do we measure abstract concepts like happiness, quality of life, personality, opinion, etc? You have to understand that the qualities of good measurement are: (i) Precise; (ii) Unambiguous; (iii) Free from errors; (iv) Valid; (v) Reliable, and; (vi) Practical.

The tools, which are developed for measurement/ collection of data, should be

- valid to measure the characteristic which it is intended to measure
- reliable to the extent to which an experiment/ test/ or any measuring procedure yields the same result on repeated trials

- sensitive enough to detect differences in a characteristics
- specific enough to represent only the characteristic of interest
- appropriate to the objectives of the study
- provides adequate distribution of response in the study population
- meets the objective of the study

These are key points to keep in mind while developing effective tools for data collection. However, the following factors may affect the validity of the data, so remedial steps should be taken accordingly:

**Respondents:** reluctance, modesty, having little knowledge about details of the research problem to answer, may not admit ignorance, guessing about response, feel boredom due to long questioning, fatigue, and anxiety, etc.

**Situation:** lack of support to field investigators, lack of assurance on anonymity and confidentiality, etc.

**Investigator/ Interviewer:** may reword or reorder questions, style, and look, carelessness in filling the reply, incorrect coding, or calculation of scores.

**Instrument:** complex words, ambiguous meaning, poor printing, inadequate space for answer, response choice omission.

### 3.2.2 Types of Data

Data can be classified as either

i. Primary or secondary data

ii. Time series, cross section and panel data

iii. Categorical and numerical data

**i. Primary or Secondary Data**

**Primary Data**

Primary data means original data that have been collected specially for the purpose in mind. Research where one gathers this kind of data is referred to as field research. Tools used for gathering primary data,include a questionnaire, an interview schedule etc.

**Secondary Data**

Secondary data are data that have been collected for another purpose. Also, after performing statistical operations on primary data the results become known as secondary data. Research where one gathers this kind of data is referred to as desk research. The source for gathering secondary data include for example data from a book.

**ii. Time series, Cross-Section and Panel Data**

**Cross-sectional data** refers to data collected by observing many subjects (such as individuals, firms or countries/regions) at the same point of time, or, without regard to differences in time. Analysis of cross-sectional data usually consists of comparing the differences among the subjects. For example, we want to measure current obesity levels in a population. The cross-sectional data provides us with a snapshot of that population, at that one point in time. Note that we do not know, based on one cross-sectional sample, if obesity is increasing or decreasing; we can only describe the current proportion.

**Time series** data is also known as longitudinal data, which follows one subject's changes over the course of time. For example, the average production of wheat from 1990 to 2009.

**Panel data** combines both cross sectional and time series data and looks at multiple subjects and how they change over the course of time. Panel analysis uses panel data to examine changes in variables over time, and differences in variables between subjects.

**iii. Categorical and Numerical Data**

**Categorical or Nominal:** Data that can be divided into categories or groups such as male and female, and can take only discrete and not decimal values. They are called categorical or nominal data. There are two types of categorical data: they are nominal or ordinal. In nominal data, the variables can be numbered and the numbers are simply labels. You can count but not order or measure the nominal data eg. sex. The ordinal data on the other hand can be ranked or ordered but not measured eg. house numbers or test levels in music.

**Continuous or Numerical:** Data that can take any value, including decimal values, are called continuous data. Data that can be measured on a scale is said to be scalar. We speak of numerical data if they are expressed in numbers. There are two types of numerical data: they are discrete or continuous. Discrete data are a distinct series of numbers. Discrete data cannot be divided and can take only certain values eg. number of students. Continuous data on the other hand can be divided infinitely eg. height of students.

In this section, you studied about the data measurement and its types. Now answer the questions given in *Check Your Progress - 1*.

**Check Your Progress-1**

**Note:** a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit

1. What is panel data?

.....

.....

.....

2. What do you understand by primary data?

.....

.....

.....

## 3.3 TABULATION AND INTERPRETATION OF DATA

The following operations need to be done to bring data into a presentable form:

— Data coding, editing and feeding

— Data tabulation

— Figures and graphs

We will now discuss these operations, one after the other, for both categorical and numerical data.

### 3.3.1 Data Coding, Editing and Feeding

Once data is collected the researcher thinks about the processing and analysis of the data. This is a crucial stage of research work. Here, the researcher has to consult the guide and other academicians who have done research in the related field. Therefore, it is advised that data processing must be planned in advance, and, necessarily, during the time of questionnaire formulation; and, during the time of data collection. Nowadays, with the advent of the computer, researchers might think it is the job of computer assistant, but it is not so. Before either giving it to the computer assistant, or doing it manually, a lot of activities have to be completed: (i) editing of the data which you received from the field; (ii) coding of the data; (iii) preparation of the master chart if the data is to be computed manually; and (iv) presentation of data.

**(i) Editing of the data**

The editing of data is the first step of data processing and analysis. After collecting data, either through the questionnaire or schedule, you have to edit it. You have to carefully check for missing and wrongly entered data. Therefore, in large scale surveys and research, the company undertaking the research project appoints supervisors, or, editors, for proper checking of data. An example of editing of data is given below.

Example – Suppose that you conduct a survey of the occupation status of the people in a village, for which you have to collect data from heads of households. The questionnaire for the purpose is as follows

| | | |
|---|---|---|
| Name of the Respondent: | - | Rama Singh |
| Age: | - | 56 |
| Sex: | - | Male |
| Cast: | - | General |
| Occupation: | - | Private Service |
| Income of the Respondent: | - | 10,000 |
| Wife's name: | - | Rita Singh |
| Age: | - | 51 |
| Occupation: | - | House wife |
| Monthly Income: | - | 800/- |

In this questionnaire, the wife of Rama Singh is a housewife, but she earns Rs. 800. She may be a housewife, but by knitting she may be earning Rs. 800 per month. Therefore, her occupation may be categorized as self-employment. Like this, you have to cross check the data and try to get accurate information which will minimize error and strengthen your research findings. Therefore editing of the data is very essential before sending it for processing.

### (ii) Coding of the data

The questionnaire must be properly coded. Before either, sending it for feeding into the computer, or entering it in the master chart, the coding of data is necessary. The coding of data will make data entry easy. Coding of data means assigning numerical symbol to each response of the question. The purpose of giving numerical symbols is to translate raw data into numerical data, which may be counted and tabulated. An example of coding of the marital status is given below.

**Marital Status**

| | | |
|---|---|---|
| Married: | - | 01 |
| Separated: | - | 02 |
| Widowed: | - | 03 |
| Divorced: | - | 05 |
| Never Married: | - | 06 |
| Any Other: | - | 07 |

The coding of data and checking that codes are properly inserted in the questionnaire must be done during the editing of the questionnaire. It is always better to prepare a code book for your questionnaire. The coding can also be done during the time of data collection, if the code book is available with you.

### (iii) Entering data in the Master Chart

If you are doing tabulation manually, it is always wise to enter the data into a master chart. The master chart is a large sheet which will enable you to enter all the codes of different variables into it. It will help you to generate tables easily. An example of master chart is given below.

**Master Chart**

| Sl. No | Name of the respondent | | Variables | | | |
|---|---|---|---|---|---|---|
| | | Sex | Age | Marital Status | Education | Occupation |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| Total | | | | | | |

In the master chart you can enter the data of 14 sample respondents. Likewise you can expand the number of respondents in the columns and variables in the rows. It is always better to enter code (numerical number) in the master chart.

### (iv) Entering Data into the Computer

Computers are widely used for the analysis of data. It makes the calculation much faster. The excel sheet and the SPSS package can be used in social

science research. The following steps are used in the analysis of data by using the SPSS package.

i. Entering of data in the SPSS statistical package

ii. Selection of analytical procedure from the menu

iii. Selection of variables for analysis

iv. Examination of the output.

**(v) Presentation of Statistical Data**

Statistical data are collected to serve a purpose. Therefore, data may be presented in such a way that it may be easily grasped and the conclusion may be drawn promptly. Generally, the following three methods are used for the presentation of statistical information.

**a) Textual Presentation**: In this method, statistical information is presented in text form. Generally, this type of presentation is made in a descriptive way. It requires careful reading of the text in order to grasp the meaning and significance of the facts and figures given, therein. But, for most people, it is not a suitable and effective method of presentation of statistical information, because it is not easy for the reader to single out the individual information and figures. The advantage of this method is that an ordinary person can prepare and present the text and a layman can read it and grasp it.

**b) Tabular Presentation**: In this method, statistical information is presented in the form of a table. Facts and figures are gathered, and then, incorporated in tables. Generally, this type of presentation is made in a tabular form with rows and columns. Tables summarize statistical data in a logical and orderly manner. The main advantage of this method is that tables are brief, concise, and contain only relevant figures. Tables also facilitate the comparison of figures. The only disadvantage of this method is that the presentation of tables and the interpretation of data require some skills and techniques.

**c) Graphical Presentation**: In this case, statistical information is presented in the form of graphs and charts. Facts and figures are gathered first, and then, they are depicted in graphs and charts for presentation. Generally, this type of presentation is made through figures, diagrams, charts, or graphs. The main advantage of this method is that the facts and figures become more attractive and appealing to eye. A disadvantage of this method is that facts cannot be shown in detail and accurately.

### 3.3.2 Data Tabulation

Tabulation is an orderly and systematic arrangement of numerical data presented in rows and columns for the purpose of information, comparison, and interpretation. So, a statistical table is a systematic arrangement of statistical data into rows and columns. It summarizes the data in a logical and orderly manner for the purpose of presentation, comparison, and interpretation. Tabulation is, thus, a scientific process and means of recording, statistical data in a systematic and orderly manner.

A statistical table has the following five parts.

**i) Title:** each table must have a title which convey the contents of the table. It should be clear, concise and self-explanatory. It should be written on the top of the table.

**ii) Stub:** this is a column used for mentioning the items and their heading. It is the left most column of the table. A stub is generally marked with rows and in each row, an item is mentioned. The stub should be clear and self-explanatory.

**iii) Caption:** this is the heading for columns, other than the stub. It is the upper part of the Table. Caption should be properly columned and worded. Sometimes, below the caption, the units of measurement and column-numbers, is called a box head.

**iv) Body:** the main part of the table. It contains the data which are exhibited in the table. The figures inserted therein should be distinct.

**v) Source & Footnote:** the last part of a table. If the researcher is procuring data from a secondary source, then the source of the data needs to be mentioned. For example, if you are citing data from the Census of India then the year and the department and the state need to be mentioned. After mentioning the sources, the researcher has to provide a footnote, e.g., in the same cell, if you are giving the figure, and in parenthesis, the percentage to the total, then, it must be mentioned in the footnote. An example of a table is given below:

Title

| Caption | | |
|---|---|---|
| STUB | BODY | BOX HEAD |
| | | |

Source:

Footnote:

### 3.3.3 Types of Tabulation

Tabulation is done based on the data. The following types of tables are generally constructed.

i. Construction of frequency distribution table

ii. Construction of cross- tabulation

iii. Construction of figures and graph

**i. Construction of Frequency Distribution Table**

A frequency distribution table can be of two types:

- Simple frequency distribution
- Grouped frequency distribution

In constructing a simple frequency distribution, the observations are not divided into groups or classes. Only individual values are shown, whereas,

in the grouped frequency distribution the observations are divided into groups or classes.

Here is a simple frequency distribution table.

**Table 3.1: Marks obtained by class fifth students in mathematics**

| Marks | Tally of marks | Frequency (No. of students) |
|---|---|---|
| 20 | ~~IIII~~ | 5 |
| 21 | ~~IIII~~ ~~IIII~~ II | 12 |
| 25 | ~~IIII~~ ~~IIII~~ III | 13 |
| 30 | ~~IIII~~ ~~IIII~~ | 10 |
| Total | | 40 |

**Table 3.2: Grouped frequency distribution**

| Marks obtained | Tally of marks | Frequency |
|---|---|---|
| 1-10 | ~~IIII~~ ~~IIII~~ I | 11 |
| 11-20 | ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ | 20 |
| 21-30 | ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ I | 21 |
| 31-40 | ~~IIII~~ ~~IIII~~ III | 13 |
| 41-50 | ~~IIII~~ ~~IIII~~ | 9 |

While preparing the group frequency distributions, the following points have to be taken into consideration.

- The groups must not overlap, otherwise there will be confusion about which group a measurement belongs to.
- There must be continuity from one group to the next, which means that there must be no gaps. Otherwise, some measurements may not fit in a group.
- The groups must range from the lowest measurement to the highest measurement so that all of the measurements have a group to which they can be assigned.
- The groups should normally be of an equal width, so that the counts in different groups can easily be compared.

### ii. Construction of Cross Tabulation

So far, we have made tables containing frequency distributions for one variable at a time**,** in order to partially describe our data. Depending on the objectives of our study, and the study type, we may have to examine the relationship between several of our variables at the same time. For this purpose it is appropriate to construct cross tabulation of data. Depending on the objectives and the type of study, different kinds of cross tabulations may be required. The examples of cross tabulation are given below. Here, three different types of cross tabulation of data have been given.

**Example 1:** A study was carried out on the degree of job satisfaction among doctors and nurses in rural and urban areas. To describe the sample, a cross tabulation was constructed which included the sex and the residence (rural,

or urban) of the doctors and nurses interviewed. This was useful, because in the analysis, the opinions of male and female staff had to be compared separately for rural and urban areas.

**Table 3.3: Type of teachers by residence**

| Residence | Type of teachers | | Total |
|---|---|---|---|
| | Principles | Teachers | |
| Rural | 10 (16%) | 69 (38%) | 79 (33%) |
| Urban | 51 (84%) | 113(62%) | 164 (67%) |
| Total | 61(100%) | 182 (100%) | 243(100%) |

**Interpretation:** Table 3.3 shows that a higher percentage of teachers than principals work in rural areas, but, that, overall, a greater proportion of teaching staff works in urban areas (67%).

**Table 3.4: Sex of teachers by residence**

| Residence | Sex of teachers | | Total |
|---|---|---|---|
| | Male | Female | |
| Rural | 54 (43%) | 25 (21%) | 79 (33%) |
| Urban | 71 (57%) | 93 (79%) | 164 (67%) |
| Total | 125(100%) | 118 (100%) | 243(100%) |

**Interpretation:** it can be concluded from Table 3.4 that there are more male teachers serving in rural areas than females.

To obtain an overview of the distribution of principals and teachers by gender in rural and urban areas, we can construct the following two-by-four cross-table.

**Table 3.5: Residence and sex of principals and teachers**

| Teaching staff | | Residence | | Total |
|---|---|---|---|---|
| | | Rural | Urban | |
| Principals | Males | 8 (10%) | 35 (21%) | 43 (18%) |
| | Females | 2 (3%) | 16 (10%) | 18 (7%) |
| Teachers | Males | 46 (58%) | 36 (22%) | 82 (34%) |
| | Females | 23 (29%) | 77 (47%) | 100 (41%) |
| Total | 79(100%) | 164 (100%) | 243(100%) | |

**Interpretation:** this table shows, at a glance, that more of male teachers serve in rural areas. It also indicates that males outnumber females as Principals, (18% M > 7% F Principals) but, that, overall, there are more female teachers, and that the females are mainly clustered in towns.

The data in the tables is usually listed in absolute figures, as well as in relative frequencies (percentages or proportions). As already seen in Unit 1, for numerical data (such as age) the mean, median, and/or mode, with standard deviation may be calculated as well, to describe the sample.

**General hints while constructing tables**

- Make sure that all the categories of the variables presented in the tables have been specified, and that they are mutually exclusive (i.e., no overlaps and no gaps) and are exhaustive.
- When making cross-tabulations, check that the column and row counts correspond to the frequency counts for each variable.
- Also, check that the grand total in the table corresponds to the number of subjects in the sample. If not, an explanation is required. This could be presented as a footnote. (missing data, for example.)
- Think of a clear title for each table. Also, be sure that the headings of rows and columns leave no room for misinterpretation.
- Number your tables and graphs and keep them together with the objectives to which they are related. [Numbering of tables and graphs in a chapter (e.g., 4) may be like table 4.1, table 4.2 and Figure 4.1 Figure 4.2, etc.]. This will assist in organizing your report and ensure that work is not duplicated.

**iii. Construction of figures and graph**

If your report contains many descriptive tables, it may be more readable if you present the most important ones in figures. The most frequently used figures for presenting data include

| | |
|---|---|
| • Bar charts | for categorical data |
| • Pie charts | |
| • Histograms | for continuous data |
| • Line graphs | |
| • Scatter diagrams | |
| • Maps | |

We will now look at example of the abovementioned figures that can be used for presenting data.

***1. Bar Chart***

The data can be presented in a bar chart, using either absolute frequencies or relative frequencies/percentages and an example is given in Figure 3.1 below.

**Figure 3.1: Relative frequency of shortage of anti-malaria drugs in rural health institutions (n=148)**

Note that the sample size must be indicated if you present the data in percentages.

### *2. Pie Charts*

A pie chart can be used for the same set of data, providing the reader with a quick overview of the data presented in a different form. A pie chart illustrates the relative frequency of a number of items. All the segments of the pie chart should add up to 100%.

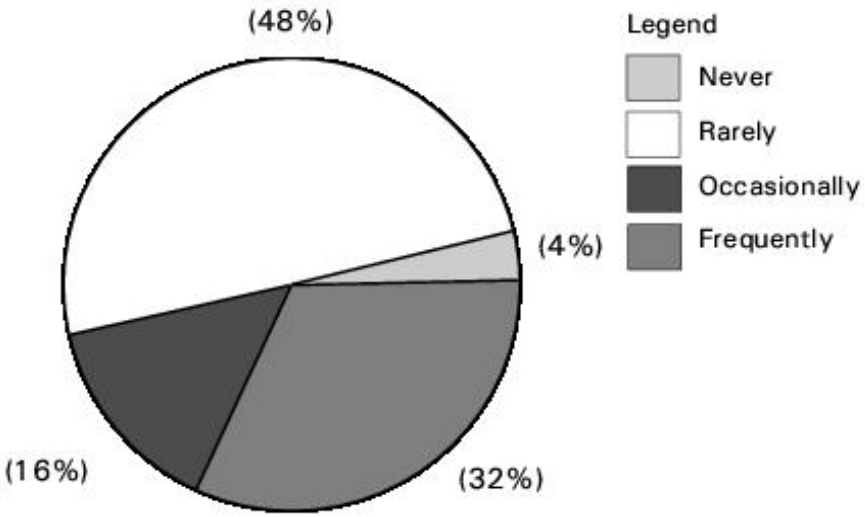



**Figure 3.2: Relative frequency of shortage of anti-malaria drugs in rural health institutions (n=148)**

### *3. Histograms*

Numerical data are often presented in histograms, which are very similar to the bar charts which are used for categorical data. An important difference, however, is that in a histogram the bars are connected (as long as there is no gap between the data), whereas in a bar chart the bars are not connected, as the different categories are distinct entities. An example of histogram is given in Figure 3.3.

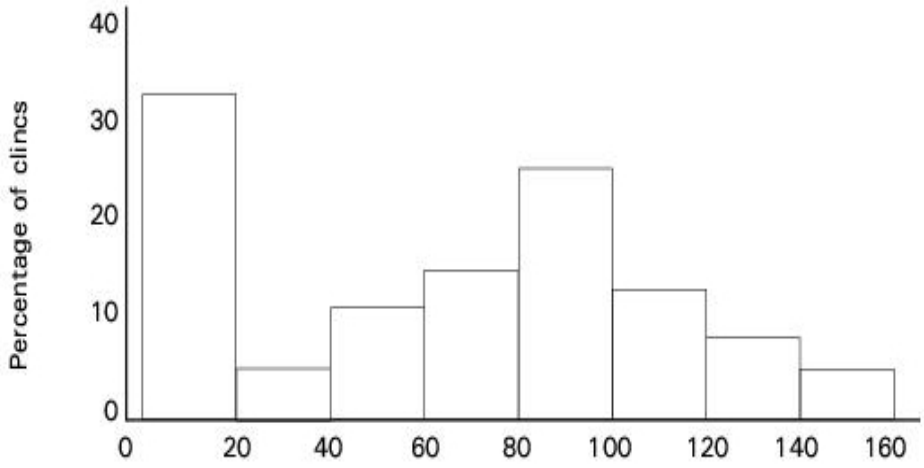



**Figure 3.3: Percentage of clinics treating different numbers of malaria patients in one month (n=80).**

No. of patients per month

### *4. Line Graphs*

A line graph is particularly useful for numerical data if you wish to show a trend over time. An example of a line graph is given in Figure 3.4.

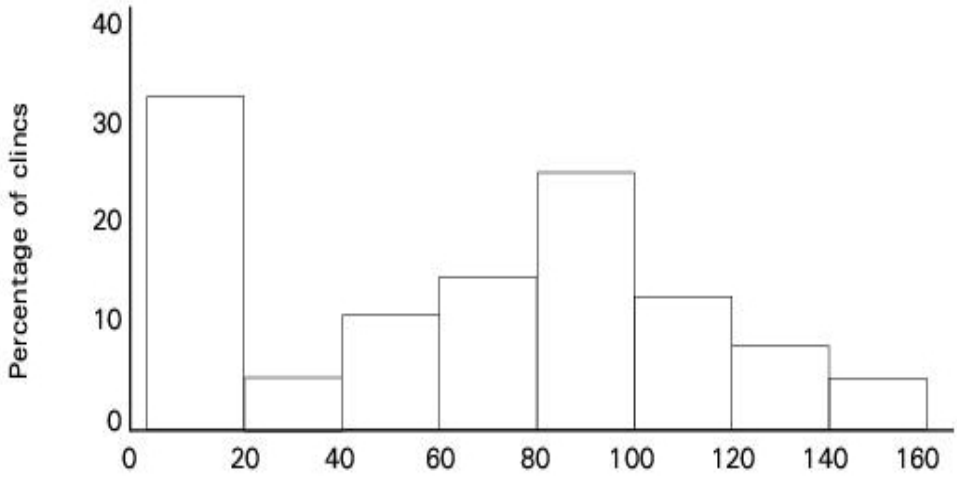



**Figure 3.4: Daily number of malaria patients at the health centers in District X**

It is easy to show two or more distributions in one graph, as long as the difference between the lines is easy to distinguish. Thus, it is possible to compare frequency distributions of different groups, i.e., the age distribution between males and females, or cases and controls.

### *5. Scatter diagrams*

Scatter diagrams are useful for showing information on two variables which are possibly related. The example of a scatter diagram, given below, is used where we are dealing with the concepts of association and correlation.

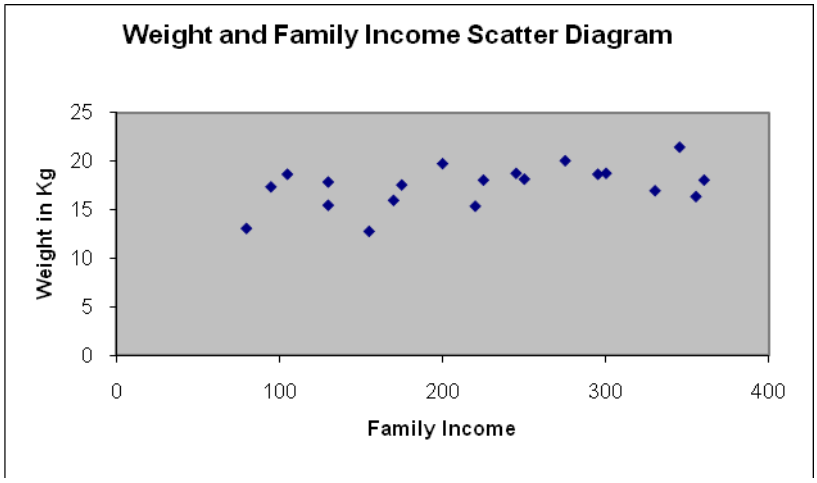



**Figure 3.5: Weight of five-year-olds according to annual family income**

**Note:** It is important that all figures presented in your research report have numbers, clear titles, and are clearly labeled (or keyed).

### 6. Maps

In addition to the figures above, the use of maps may be considered to present information. For instance, the area, where a study was carried out, can be shown in a map. If the study explored the epidemiology of cholera, a map could be produced showing the geographical distribution of cholera cases,

together with the distribution of protected water sources, thus illustrating that there is an association. If the study related to vaccination coverage, a map could be developed to indicate the clinic sites and the vaccination coverage among under-fives in each village, perhaps showing that home-clinic distance is an important factor associated with vaccination status.

In this section, we discussed about the tabulation and interpretation of data. Now answer the questions given in *Check Your Progress - 2*.

**Check Your Progress-2**

**Note:** a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit

1. What is meant by coding of data?

.....

.....

.....

2. What is a pie chart and where is it used?

.....

.....

.....

## 3.4 LET US SUM UP

Understanding data quality and its measurement are of utmost importance for any researcher. Poor quality data cannot be analyzed properly, and, may also give results which may not be valid, or, sometimes give results which could have adverse consequences for society if those results are used as a base for policy making. The presentation of data needs to be made in simple, as well as cross table format. It is always advisable to prepare a cross tabulation plan as per study requirements, and to present data in graphical way for clarity.

## 3.5 KEYWORDS

**Data Measurement:** measurement is the process of observing and recording the observations that are collected as part of a research effort.

**Type of Data:** broadly there are two types of data: (i) quantitative and; (ii) qualitative which can be further classified as categorical, nominal and continuous data.

**Data Quality:** the quality data can be characterized as: (i) precise, (ii) unambiguous, (iii) free from errors, (iv) valid, (v) reliable, and (vi) practical.

**Data Processing:** means the generation of frequency distribution and cross tabulation and calculation of other statistical measures.

**Frequency Distribution:** preparation of tables which distribute respondents according to a particular characteristic of sample, or research outcome.

**Cross Tabulation:** this is a process of generating tables giving the outcome of interest in columns, and various characteristics of respondents, or factors affecting outcomes in rows.

**Data Interpretation:** is drawing valid and meaningful conclusions from the tables generated with the help of collected data.

**Report Preparation:** is the process of documenting the whole process of research conducted to identify the problem, or to prove some relationships, or for proving the success of some programme related activities.

## 3.6 REFERENCES AND SELECTED READINGS

Gibaldi, J. (1995), *MLA Handbook for Writers of Research Papers*, Modern Language Association of America, New York.

Yang, J. T. et al. (1996), *An outline of Scientific Writing: For Researchers with English as a Foreign Languag*,. World Scientific Publishing, Singapore.

Trochim, W. M. (1999), The Research Methods Knowledge Base, 2nd Edition, Online textbook, URL: <http://www.socialresearchmethods.net/kb/ .

Training modules of International Development Research Council, Canada.

Health System Research Modules published by WHO.

Modules on Primary Health Care, Agha Khan Foundation, Geneva.

## 3.7 CHECK YOUR PROGRESS - POSSIBLE ANSWERS

**Check Your Progress 1**

1) Panel data combines both time series and cross sectional data and looks at multiple subjects and how they change over the course of time. Panel analysis uses panel data to examine changes in variables over time, and differences in variables between subjects.

2) Primary data is original data that have been collected specially with a purpose in mind. Research where one gathers this kind of data is referred to as field research, for example: a questionnaire.

**Check Your Progress 2**

1) A questionnaire must be properly coded. Before feeding it into a computer, or entering the data into the master chart, coding of data is necessary. The coding of data will make data entry easy. Coding of data means assigning a numerical symbol to each response of the question. The purpose of giving numerical symbols is to translate raw data into numerical data, which may be counted and tabulated.

2) A pie chart can be used for providing the reader with a quick overview of the data presented in a different form. A pie chart illustrates the relative frequency of a number of items. All the segments of the pie chart should add up to 100%.

# UNIT 4 REPORT WRITING

**Structure**

4.1 Introduction

4.2 Types of Report

4.3 Writing the Research Report

4.4 The Preliminary Pages of Research Report

4.5 Main Components or Chaptering the Research Report

4.6 Style and Layout of the Report

4.7 Common Weaknesses in Report Writing and Finalizing the Text

4.8 Let Us Sum Up

4.9 References and Selected Readings

4.10 Check Your Progress – Possible Answers

## 4.1 INTRODUCTION

A research report is considered a major component of any research study as the research remains incomplete till the report has been presented or written. No matter how good a research study, and how meticulously the research study has been conducted, the findings of the research are of little value unless they are effectively documented and communicated to others. The research results must invariably enter the general store of knowledge. Writing a report is the last step in a research study and requires a set of skills somewhat different from those called for in actually conducting a research.

After reading this unit you will be able to:

- describe the various steps involved in writing a research report.
- explain the various components of a research report
- identify common mistakes committed while writing a research report.

## 4.2 TYPES OF REPORT

Research reports vary greatly in length and type depending on the subject. For example banks and other financial institutions prefer short balance sheet type of tabulations for their annual report. In mathematics, the report may consist of many algebraic notations, whereas a chemists report may be in the form of symbols and formulae. Students of literature usually write a long report critically analysing a writer or book.

The news items found in newspapers are also a form of report writing. Other examples of reports include book reviews, reports prepared by government bureaus, PhD theses, etc. Any research investigation may be presented in the form of a technical report, a popular report, an article, a monograph, or, at times, even in the form of an oral presentation. The technical report is prepared for specialists who have interest in understanding the technical procedure and

terminology used in the research project. The report will be in technical language. In the technical report, the main emphasis is on: (i) the methods employed; (ii) assumptions made in the course of study and; (iii) the detailed presentation of the findings, including their limitations and supporting data.

Popular data is intended for persons who have limited interest in the technical aspects of the research methodology and research findings. The audience will include laymen and even top executives who want summary reports. The popular report is one which gives emphasis on simplicity and attractiveness. The simplification should be sought through clear writing, minimizing of technical, particularly mathematical details, and liberal use of charts and diagrams. Attractive layouts along with large print and many subheadings is another feature of a popular report. In such a report, emphasis is given on practical aspects and policy implications.

## 4.3 WRITING THE RESEARCH REPORT

Once the data collection and analysis work is over, the researcher will start writing the research report. Social and development research reports need to

- have a logical, clear structure
- be to the point
- use simple language, and have a pleasant layout

Just as an architect has to draw a layout plan for a house that is being designed, you first have to make an outline for your report. This outline will contain a head, a body, and a tail. **The head** consists of a description of your problem within its context (the country and research area), the objectives of the study and the methodology followed. This part should not comprise more than one quarter of the report, otherwise it becomes top-heavy. **The body** will form the bigger part of your report: it will contain the research findings. **The tail**, finally, consists of the discussion of your data, conclusions, and recommendations.

Before you start writing, it is essential to group and review the data you have analysed by objective. Check whether all data has indeed been processed and analysed as you planned in the research protocol/proposal which is duly approved. Draw major conclusions and relate these to the research literature. Again, you may be inspired to go back to your raw data and refine your analysis, or to search for additional literature to answer questions that the analysis of your data may evoke. Compile the major conclusions and tables or quotes from qualitative data related to each specific objective. You are now ready to draft the report.

The research report will have, broadly, three parts.

Part I: The Preliminary Pages

Part II: The Main Text of the Research Report

Part III: The End Matter

## 4.4 THE PRELIMINARY PAGES OF RESEARCH REPORT

The preliminary pages of the research report should have the following main constituents.

- Title and cover page
- A foreword
- Preface
- Acknowledgements
- Table of contents
- List of tables
- List of figures
- List of appendices
- List of abbreviations
- Executive Summary

### (i) Title and Cover page

The cover page should contain the title, the names of the authors with their designations, the institution that is publishing the report with its logo, (e.g., Health Systems Research Unit, Ministry of Health), the month, and the year of publication. The title could consist of a challenging statement or question, followed by an informative subtitle covering the content of the study and indicating the area where the study was implemented. However, this is suggestive in nature and should not be considered standard. It would be appropriate if the cover page is designed by an expert in computer graphics who may be suggested to include some important photograph related to identity of organization or problem under study or from the field within the background. Design software may be used. An example of a title of a research report is given in the box below.

**Title of the research report**

Labour Migration and its Implication on Rural Economy of Indo-Gangetic Plains of India

### (ii) Foreword

A foreword is usually a short piece of writing found at the beginning of a book or other piece of literature, before the introduction. This may or may not be written by the primary author of the work. Often, a foreword will tell of some interaction between the writer of the foreword and the story, or, the writer of the story. A foreword to later editions of a work often explains how the new edition differs from previous ones. Unlike a preface, a foreword is always signed. An example of a foreword is given in the box below.

**Foreword**

Migration of all kinds, particularly income seeking migration across state boundaries, has attracted much attention in recent scholarly and policy literature. This study provides sufficient evidences of the effect of labour migration, more specifically, male outmigration on the rural economy of the Indo-Gangetic region. The number of districts of high and moderately high male outmigration has increased. The findings reveal the holistic scenario of migration led changes in agricultural

and household domains. I am sure that this volume would be of great interest to researchers, policy makers, and development agencies while framing strategies for agricultural and rural development.

**(iii) Preface**

A preface, by contrast, is written by the author of the book. A preface generally covers the story of how the book came into being, or how the idea for the book was developed; this is often followed by thanks and acknowledgments to people who were helpful to the author during the time of writing. A preface is an introduction to a book or other literary work written by the work's author. An example of preface is given in the box below.

**Preface**

The present study was conducted in three states of Bihar, Uttar Pradesh, and Punjab to study various aspects of labour migration, and its impact on rural economy in the Indo-Gangetic plains in India. The study focused on labour outmigration across two states of the Indo-Gangetic Region and in-migration in Punjab. The results of this study would help researchers, policy makers and planners as well as development agencies in addressing various issues of labour migration and its implication in India.

**(iv) Acknowledgements**

It is good practice to thank those who supported you technically or financially in the design and implementation of your study. You should not forget to thank your research guide and your employer too, who has allowed you to invest time in the study; and, the respondents may be acknowledged. You should not forget to acknowledge the contribution of computer professionals, library staff, local officials, and the community at large that provided the information. Acknowledgements are usually placed right after the title page or at the end of the report, before the references. An example of acknowledgement is given in the box below.

**Acknowledgements**

I take this opportunity to thank the (Name of the funding agency) for providing funds and facilities for the project. I offer my sincere thanks to the (Name of your employer) for his encouragement and support for pursuing this study. I am also grateful to the head, (Name of your department) for providing all needed support, encouragement, and technical guidance. All the Research Associates, Senior Research Fellows and technical assistants working under the project deserve special appreciation for their hard work and sincere efforts in completing this project.

**(v) Table of Contents**

A table of contents is essential. It provides the reader a quick overview of the chapters with major sections and sub sections of your report, and page references, so that the reader can go through the report in a different

order, or skip certain sections. The sections and sub sections within each chapter may be given numbers that are specific to the chapter. For example, a section in chapter III may be given no as 3.1; and, a sub section as 3.1.1. An example of a table of contents is given below.

**Contents**


| S. No. | Contents | Pages |
|---|---|---|
| 1 | Introduction | |
| 2 | Review of Literature | |
| 3 | Methodology | |
| 3.1 | Data | |
| 3.2 | Analytical Tools | |
| 3.3 | Profile of Area Under Study | |
| 4 | Research Findings | |
| 4.1 | Macro Level Evidences | |
| 4.2 | Evidences from filed Survey | |
| 5 | Discussion | |
| 6 | Conclusions and Policy Implications | |
| 7 | References | |
| | Appendix | |


**(vi) List of Tables**

If you have many tables or figures, it is essential to list these also in a table of contents with formatted page numbers. The initial letters of the key words in the title are capitalized and no terminal punctuation is used. An example is given below.

**List of Tables**


| S.No. | Name of the Table | Pages |
|---|---|---|
| 2.1 | Sampling Pattern of Households in the Study Area | |
| 3.1 | Migrants by Last Residence in India | |
| 3.2 | Total Inter-State Migrants by Place of Birth in Major States | |
| 3.3 | Social Characteristics of Households in the Study Area | |


**(vii) List of Figures**

The list of figures appears in the same format as the list of tables, titled List of Figures.

**(viii) List of Appendices**

The appendices will contain any additional information that the researcher has collected while carrying out the study. It may be a questionnaire, a letter

of appreciation, a government notification, etc. The list of appendices appears in the same format as the list of tables.

**(ix) List of Abbreviations (optional)**

If abbreviations or acronyms are used in the report, these should be stated in full in the text the first time that they are mentioned. If there are many, they should be listed in alphabetical order as well. The list can be placed before the first chapter of the report.

The table of contents and lists of tables, figures, abbreviations should be prepared last, as only then can you include the page numbers of all chapters and sections, sub-sections in the table of contents. Then, you can also finalise the numbering of figures and tables and include all abbreviations. An example of a List of Abbreviations follows.

**(x) List of Abbreviations**

| **List of Abbreviations** | |
|---|---|
| AI: | Agreement Index |
| CMIE: | Centre for Monitoring of Indian Economy |
| CV: | Coefficient of Variation |
| DEA: | Data Envelopment Analysis |

**(xi) Executive Summary**

The summary should be written only after the first or even the second draft of the report has been completed. It should contain

- a very brief description of the problem (**Why** this study was needed)
- objectives (**What** has been studied)
- the place of study (**Where**)
- the type of study and methods used (**How**)
- the major findings and conclusions
- the major (or all) recommendations.

The summary will be the first (and for busy programme manager/decision makers most likely the only) part of your study that will be read. Therefore, it demands thorough reflection and is time consuming. Several drafts may have to be made, each discussed by the research team as a whole.

As you may have collaborated with various groups during the drafting and implementation of your research proposal, you may consider writing **different summaries** for each of these groups. For example, you may prepare different summaries for policymakers and programme managers, for implementing staff of lower levels, for community members, or for the public at large (newspaper, TV). In a later stage, you may write articles in scientific journals.

In this section, we discussed about the types of report and the contents to be included in the preliminary pages of research report. Now answer the following questions given in *Check Your Progress 1*.

**Check Your Progress-1**

**Note:** a) Write your answer in about 50 words.

b) Check your answer with possible answers given at the end of the unit

1. What should be included on the cover page of a research report?

.....

.....

.....

2. What is the importance of writing an acknowledgement in a research report and where should it be placed?

.....

.....

.....

## 4.5 MAIN COMPONENTS OR CHAPTERING THE RESEARCH REPORT

The Main Text includes the following chapters

- Introduction
- Review of Literature
- Methodology
- Research Findings
- Discussion
- Conclusion and Recommendations
- Summary

### 4.5.1 Chapter 1: Introduction

The introduction is a relatively easy part of the report that can best be written after a first draft of the findings has been made. It should certainly contain some relevant (environmental/ administrative/ economic/ social) background data and information about the topic on which you are carrying out research for example if you are doing research on primary education, then a brief about the status of primary education, such as their number, state-wise break up, expenditure on primary education, etc., need to be described. You may make additions to the corresponding section in your research proposal, including additional literature, and use it for your report.

Then, the statement of the problem should follow, again, revised from your research proposal with additional comments and relevant literature collected during the implementation of the study. It should contain a paragraph on what you hope/ hoped to achieve from the results of the study. Enough background should be given to make clear to the reader why the problem was considered worth investigating.

The general and specific objectives should also be included in this chapter. If necessary, you can adjust them slightly for style and sequence. However, you should not change their basic nature. If you have not been able to meet

some of the objectives of the project, this should be stated in the methodology section, and in the discussion of the findings. The objectives form the heart of your study. They determined the methodology you chose and will determine how you structure the reporting of your findings.

### 4.5.2 Chapter 2: Review of Literature

Global literature can be reviewed in the introduction to the statement of the problem if you have selected a problem of global interest. Otherwise, relevant literature from individual countries may follow as a separate literature review after the statement of the problem. A literature review is a body of text that aims to review the critical points of current knowledge and/or methodological approaches on a particular topic. Literature reviews are secondary sources, and, as such, do not report any new or original experimental work. Its ultimate goal is to bring the reader up to date with current literature on a topic, and forms the basis for another goal, such as future research that may be needed in the area.

A well-structured literature review is characterized by a logical flow of ideas; current and relevant references with consistent, appropriate referencing style; proper use of terminology; and an unbiased and comprehensive view of the previous research on the topic. One research study should be presented in one paragraph and it should mention the name of the researcher, year of study, topic and area of study, sample size, main objectives, and findings of the study. An example of a review is given in the box below.

**Review of Literature**

Singh (2008) conducted a study on labour out-migration from the Indo-Gangetic plains of India. The study provides sufficient evidence of the effect of male out-migration on the rural economy of the Indo-Gangetic plains of India. Male out-migration has resulted in gender role reversal in terms of decision making on important household and farm issues. Besides, the women of the migrant households had to take up many male specific activities, like land preparation, seed selection, broadcasting, irrigation, and herbicide application. The study also proved that the crop returns of non-migrant households were significantly higher than that of migrant households in case of both rice and wheat cultivation. The technical, allocative and economic efficiencies of non-migrant households was much higher that the migrant households in both rice and wheat cultivation.

### 4.5.3 Chapter 3: Methodology

The methodology adopted in conducting the study must be fully explained. The scientific reader would like to know about the basic design of the study, the methods of data collection, information regarding the sample used in the study, the statistical analysis adopted and the factors limiting the study. The methodology section should include a description of

- the study type
- major study themes or variables (a detailed list of variables on which data was collected may be annexed)
- the study/ target population(s), sampling method(s) and the size of the sample(s)

- data collection techniques used for the different study populations
- duration of data collection
- how the data was collected and by whom
- procedures used for data analysis, including statistical tests (if applicable)
- any constraints and its management
- limitations of the study.

If you have deviated from the original study design presented in your research proposal, you should explain to what extent you did so, and why. The consequences of this deviation for meeting certain objectives of your study should be indicated. If the quality of some of the data is weak, resulting in possible biases, this should be described as well under the heading 'limitations of the study'. An example of methodology is given in the box below.

**Methodology**

**3.1 Data Collection / Sample**

A micro level study based on primary cross section data was designed to attain the objectives of this project. The survey was conducted in three states; Bihar, Uttar Pradesh and Punjab. A systematic interview schedule was used to collect information on various aspects of labour migration and its impact on rural economy of Indo-Gangetic Plains of India. The data was collected for 200 families with migration and 200 families without migrating members.

**3.2 Analytical tools**

Various statistical tools were used in the analysis of data. Those are mean, standard deviation, correlation, t-test, and regression.

### 4.5.4 Chapter 4: Research Findings

A detailed presentation of the findings of the study with supporting data in the form of tables and charts, together with a validation of the results is the next step in writing the main text of the report. The result section of the study should contain the statistical summaries and reductions of data, rather than raw data. All the results should be presented in a logical sequence and split into readily identifiable sections.

The systematic presentation of your findings in relation to the research objectives is the crucial part of your report.

The list of data by objectives will help you to decide how to organise the presentation of data. The decision concerning where to put what can best be made after all data have been fully processed and analysed, and before the writing starts.

When all data have been analysed, a detailed **outline** has to be made for the presentation of the findings. This will help the decision-making on how to organise the data, and is an absolute precondition for optimal division of tasks among group members in the writing process.

At this stage you might as well prepare an outline for the whole report, taking the main components of a research report as a point of departure.

An **outline** should contain

- the headings of the main sections of the report
- the headings of subsections
- the points to be made in each section
- the list of tables, figures and/or quotes to illustrate each section.

The outline for the chapter on findings will predictably be the most elaborate.

The first section under findings is usually a description of the study/ target population. When different study populations have been studied, you should provide a short description of each group before you present the data pertaining to these informants.

Then, depending on the study design, you may provide more information on the problem you studied (size, distribution, characteristics). Thereafter, in an analytic study, the degree to which different independent variables influence the problem will be discussed.

For better understanding, an example of how the research findings are tabulated and presented in the form of findings is given in the following table. An analysis of table 4.1 is given in the box below.

**Table 4.1: Social Characteristics of Migrants**

(Percentage)

| Particulars | Bihar | UP | Overall |
|---|---|---|---|
| **Number** | **245** | **308** | **553** |
| **(i) Age Profile** | | | |
| Up to 30 Years | 69.80 | 56.49 | 62.39 |
| 31 to 45 Years | 26.53 | 35.39 | 31.46 |
| Above 46 Years | 3.68 | 8.11 | 6.15 |
| **(ii) Literacy Status** | | | |
| Illiterate | 33.88 | 19.16 | 25.50 |
| Primary | 50.20 | 29.87 | 38.00 |
| Matriculation and above | 15.92 | 50.97 | 36.48 |
| **(iii) Social Status** | | | |
| Upper Caste | 22.86 | 9.42 | 15.37 |
| SC/ST/BC | 77.15 | 90.58 | 84.63 \ |

**Analysis of Table 4.1**

The socio-economic characteristics of the migrants are depicted in Table 4.1. The table clearly shows that in UP there were 308 migrants from 200 households while Bihar had only 245 migrants from 200 households. On an average, 62 percent of the migrants were below 30 years of age with a higher percentage of younger migrants from Bihar than from UP. Most of the migrants from both UP and Bihar were literate, and only 25 per cent of the total migrants from both UP and Bihar were illiterate. Most of the migrants belonged to a schedule caste or backward class, the percentage being higher in UP

(91%) compared with Bihar (77%). **Tables** and **Figures** in the text should be numbered and have clear titles. It is advisable to first use the number of the section to which the table belongs. In the final draft you may decide to number tables and figures in sequence. It is appreciated in case some pictures from the field are also appropriately presented to give visual presentation of the field information.

Include only those tables and figures that present main findings and need more elaborate discussion in the text. Others may be put in annexes, or, if they don't reveal interesting points, be omitted.

It is advisable to involve a statistician/data analyst from the very beginning in each process of the research so that he/she may provide meaningful tables and help remove irrelevant findings.

**Note:** It is unnecessary to describe in detail a table that you include in the report. Only present the main conclusions.

The first draft of your findings is never final. Therefore, you might concentrate primarily on content rather than on style. Nevertheless, it is advisable to structure the text from the beginning in paragraphs and to attempt to phrase each sentence clearly and precisely.

### 4.5.5 Chapter 5: Discussion

The findings can now be discussed by objective or by cluster of related variables or themes, which should lead to conclusions and possible recommendations. The discussion may also include findings from other related studies that support or contradict your own. For easy understanding, the discussion of the table given in findings is given in the box below.

The socio-economic characteristics of the migrants are depicted in Table 4.1. The number of migrants gives an idea about frequency of migrants in a household. In UP, the percentage of households having more than one migrant was relatively higher when compared with that of Bihar. Most of the migrants in both the states were up to 30 years of age. This clearly indicates that young men in their productive age were more involved in migration. Similar results were reported by Sidhu et.al. (1997) and Kumar et.al. (1998) in their studies, that most of the migrants of both the states were literate and belong to the backward sections of the society. The underlying fact is that the backward classes belonging to the lower social hierarchy were more capable of doing menial jobs and tasks, which required lot of energy.

### 4.5.6 Chapter 6: Conclusions and Recommendations

The conclusions and recommendations should follow logically from the discussion of the findings. As the discussion will follow the sequence in which the findings have been presented (which in turn depends on your objectives) the conclusions should logically follow the same order. Sometimes, it is advisable to present conclusion and recommendations in specific sections related to issues of importance/under investigation/objectives of the study for better clarity to different stake holders. The conclusions should be given in bullets so that it can easily catch the attention of the reader.

Remember that action-oriented groups are most interested in this section.

The conclusions should be followed by suggestions or recommendations. While making recommendations, use not only the findings of your study, but also supportive information from other sources. The recommendations should be generated from the findings and conclusions. It should not be generalized; rather it should be specific to particular stake holders in pure, actionable term which is feasible in relation to social context, policy and constitution of country, political acceptability, budget, time, etc. One should **not give general recommendations** such as, "Government should provide free treatment to everyone for all health problems".

If your recommendations are short (roughly one page), you might include them all in your summary and omit them as a separate section in Chapter 6 in order to avoid repetition.

### 4.5.7 Chapter 7: References

This is the list of books/articles in some way pertinent to the research which was followed while conducting research. It should contain all those works which the researcher has consulted. The references in your text can be numbered in the sequence in which they appear in the report and then listed in this order in the list of references (Vancouver system). Another possibility is the Harvard system of listing in brackets the author's name(s) in the text, followed by the date of the publication and page number, for example: (Sharma et al., 2000: 84). The most commonly used style for citation in the text is the American Psychological Association (APA) style.

- In this, the work by a single author is cited in text as follows: Smith (1978).
- To cite work by more than two authors cite all authors the first time the reference occurs; in subsequent citations include only the surname of the first author followed by "et al." Eg. Williams et al. (1985)

In the list of references, the publications are then arranged in alphabetical order by the principal author's last name. For the APA style of reference,

- The entries are arranged in alphabetical order by last name of the first author.
- General format: Author last name, first initial (year). Title. Journal, issue, pages.
- Use a hanging indent for 2nd line of reference
- When your reference list contains multiple works by the same author:
- Single author entries precede multiple-author entries beginning with the same last name
- References with the same first author and different second or third authors are arranged alphabetically by the last name of the second author, etc.
- References with the same authors in the same order are arranged by year of publication, earliest first

Examples of references

**Journal Article, One Author**

Baumrind, D. (1967). Child care practices anteceding three patterns of preschool behavior. Genetic Psychology Monographs, 75(1), 43-88.

**Journal Article, Multiple Authors**

Ahadi, S. A., Rothbart, M. K., & Ye, R. (1993). Children's temperament in the US and China: Similarities and differences. European Journal of Personality, 7(5), 359-377.

**Entire Book**

Galvan, J. L. (2004). Writing Literature Reviews: A guide for students of the social and behavioral sciences (2 nd Ed). Glendale, CA: Pryzcak Publishing

**Article or Chapter in Edited Book**

LeVine, R. A. (1988). Human parental care: Universal goals, cultural strategies, individual behavior. In R. A. LeVine & P. M. Miller & M. M. West (Eds.), Parental behavior in diverse societies (pp. 3-12). San Francisco: Jossey-Bass.

**Website**

Try to use the format above with the information you have available on the website. If you do not have an author, use website name at beginning. For example:

Hamilton College Writing Center (2004). http://onthehill.hamilton.edu/ academics/resource/wc/ index.html.

### 4.5.8 Annexure

The annexes should contain any additional information needed to enable professionals to follow your research procedures and data analysis.

Information that would be useful to special categories of readers but is not of interest to the average reader can be included in annexes as well.

Examples of information that can be presented in annexes are

- tables, figures (graphs) and pictures referred to in the text but not included in order to keep the report short
- lists of hospitals, districts, villages, etc., that participated in the study
- questionnaires or check lists used for data collection
- A list of research team members.

**Note:** Never start writing without an outline. Make sure that all sections carry the headings and numbers consistent with the outline before they are word-processed. Have the outline visible on the wall so that everyone will be aware immediately of any additions or changes, and of progress made.

## 4.6 STYLE AND LAYOUT OF THE REPORT

The style of writing and layout of writing are two important components of report writing. However, revising and finalizing the text may also be considered as another important aspect in same line.

### 4.6.1 Style of Writing

Remember that your reader

- is short of time

- has many other urgent matters demanding his or her interest and attention
- is probably not knowledgeable concerning 'research jargon'.

Therefore, the rules are

- simplify- Keep to the essentials
- justify- Make no statement that is not based on facts and data
- do not quote the name of anyone who has provided the information
- in case of sensitive findings, one should think not to clearly mention name of village/ location, etc.
- quantify when you have the data to do so; avoid 'large', 'small'- instead, say '50%', 'one in three'
- round off to the nearest whole number. The percentage 45.8 in table may be presented in the text as about 46% and 45.3% may be presented as approximately 45%
- be precise and specific in your phrasing of findings
- inform, not impress - avoid exaggeration
- use short sentences
- use adverbs and adjectives infrequently
- be consistent in the use of past and present tenses
- avoid the passive voice, if possible, as it creates vagueness (e.g., 'patients were interviewed' leaves uncertainty as to who interviewed them) and repeated use makes dull reading
- aim to be logical and systematic in your presentation.

### 4.6.2 Layout of the Report

A good *physical layout* is important, as it will help your report

- make a good initial impression
- encourage the readers
- give them an idea of how the material has been organised so the reader can make a quick determination of what he will read first.

Particular *attention* should be paid to make sure there is

- an attractive layout for the title page and a clear table of contents
- consistency in margins and spacing
- consistency in headings and subheadings, e.g.: **Font size 16 or 18 bold**, for headings of chapters; **size 14 bold** for headings of major sections; **size 12 bold**, for headings of sub-sections, etc.
- good quality printing and photocopying
- correct drafts carefully with spell check as well as critical reading for clarity by other team-members, your facilitator and, if possible, outsiders
- numbering of figures and tables, provision of clear titles for tables, and clear headings for columns and rows, etc.
- accuracy and consistency in quotations and references.

### 4.6.3 Revising and Finalising the Text

Prepare a double-spaced first draft of your report with wide margins so that you can easily make comments and corrections in the text. Have several copies made of the first draft, so you will have one or more copies to work on, and one copy on which to insert the final changes for revision. When a first draft of the findings, discussion, and conclusions has been completed, all working group members and facilitators should read it critically and make comments.

The following questions should be kept in mind when reading the draft.

- Have all important findings been included?
- Do the conclusions follow logically from the findings? If some of the findings contradict each other, has this been discussed and explained, if possible? Have weaknesses in the methodology, if any, been revealed?
- Are there any overlaps in the draft that have to be removed?
- Is it possible to condense the content? In general a text improves by shortening. Some parts less relevant for action may be included in annexes. Check if descriptive paragraphs may be shortened and *introduced or finished by a concluding sentence*.
- Do data in the text agree with data in the tables? Are all tables consistent (with the same number of informants per variable), are they numbered in sequence, and do they have clear titles and headings?
- Is the sequence of paragraphs and subsections logical and coherent? Is there a smooth connection between successive paragraphs and sections? Is the phrasing of findings and conclusions precise and clear?

The original authors of each section may prepare a second draft, taking into consideration all comments that have been made. However, you might consider the appointment of two editors amongst yourselves, to draft the complete version. The help from proof readers may also be taken to remove minor mistakes from the draft.

It is advisable to have one of the other groups and facilitators read the second draft and judge it on the points mentioned in the previous section. Then a final version of the report should be prepared. This time you should give extra care to the presentation and layout: structure, style and consistency of spelling (use spell check).

Use verb tenses consistently. Descriptions of the field situation may be stated in the past tense (e.g., ‘Five households owned less than one acre of land.’). Conclusions drawn from the data are usually in the present tense (e.g., ‘Food taboos hardly have any impact on the nutritional status of young children.)

**Note:** For a final check on readability you might skim through the pages and read the first sentences of each paragraph. If this gives you a clear impression of the organisation and results of your study, you may conclude that you did the best you could.

## 4.7 COMMON WEAKNESSES IN REPORT WRITING AND FINALIZING THE TEXT

It is important to know the general mistakes committed in report writing and also the points to consider while finalising the text.

**(i) Endless Description** without interpretation is a pitfall. Tables need conclusions, not detailed presentation of all numbers or percentages in the cells which readers can see for themselves. The chapter discussion, in particular, needs comparison of data, highlighting of unexpected results, your own or others' opinions on problems discovered, weighing of pros and cons of possible solutions. Yet, too often the discussion is merely a dry summary of findings.

**(ii) Neglect of Qualitative Data** is also quite common. Quotes of informants as illustration of your findings and conclusions make your report lively. They also have scientific value in allowing the reader to draw his/her own conclusions from the data you present. Presentation of important photographs also makes report attractive and explains facts better.

(iii) Sometimes qualitative data (e.g., open opinion questions) are just coded and counted like quantitative data, **without interpretation,** whereas they may provide interesting illustrations of reasons for the behaviour of informants or of their attitudes. This is serious maltreatment of data that needs correction.

In these sections you have read about the main text and end matter of the research report. You have also read about the style and layout of the research report. The general mistakes committed while writing a research report and the method of finalizing the text have also been given. Now, answer the questions that follow in *Check Your Progress-2.*

**Check Your Progress - 2**

**Note:** (a) Write your answer in about 50 words.

(b) Check your answer with possible answers given at the end of the unit.

1. What is the order of chaptering in a research report?

   .....

   .....

   .....

2. What information do annexes and appendices contain?

   .....

   .....

   .....

## 4.8 LET US SUM UP

The last part of any research is writing the research report. The report writing is an art as well as science. You have to identify who will be reading your report and the report should be prepared accordingly. A summary of report in the beginning is important. The report layout plan should be comprehensive and all aspects of report including realistic recommendations and future directions of research should be described.

## 4.9 REFERENCES AND SELECTED READINGS

Ackoff, R. L. (1961), *The Design of Social Science Research*, Chicago: University of Chicago Press.

Bailey, K. D. (1978), *Methods of Social Research*, New York.

Berelson, B. (1952), *Content Analysis in Communication Research*, Free Press, New York.

Berenson, B. and C. Raymond (1971), *Research and Report Writing for Business and Economics*, Random House, New York.

Kothari, C.R.(1978), *Quantitative Techniques*, New Delhi, Vikas Publishing House Pvt. Ltd.

Gatner, E.S.M and C. Francesco (1956), *Research and Report Writing*, Barnes & Noble Inc., New York.

Gaum, C.G., H.F. Graves and L. Hoffman (1950), *Report Writing, 3rd ed.*, Prentice Hall, New York.

Gopal, M.H. (1965), *Research Reporting in Social Sciences*, Karnatak University, Dharwad.

## 4.10 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

**Check Your Progress 1**

**1.** The cover page should contain the title, the names of the authors with their titles and positions, the institution that is publishing the report with its logo, and the month and year of publication. The title could consist of a challenging statement or question, followed by an informative subtitle covering the content of the study and indicating the area where the study was implemented.

**2.** It is good practice to thank those who supported you technically or financially in the design and implementation of your study. Also your employer who has allowed you to invest time in the study and the respondents may be acknowledged. You should not forget to acknowledge the contribution of computer professionals, library staff, local officials, and community at large that provided the information. Acknowledgements are usually placed right after the title page or at the end of the report, before the references.

**Check Your Progress 2**

**1.** In any research report, the general trend of chaptering is as follows:

Chapter 1 Introduction

Chapter 2 Objectives

Chapter 3 Methodology

Chapter 4 Research Findings

Chapter 5 Discussion

Chapter 6 Conclusions and Recommendations

**2.** The annexes should contain any additional information needed to enable professionals to follow your research procedures and data analysis.

Information that would be useful to special categories of readers but is not of interest to the average reader can be included in annexes as well.

# MDV-106: RESEARCH METHODOLOGY IN DEVELOPMENT STUDIES

(6 CREDITS)

| BLOCK | UNIT NOS | UNIT TITLES |
|---|---|---|
| 1 | | **Fundamentals of Social Science Research** |
| | 1 | Social Science Research: An Overview |
| | 2 | Components of Social Science Research |
| | 3 | Research Designs |
| | 4 | Research Project Formulation |
| 2 | | **Development Research** |
| | 1 | Basics of Development Research |
| | 2 | Methods of Development Research |
| | 3 | Development Research Applications |
| **3** | | **Measurement and Sampling** |
| | 1 | Measurement |
| | 2 | Scales and Tests |
| | 3 | Reliability and Validity |
| | 4 | Sampling |
| 4 | | **Data Collection** |
| | **1** | **Quantitative Data Collection Methods and Devises** |
| | **2** | **Qualitative Data Collection Methods and Devises** |
| | **3** | **Data Sources** |
| 5 | | **Data Analysis** |
| | 1 | Overview of Statistical Tools |
| | 2 | Use of Computer in Data Analysis |
| | 3 | Data Processing and Analysis |
| | 4 | Report Writing |