Indira Gandhi National Open University
School of Extension and Development Studies

MEDS-044
Monitoring and Evaluation of Projects and Programmes

Block

1

PROJECT FORMULATION AND MANAGEMENT

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MEDS-044 MONITORING AND EVALUATION OF PROJECTS AND PROGRAMMES

People needs should be the central to the developmental professionals who formulate, implement, manage, monitor and evaluate the urban development programmes. Then the questions are:

- How to formulate programmes based on identified needs of the urban people?
- What are the steps in programme planning for urban development?
- How to involve urban people in participatory urban planning?
- What are the tools to identify the needs of the urban people?
- How the knowledge of management, sampling, data collection and analysis facilitate effective monitoring and evaluation of urban development programmes?

In short, the essence of this course 'MEDS 044 – Monitoring and Evaluation of Projects and Programmes is to provide answers to the above questions and make you understand these concepts.

Block 1 Project Formulation and Management deals with an overview of project formulation, project appraisal and project management techniques.

Block 2 Monitoring and Evaluation appraises you about the concepts of urban programme planning, monitoring and evaluation of urban development programmes.

Block 3 Measurement and Sampling makes you understand the basic concepts of measurement and sampling with focus on measurement, tests, scales, reliability, validity and sampling.

Block 4 Data Collection and Analysis gives an overview of various tools and techniques of data collection, analysis and report writing needed for conducting urban development research.

BLOCK 1 PROJECT FORMULATION AND MANAGEMENT

Project formulation and management are pre-requisites for any kind of urban development programme to: ensure what is to be done and why?; identify actions to be taken; distinguish desired/intended and undesired/unintended goals and objectives; allocate resources to achieve goals; ensure continuity of the project, and; accomplish programme objectives in cost-effective and time-effective manner. Therefore, the purpose of this block is to make you understand the basic concepts of project formulation, appraisal and management techniques.

Unit 1 Project Formulation gives an account of the concept of project proposal, steps in the formulation of a project proposal, format for writing project proposal and logistic framework approach in project formulation.

Unit 2 Project Appraisal, distinguishes between projects and programmes, describes the criterion for project appraisal and project appraisal techniques.

Unit 3 Project Management, discusses about the concepts and steps in project cycle managment. It also deals with project management techniques and pre-requisites of effective project management.

UNIT 1 PROJECT FORMULATION

Structure

1.1 Introduction

1.2 Project Proposal: Concept and Meaning

1.3 Steps in Project Formulation

1.4 Format for Writing Project Proposal

1.5 Logistic Framework Approach in Project Formulation

1.6 Let Us Sum Up

1.7 References and Selected Readings

1.8 Check Your Progress - Possible Answers

1.1 INTRODUCTION

Preparing a project proposal is a daunting task for an individual or an organization. A project proposal on any aspect of urban development should identify the scope of the project to be undertaken and describe the audience to be benefited. It needs to cover the objectives, activities and expected outcomes to be derived out of the project. The proposal should also describe the resources, both financial and human, that will be needed to achieve the project goal and objectives. It has to propose a time frame for development and delivery of the programme.

The proposal must be carefully crafted and its presentation must be professional. It is important that the proposal be technically sound, grammatically correct, and well designed, because the project proposal would most likely to compete with similar proposals submitted by other agencies and consultants. The proposal must communicate ideas and plans with eloquence that it will rise to the top of possible competition.

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

- Describe the meaning of project proposal
- Explain various steps in project proposal formulation
- Formulate a training project proposal for urban health workers
- Prepare logistic framework of a urban health workers training project proposal

1.2 PROJECT PROPOSAL: CONCEPT AND MEANING

According to Connor et.al (1996), “a proposal is a request for action. Its purpose is to persuade decision makers that a need exists for action and that the action described in the document is the best response to that need”.

According ITTO, “a project proposal is a detailed description of a series of activities aimed at solving a certain problem. The proposal should contain a detailed explanation of the:

- Justification of the project

- Activities and implementation time line
- Methodology, and
- Human, material and financial resources required.

A project is a time-bound intervention consisting of a set of planned and interrelated activities executed to bring about a beneficial change. It has a start and a finish, involves a multidisciplinary team collaborating to implement activities within constraints of cost, time and quality and has a scope of work that is unique and subject to uncertainty.

1.3 STEPS IN PROJECT FORMULATION

The formulation of a good project proposal is not an easy task. It requires a lot of exercise on the part of proposal formulator both before and during the preparation of project proposal. Before writing a project proposal, the project coordination or institution has to take care of following pre- project formulation aspects.

1) **Review of past project proposals:** A group that is involved in the formulation of project proposal needs to review similar types of project proposal formulated by its own institution or other institutions. This will give an idea about the strengths and weaknesses to the project coordinator while thinking about formulating any project.

2) **Consulting experts, consultants, and previous project coordinators:** A person or group formulating proposal could consult an expert in the area in which the intended project is going to be formulated and even can appoint a consultant who could be helpful in the preparation of the proposal. It is always better to consult a person who has already completed similar type of projects which are being attempted. The project coordinator formulating project proposal can consult his/her fellow colleagues who have already formulated similar types of project proposals.

3) **Review past project evaluation reports:** Before formulating a proposal, it is advisable to go through the reports prepared by a similar type of research organizations/institutions. The project evaluation report, besides, providing the components of project activities and strategies, will give details about the methodology, evaluation, and impact assessment strategy.

4) **Interact with the prospective beneficiaries:** The project team can also interact with the prospective beneficiaries to be benefited from the project interventions and assess their need. It would be better if the coordinator could also interact with those who have already received benefits from the similar types of project.

5) **Check statistical data/ report:** The data regarding a previous similar types of projects from various documents must be collected so that an appropriate project strategy is formulated.

6) **Hold focus group discussion:** It is always better that the person who prepares a proposal undertakes a focus group discussion with the beneficiaries or the prospective clienteles or the stakeholders. If it is a training project for

grassroots level representatives e.g., urban local bodies, then the training organizer could conduct a focus group discussion with the elected representatives and functionaries of urban local bodies and assess their needs.

1.4 FORMAT FOR WRITING PROJECT PROPOSAL

After completing the ground work, the writing of a project proposal will begin. Here, we will mention the important components of a project proposal.

1) **Title page:** The project proposal must start with a title page. The title page needs to clearly spell out the title of the project proposal, the name of the sponsoring agency and the institution submitting the project proposal, and the address of the institution from where the proposal originates.

> **Title**: **Training of Urban Health Workers on National Urban Health Mission**
>
> Submitted to
>
> **Ministry of Health and Family Welfare**
> **Government of Delhi**
>
> Submitted by
>
> **National Institute of Urban Affairs, New Delhi**

2) **Abstract:** Many project proposal peer group evaluators may not have the sufficient time to read the entire project proposal. Therefore, it is prudent to give an abstract. The abstract needs to include the following aspects.

   i) The problem statement
   ii) The project objectives
   iii) Implementing organisations
   iv) Key project activities
   v) Expected outputs
   vi) Total project budget

3) **Introduction:** Briefly introduce the topic of the project, and why an project in the areas is deemed necessary. Introduction must be brief and to the point focusing on the topic on which project is being proposed.

4) **Problem statement:** The project formulator must clearly give some background of the problem which the project is trying to solve in order to

make a case for the project. It also needs to clearly mention the needs of the target group which the project is attempting to address. Some of the essential points to be taken into consideration while narrating the problem statement are mentioned in the box below.

Problem Analysis

- Describe the key problem identified and its causes and effects.
- Delineate how these problems affect the target group.
- Explain how addressing the causes will lead to the eradication of the key problem.
- The description should be clear, concise and convincing.

5) **Project goal & objectives:** After delineating the statement of the problem, the second aspect to be covered in the project proposal is to clearly state the goal and objectives. The goal is the general aim of the project, while objectives are the core problems\ issues the project is trying to address to achieve the goal. Remember that there is one goal and more than one objective. The guidelines for preparing realistic objectives is given in the box below.

Guideline for Objectives Formulation

In nutshell objective must be 'SMART' -

S – Simple: It should be simple and covering one point at a time.

M– Measurable : It must be measurable so that a conclusion can be drawn

A – Attainable : It can be handled within the limit imposed by the time

R – Realistic : It must not be unrealistic which can not be achieved

T – Time-bound: It must be so framed that it is achieved with the set time.

6) **Project Output:** The project output should describe the services or products which the coordination intend to deliver to the beneficiaries or the survey which the organizers/coordinator intends to administer over the respondents. The results needed to be more detail and can be presented in measurable terms. It should be remembered that the results should address the main causes of the problem that the target group faces. The following are key points to be taken into consideration while formulating outputs.

i) It should clearly relate to the objectives and should be stated in such a way that these can be measured in quantity, time, and space.

ii) It should be achievable with in the available resources.

iii) It should not be confused with activities.

7) **Target group:** The project proposal needs to clearly define the target group and show how they will benefit from the project/programme. The project should give clear details of the designation, caste, and age; the gender breaks up of the target group which will be covered in the project. If possible, a list of categories of participants may be given as an annexure in the proposal.

8) **Strategies:** The project proposal must clearly delineate strategies to be adopted during various steps of project implementation. The formulated strategies must be logically linked with the formulated objectives.

9) **Project Implementation Plan:** The project implementation plan must describe activities and resources allocation in as much detail as possible. The time and place of project implementation must be clearly mentioned. It should also specify the experts and other institutions who will be involved during the process of conducting the project activities. The implementation plan may be divided into the following two key elements.

   a) **The activity plan:** the activity plan must clearly include information about the activities to be conducted by the project. The activities must be drawn from the specific objectives and outputs formulated for the project. They should be stated in such a way that they precisely describe the actions or tasks to be undertaken by the project coordinator. It will be better if activities are further broken into tasks. Activities should indicate what will be done to transform inputs into outputs.

Some of the guidelines for the formulation of appropriate activities are:

i) It should examine each output listed in the implementation plan.

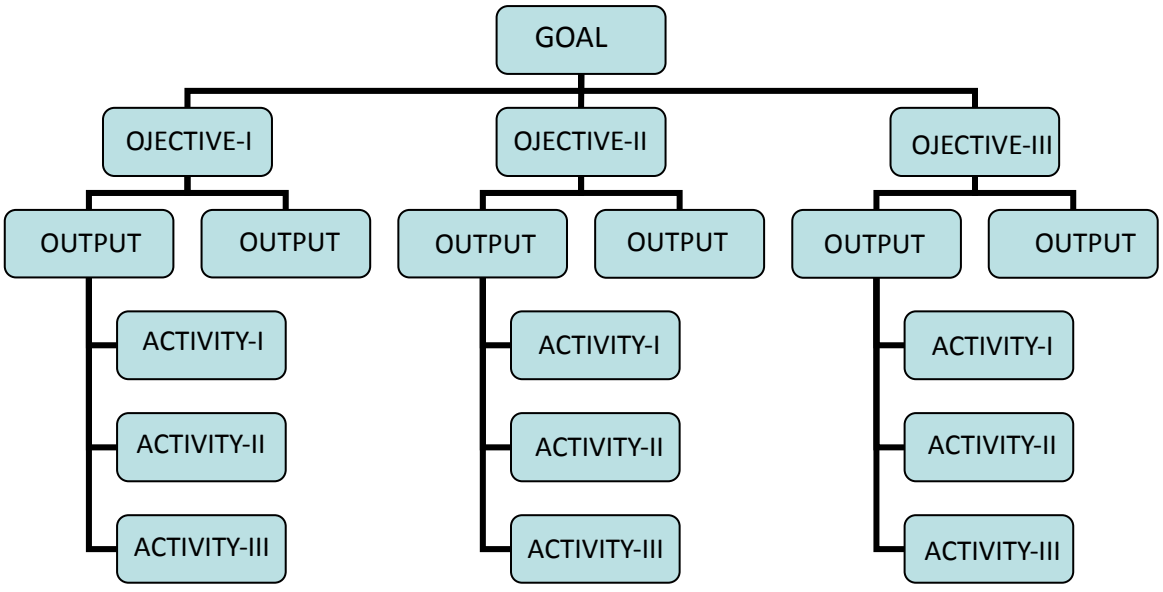
ii) Formulate the complete set of activities required for achieving the stated objectives.

iii) Always verify that the formulated set of activities is sufficient for achieving the stated project output.

iv) Check the available set of inputs necessary for the implementation of formulated activities.

A good tool for establishing activities is the work breakdown structure, which identifies groups of activities related to each project output and presents them in a hierarchical structure as given in Flowchart 1.

A flow chart of goal, objectives, activities, and output is given below:



The activity map can be presented in a tabular form, popularly know as Gantt chart. An example of training project activities for urban health workers of a training programme for four months is presented in a Gantt Chart given below:

Gantt Chart

S.No.	Activities	Month-1	Month-2	Month-3	Month-4
1.	Conducting a need assessment	√			
2.	Preparation of training module	√	√		
3.	Conducting the training programme		√	√	
4.	Writing Training Report				√

b) Resource Plan: The resource plan must clearly provide information regarding resources required for the project. International project donors expect contributions from the project applicant organization. In this case, the training organizer should clearly mention the organization's contribution in the project budget.

Broadly, the resources may include instructional materials, hardware, software, and personnel. The various resources required for a training project of urban health are narrated below:

1) Instructional materials: training manual, handouts, models, transparencies, flow charts, white boards, white sheets, reference guides, etc.

2) Hardware: computer, video cameras, multimedia setup, overhead projector, power point presentation, etc.

3) Software

4) Personnel: Training consultants, resource persons, training assistants, and other support staff required during the training programme.

Customarily, the budget for a project proposal for training includes expenditures on following broad headings.

1) Payment to training coordinators
2) Payment to training Associate/Assistant
3) Payment to consultant trainers
4) Payment to resource persons
5) *Per diem* / TA/DA of the participant
6) Cost of training materials/modules
7) Charges of training hall (if available with the organization)
8) Charges of board / lodging of the participants
9) Cost of stationary/software/hardware
10) Miscellaneous charges (postage, photocopying, etc.)

However, this may vary from one training programme to that of the other. Budget for three months training of 12 participants is presented below.

Table 1.1: Format of Budget for Training Programme

Categories	Number of Units	Unit Cost permonth	Number of Months	Total Cost
1. Project Coordinator	1	10000	3	30,000
2. Project Associate/ Assistant	1	5000	3	15,000
3. Computer Assistant	1	4000	3	12,000
4. TA/ DA of the participants	12	500	3	18,000
5. Training venue rent for three days	—	—	—	3,000
6. Conveyance	—	—	—	10,000
7. Training material cost	—	—	—	20,000
8. Miscellaneous	—	—	—	10,000
Total Cost				1,18,000

11) **Monitoring and Evaluation:** the project should clearly outline the monitoring mechanism. It will have to spell out the methods to be used for monitoring and evaluating the project.

12) **Reporting:** The reporting mechanism to be used by the project coordinator must be clearly stated in the project. Generally, the mid-term evaluation and end-term evaluation are done. Moreover, as far as, monitoring is concerned the monthly progress reports need to be sent to the donor agency to inform them about the progress of the project.

13) **Management and Personnel:** A brief description about the management of the project and personnel to be involved should be given. For example the type of consultants and resource persons to be hired, their qualification and experience, the payment as per official norms, etc must be delineated.

1.5 LOGISTIC FRAMEWORK APPROACH IN PROJECT FORMULATION

Now a day's most of the donor agencies are asking for logistic framework in preparing project proposals. The logical frame work analysis is an interactive process intended to promote clear conceptual thinking on what a project intends to do, and how it intends to do it. It is logical in the sense that it establishes internal relationships between project objectives, outputs and activities (inputs).

The steps that are used to construct a logical framework are given below.

Step 1: Define the overall **goal** which the project intends to achieve.

Step 2: Define the **objectives** (Purposes) to be achieved by the project.

Step 3: Define **outputs** for achieving the objective

Step 4: Formulate **activities** for achieving each output.

Step 5: Define **assumptions** under which success in achieving the objective of one level will contribute to achieving objectives at the next level.

Step 6: Define the **Objectively Verifiable Indicator (OVI)** at goal, objective, output and activity levels.

The contents of logistic framework are given below in tabular form.

Table 1.2: Contents of the Logframe Matrix

1. Project summary	2. Objectively Verifiable Indicators	3. Sources and Means of Verification	4. Assumption
1. Overall Objectives/ Goal The shared vision that your project contributes to	The extent of your contribution (not always possible)	How you will measure your contribution (not always possible)	—
2. Specific Objective/ Purpose What you intend to change during project period	How you will know the intended change has occurred and is sustainable	How you will measure change (the basic for evaluation)	**Assumptions** about *external factors* that need to be in place if project is to contribute to the Goal
3. Expected Results/ Outputs Tangible result of each activity intended to bring about change	How you will know the expected result of your project have been achieved	How you will measure results (the basis of periodic review)	**Assumptions** about *external factors* that many affect whether the project purpose is achieved
4. Activities (and processes) Groups of tasks needed to achieve each expected result	The **means, inputs and resources** needed to carry out the each task	Proof that each activity/ task completed (what needs to be regularly monitored)	**Assumptions** about *external factors* that may affect activities achieving the expected results **Preconditions** (that need to be fulfilled before the project can start)

Source: Greta Jensen, The Logical framework approach, How to guide, July, 2010 bond for International Development, UK.

Some of the terms used in logical framework are described below:

1) **Objectively Verifiable Indicators:** Means features which can be measured or at least described precisely in terms of quantity and quality, which would show a change in situation.

2) **Means of Verification**: Indicate where and in what form information on the achievement of objectives and results can be found.

3) **Assumptions:** conditions which could affect the progress of the project but which are not under direct control of project management.

One example of logical framework is given below.

Table 1.2: Logframe of A Health Training Project

Objective (Narrative Summary)	Objectively Verifiable Indicators	Means of Verification	Assumption
Goal: To enhance knowledge of health care to reduce child mortality	Child mortality rate reduced form 50% to 30% by 2015	Record of Primary Health centre	—
Objective: Raise health status of children in the age group 0-5 years	i. The percentage of delivery by trained personnel increased from _ % to __% ii. The incidence of ARI and diarrhoea reduced form __ % to __% by 2015	Hospital & Clinic records	Incidence of death among children 0-5 reduced
Outputs: i. Enhanced efficiency of health worker in delivery of immunisation programme ii. Improved skills identification of referral cases by the health works	i. The percentage of immunization increased from _% to __% by 2015 ii. The number of referral cases send to referral centre increased from __% to __%	i. Clinic attendance record ii. Hospital register	The health workers became more efficient in dealing with child health care problems
Activities: i. To impart training on antenatal care delivery ii. To impart hands on training on how to conduct aseptic delivery and take care of new born iii. To improve skill as how to do various vaccination of children in the age group 0-5 years iv. To impart training on management of respiratory infection and diarrhoea	i. The knowledge of health workers increased from __% to __% on child health care ii. The skill level of health workers on conducting immunization enhanced by __%. iii. The knowledge and skill of health workers on identification of referral cases of respiratory infection and diahorrea enhanced by __%.	Activity Schedule & Interacting with the field visit unit	The health workers are motivated to work for the promotion of health care of children

Till now you have read about the steps involved in format writing and the logical framework approach of training project proposal formulation. Now, 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 are the different steps in project formulation?

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2) What is the full form of "SMART" objective?

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1.6 LET US SUM UP

Preparing a project proposal is a daunting task. The project proposal must be carefully crafted and its presentation must be professional, because most probably the project might be competing with similar proposals for grants. This unit at the outset has described the meaning of the project and various steps starting from the review of past project proposal to discussion on project while formulating a project proposal is dealt in detail. The project proposal required to be painted in a particular format. The fourth section of this unit has described in detail the format for writing project proposal. Logistic framework which now a days a requirement of bilateral and multi-lateral funding agencies is also discussed in the last section.

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1.8 CHECK YOUR PROGRESS: POSSIBLE ANSWERS

Check Your Progress 1

1) What are the different steps in project formulation?

   Different steps in the project formulation are: (i) Review of past project proposals; (ii) Consulting experts, consultants, and previous project coordinators; (iii) Review past project evaluation reports; (iv) Interact with the prospective beneficiaries; (v) Check statistical data/ report; and (vi) Hold focus group discussion

2) What is the full form of "SMART" objective?

   In nutshell objective must be 'SMART' -

   S – Simple: It should be simple and covering one point at a time.

   M– Measurable : It must be measurable so that a conclusion can be drawn

   A – Attainable : It can be handled within the limit imposed by the time

   R – Realistic : It must not be unrealistic which can not be achieved

   T – Time-bound: It must be so framed that it is achieved with the set time.

UNIT 2 PROJECT APPRAISAL

Structure

2.1 Introduction

2.2 Projects: Meaning and Concept

2.3 Difference Between a Project and a Programme

2.4 Criterion for Project Appraisal

2.5 Project Appraisal Techniques

2.6 Let Us Sum Up

2.7 References and Selected Readings

2.8 Check Your Progress – Possible Answers

2.1 INTRODUCTION

In the previous unit you have read about project formulation. This unit deals with the project appraisal techniques. Projects often provide the base for sustainable development intervention. Project appraisal is a generic term that refers to the process of assessing, in a structured way, the case for proceeding with a project or proposal. It often involves comparing various options, using economic appraisal or some other decision analysis technique. A good appraisal justifies spending money on a project. It is an important tool in decision making and lays the foundation for delivery and evaluation. Appraisal asks fundamental questions about whether funding is required and whether a project offers good value for money. It can give confidence that public money is being put to good use, and help identify other funding to support a project.

2.2 PROJECTS: MEANING AND CONCEPT

What are Projects?

Projects are the cutting edge of development. Projects are an investment activity in which financial resources are expended to create capital assets that produce benefits over an extended period of time.

UNIDO defines a project as a proposal for an investment to create and develop certain facilities in order to increase the production of goods/services in a community during a certain period of time.

The Chartered Management Institute define a project as “an activity that has a beginning and an end which is carried out to achieve a particular purpose to a set quality within given time constraints and cost limits”.

A project may be defined as an activity for which money will be spent in an expectation of returns and which logically seems to lend itself to planning financing and implementation as a unit. It is the smallest operational element prepared and implemented as a separate entity in a national plan of programmes of development.

A project is also defined as a proposal for an investment to create, expand and develop certain facilities in order to increase the production of goods and services

in a community during a certain period of time. Furthermore, for evaluation purposes, a project is a unit of investment, which can be distinguished technically, commercially and economically from other investments.

2.3 DIFFERENCE BETWEEN A PROJECT AND A PROGRAMME

Many people are uncertain about the difference between a project and a programme. A project is a temporary entity established to deliver specific (often tangible) outputs in line with predefined time, cost and quality constraints. Whereas, a program is a portfolio comprising of multiple projects that are managed and coordinated as one unit with the objective of achieving (often intangible) outcomes and benefits for the organization. Table 3.1 summarizes the main areas of differences between a project and a programme.

Table 2.1: Difference between Project and a Programme

Parameter	Project	Programme
Objectives	Outputs are tangible; relatively easy to describe, define and measure; tending towards objective.	Outcomes are often intangible; difficult to quantify; benefits often based on changes to organizational culture and behaviours; introducing new capabilities into the organization; tending towards subjective.
Scope	Strictly limited; tightly defined; not subject to change during the life of the project.	Not tightly defined or bounded; likely to change during the life cycle of the program.
Duration	Relatively short term; typically three to six months.	Relatively long term typically eighteen months to three years.
Risk profile	Project risk is relatively easy to identify and manage. The project failure would result in relatively limited impact on the organization relative to programme risk.	Program risk is more complex and potentially the impact on the organization if a risk materializes will be greater relative to project risk. Programme failure could result in material financial, reputational or operational loss.
Nature of the problem	Clearly defined.	Ill-defined; often disagreement between key stakeholders on the nature and definition of the problem.
Nature of the solution	A relatively limited number of potential solutions.	A significant number of potential solutions with disagreement between stakeholders as to the preferred solution.
Stakeholders	A relatively limited number of potential solutions.	A significant number of potential solutions with disagreement between stakeholders as to the preferred solution.
Relationship to environment	Environment within which the project takes place is understood and relatively stable.	Environment is dynamic; and programme objectives need to be managed in the context of the changing environment within which the organization operates.
Resources	Resources to deliver the project can be reasonably estimated in advance.	Resources are constrained and limited; there is competition for resources between projects.

2.4 CRITERION FOR PROJECT APPRAISAL

After a project has been prepared, it is generally appropriate for a critical review or an independent appraisal to be conducted. This provides an opportunity to reexamine every aspect of the project plan to assess whether the proposal is appropriate and sound before large sums are committed. The appraisal process builds on the project plan, but it may involve new information if the specialists on the appraisal team feel that some of the data are questionable or some of the assumptions faulty. If the appraisal team concludes that the project plan is sound, the investment may proceed. But if the appraisal team finds serious flaws, it may be necessary for the analyst to alter the project plan or to develop a new plan altogether.

If a project is to be financed by an international lending institution such as the World Bank or by a bilateral assistance agency, such an external lender will probably want a rather careful appraisal even if it has been closely associated with earlier steps in the project cycle. The World Bank, for example, routinely sends a separate mission to appraise proposed projects for which one of its member governments intends to borrow.

The preparation of a project entails consideration of many aspects. The major aspects to be considered during the appraisal of the project are:

1) Technical
2) Institutional
3) Organizational
4) Managerial
5) Social
6) Commercial
7) Financial
8) Economic
9) Sustainability

Let us now discuss each of these criterions of project appraisal.

1) Technical Aspect

The technical aspect of any project considers the technical feasibility of any project. It concerns with the technical aspect of a project form both input supply side and output delivery side. For example if you want to take up a metro project in a urban region, you may have to examine the soil type of the region for pillar strength, urban population to be benefited, availability of land, route etc. Such information can be collected through surveys.

2) Institutional Aspect

The institutional aspect of a project deals with the framework within which the project will have to operate. A complete knowledge of the institutional aspect helps identifying the components of institutional framework that will have a bearing on the project. Some of the elements that constitute the

institutional framework include government institutions, project authority, corporate bodies, land systems, banking and credit institutions, religious customs, practices and social mores. There is a need to understand the administrative system of the region where the project has to be undertaken.

3) Organizational Aspect

Here the term organization refers to the structure if the body that would undertake the task of project execution. The proposed organization must have the capacity to carry out the assignments given to it. Some of the basic principles to be followed include:

1) There must be clear lines of authority running from top to bottom of the organization and the chain of command should be clear.

2) The responsibilities of each authority should be clearly defined in writing.

3) The decision making power should be placed as near as possible to the scene of action.

4) The number of levels of authority should be kept at minimum.

5) The organization should be kept as simple as possible and should be flexible to adjust to changing conditions.

4) Management Aspect

The main task of management is to implement the project objectives within the framework of organizational structure. For good management, a clear definition of functions and activities are required. There is also a need for allocating responsibilities to various agencies for various project activities. A suitable mechanism for coordination of the activities of participating agencies should also be developed. Besides, proper staffing also comes under the purview of the management.

5) Social Aspect

It is very important to assess the social patterns, customs, culture, traditions and habits of the clientele. Various aspects like changes in living standards, material welfare, income distribution etc. In selecting some projects, weights are assigned for income distribution so that the projects which benefit the lower income group are benefitted. The adverse effect of the project on particular group is also examined. Preserving the environment and wildlife habitats is given high priority.

6) Commercial Aspect

The commercial aspects of a project involves the arrangements of marketing the output produced by the project and ensuring supply of inputs needed for the project to operate. There is a need to assess the effective demand of the project output and the prices that may prevail under the demand and supply situations. The analyst also needs to cautiously evaluate the impact of product supply on the price of the product and the viability of the project under such changed price situation.

7) Financial Aspect

Decisions about undertaking any project depend a lot on financial analysis of a project. As there could be many beneficiaries/participating agencies of any project, there is a need for separate financial analysis each.

8) Economic Aspect

The economic aspect is very important to be taken into consideration while appraising a project proposal. If it is a developmental project aims at improving the quality of life of the people in the project area, then what will be its economic impact in terms of raising income and standard of living of the people is essential.

9) Sustainability Aspect

Donor agencies are emphasising on the sustainability of the project after the intervention is withdrawn from the project area. While appraising the project proposal the reviewer must see that adequate attention has been given to the sustainability of the project by enquiring several questions i.e How will the project to be sustained after the project activities are withdrawn? Who will sustain it, both financially and technically? and What endeavour has been made by the proposer while proposing the project? and so on.

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 projects? How do they help in development?

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2) Describe with an example the technical aspects to be considered while preparing a project?

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2.5 PROJECT APPRAISAL TECHNIQUES

Project appraisal is the effort of calculating a project's viability. Appraisal involves a careful checking of the basic data, assumptions and methodology used in project preparation, an in-depth review of the work plan, cost estimates and proposed financing, an assessment of the project's organizational and management aspects, and finally the viability of project. The project appraisal criteria can be divided under two heads:

1) Non-Discounting Technique
   - Urgency
   - Payback Period
   - Accounting Rate of Return
   - Debt Service Coverage Ratio (DSCR)
2) Discounting Criteria Technique
   - Net Present Value (NPV)
   - Internal Rate of Return (IRR)
   - Benefit Cost Ratio (BCR)
   - Annual Capital Charge

Now we will discuss the techniques in detail

2.5.1 Non-Discounting Techniques

i) Urgency

According to this criterion, the projects that are more urgent get preference over those that are less urgent. However, one of the problems in using this criterion is to judge the urgency of any project. The decision taken may be subject to the personal bias of the decision maker. In view of this limitation, it should not be used for investment decision making.

ii) Payback Period

In simple terms, the payback period is the length of time required to recover the initial cash outlay on the project. If the cash inflows are constant, then the payback period is calculated by dividing the initial outlay by the annual cash inflow. For example, a project which has an initial cash outlay of Rs 10,00,000 and a constant annual cash inflow of Rs 2,00,000 has a payback period of : 10,00,000/ 2,00,000 = 5 years.

If the cash flow is not constant, e.g. if a project involves a cash outlay of 6,00,000 and generates cash inflow of Rs 1,00,000, Rs 1,50,000, Rs 1,50,000 and Rs 2,00,000 in the first, second, third and the forth years respectively, its payback period is four years because the sum of cash inflow during four years is equal to the total outlay.

Decision making: According to the payback period criterion, the shorter the payback period, the more desirable is the project. Firms using this criterion, generally specify the maximum acceptable payback period.

Evaluation of this method:

- It is simple in concept and application.
- It favours those projects that generate substantial inflows in earlier years and discriminate against projects that bring substantial cash flows only in later years.
- As this criterion emphasises on earlier cash flows, it may be a good criterion when the firm is pressed with the problem of liquidity.
- It fails to consider the time value of money thus violating the most basic principle of financial analysis which says that cash flows occurring at different points of time can be added or subtracted only after suitable compounding and discounting.
- Since payback period is the measure of a project's capital recovery, it may divert attention from profitability.

In spite of the shortcoming of not using the time value of money, payback period is used with advantage in apprising investments for the following reasons:

- The payback period may be considered roughly as the internal rate of return when annual cash flow is constant and the life of the project fairly long.
- The payback period is somewhat akin to the breakeven point.
- The payback period also gives information about the rate at which the uncertainty associated with the project is resolved. The shorter the payback period, the faster the uncertainty associated with the project is resolved.

iii) Accounting Rate of Return

The accounting rate of return or the simple rate is the measure of profitability which relates income to investment, both measured in accounting terms. As there are various ways of measuring income and investment, there are a large number of measures for accounting rate of return. The commonly used ones are given:

1) $\dfrac{\text{Average income after tax}}{\text{Initial investment}}$

2) $\dfrac{\text{Average income after tax}}{\text{Average investment}}$

3) $\dfrac{\text{Average income after tax but before interest}}{\text{Initial investment}}$

4) $\dfrac{\text{Average income after tax but before interest}}{\text{Average investment}}$

5) $\dfrac{\text{Average income before interest and taxes}}{\text{Initial investment}}$

6) $\dfrac{\text{Average income before interest and taxes}}{\text{Average investment}}$

Decision making: The higher the accounting rate of return, the better the project.

Evaluation:

- It is simple to calculate.
- It is based on accounting information which is readily available.
- It considers benefits over the entire life of the project.
- Though the income data of the entire life of the project is required, one can work out accounting rate of return even if the complete income data is not available by taking income from a typical year.

Disadvantages of accounting rate of return:

- It does not take into account the time value of money.
- There are numerous measured of accounting rate of return which can create confusion.

iv) Debt Service Coverage Ratio (DSCR)

The debt service coverage ratio is generally used to find the financial worthiness of the projects which need long term financing. The formula is [net profit + interest (on long term loan) + depreciation] / [interest (on long term loan) + principal loan].

Decision Making: Generally, the financial institutions regard a debt service coverage ratio of 2 as satisfactory.

Drawback:

In DSCR, both the numerator and the denominator consist of a mixture of post tax and pre tax figures (profit after tax in the numerator and loan repayment instalment in the denominator are post tax figures and interest in both numerator and denominator is pre tax figure). It is difficult to interpret a ratio that is based on a mixture of post tax and pre tax figures.

2.5.2 Discounting Techniques

i) NPV

The difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of an investment or project.

NPV analysis is sensitive to the reliability of future cash inflows that an investment or project will yield.

The formula for **NPV** is:

$$\text{NPV} = \sum_{t=0}^{n} \frac{\left(\text{Benefits} - \text{Costs}\right)_t}{\left(1+r\right)^t}$$

where:

r = discount rate

t = year

n = analytic horizon (in years)

Decision making:

If the NPV of a prospective project is positive, it should be accepted. However, if NPV is negative, the project should probably be rejected because cash flows will also be negative.

Features of NPV:

- The NPV is based on the assumption that the intermediate cash inflows of the project are re-invested at a rate of return equal to the firm's cost of capital.
- The NPV of a simple project decreases as the discount rate increases, the decrease in NPV however is at a decreasing rate.

Merits of NPV

- It takes into account the time value of money.
- It considers the cash flow stream in its entirety.
- The NPV's of various projects can be added. The NPV of a scheme consisting of two projects A and B will simply be the sum of NPV's of these projects individually.

  NPV (A+B) = NPV(A) + NPV(B).

To illustrate the calculation of net present value, consider a project which has the following cash flow stream:

Year	Cash Flow
0	-10,00,000
1	2,00,000
2	2,00,000
3	3,00,000
4	3,00,000
5	3,50,000

The cost of capital k for the firm is 10 percent. The net present value of the proposal is:

$$NPV = \frac{10.00,000}{(1.10)^0} + \frac{2,00,000}{(1.10)^1} + \frac{2,00,000}{(1.10)^2} + \frac{3,00,000}{(1.10)^3} + \frac{3,00,000}{(1.10)^4} + \frac{3,50,000}{(1.10)^5}$$

$$= -5273$$

Since the decision rule associated with the net present value is to accept the project if the net present value is positive and reject if it is negative, in this example, the decision should be to reject the project.

ii) IRR

The discount rate often used in capital budgeting that makes the net present value of all cash flows from a particular project equal to zero. Generally speaking, the higher a project's internal rate of return, the more desirable it is to undertake the project. As such, IRR can be used to rank several prospective projects a firm is considering. Assuming all other factors are

equal among the various projects, the project with the highest IRR would probably be considered the best and undertaken first.

IRR is sometimes referred to as "economic rate of return (ERR)". It is the discounted rate in the equation:

$$0 = \frac{CF_0}{(1+r)^0} + \frac{CF_1}{(1+r)^1} + ... + \frac{CF_n}{(1+r)^n} = \sum \frac{CF_t}{(1+r)^t}$$

$CF_{t=}$ cash flow at the end of the year t

r = discount rate

n = life of the project

In the internal rate of return, we set the net present value equal to zero and determine the discount rate which would also be the internal rate of return.

E.g. Consider the cash flow of a project

Year	Cash Flow
0	-1,00,000
1	30,000
2	30,000
3	40,000
4	45,000

The internal rate of return is the value of r which satisfies the following condition.

$$1,00,000 = \frac{30,000}{(1+r)} + \frac{30,000}{(1+r)^2} + \frac{40,000}{(1+r)^3} + \frac{45,000}{(1+r)^4}$$

The calculations of r consist of a process of trial and error. We try different values of 'r' till we find that the right hand side of the above equation is equal to the left hand side. By putting the value of 'r' as 12 we get 1,07,773, for 14 it is 1,03,046, for 15 it is 1,00,802 and for 16 it is 98,641. Since at 16 percent, the value is less than 1,00,000, we conclude that the value of 'r' lies between 15 % and 16%.

A 1 percent difference (between 15 and 16 percent) corresponds to a difference of 2161 (1,00,802 – 98,641). The difference between the net present value at 15% (1,00,802) and that at present target value (1,00,000) is (1,00,802 – 1,00,000) is Rs.802. This difference will correspond to a percentage difference of 802/2131 = 0.37.

Adding this number to 15 percent we get the value as 15.37 percent.

You can think of IRR as the rate of growth a project is expected to generate. While the actual rate of return that a given project ends up generating will often differ from its estimated IRR rate, a project with a substantially higher IRR value than other available options would still provide a much better chance of strong growth.

IRRs can also be compared against prevailing rates of return in the securities market. If a firm can't find any projects with IRRs greater than the returns that can be generated in the financial markets, it may simply choose to invest its retained earnings into the market.

The discount rate often used in capital budgeting that makes the net present value of all cash flows from a particular project equal to zero. Generally speaking, the higher a project's internal rate of return, the more desirable it is to undertake the project. As such, IRR can be used to rank several prospective projects a firm is considering. Assuming all other factors are equal among the various projects, the project with the highest IRR would probably be considered the best and undertaken first.

iii) Benefit-Cost Ratio (BCR)

A Benefit Cost Ratio is an indicator, used in the formal discipline of cost-benefit analysis, that attempts to summarize the overall value for money of a project or proposal. A BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. All benefits and costs should be expressed in discounted present values.

The benefit-cost ratio (BCR) represents the ratio of total benefits over total costs, both discounted as appropriate. The formula for calculating BCR is:

$$BCR = \frac{PV_{benefits}}{PV_{costs}}$$

where:

$PV_{benefits}$ = present value of benefits

PV_{cost} = present value of costs

In other words, since the present value of costs is nothing but the initial investment, the BCR may be defined as the ratio of present value of benefits to initial investment.

To illustrate the calculation of this measure, let us consider a project which is being evaluated by a firm that has a cost capital of 12 percent.

The initial investment in the project is Rs1,00,000.

Year	Benefits
Year 1	25,000
Year 2	40,000
Year 3	40,000
Year 4	50,000

The benefit cost ratio of this project will be

$$BCR = \frac{\frac{25,000}{(1.12)} + \frac{40,000}{(1.12)^2} + \frac{40,000}{(1.12)^3} + \frac{50,000}{(1.12)^4}}{1,00,000}$$

$$= 1.145$$

Decision making: If BCR is >1, the project should be accepted and would be beneficial.

If BCR =1, we interpret it as being indifferent.

If BCR <1, the project should be rejected.

The BC ratio is preferable to NPV as this criterion measures per rupee of outlay and it can discriminate between large and small investments.

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 payback period?

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2) What is Benefit Cost ratio? What is the decision making criteria while using BC ratio?

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2.6 LET US SUM UP

In this unit we read about the meaning of projects. The unit also discusses the various aspects to be considered while preparing the project. Many people are uncertain about the difference between a project and a programme. In this unit we have discussed in detail the difference between a project and a programme. The various criterion for project appraisal, discounting and non-discounting techniques of project appraisal have also been discussed.

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2.8 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

1) Projects are the cutting edge of development. Projects are an investment activity in which financial resources are expended to create capital assets that produce benefits over an extended period of time.

2) The technical aspect of any project considers the technical feasibility. It concerns with the technical aspect of a project form both input supply side and output delivery side. For example if you want to take up an agricultural project in a region, you may have to examine the soil type of the region, water availability, crops grown, livestock breed suitable for the area, pests prevalent in the area etc.

Check Your Progress 2

1) Payback period is used with advantage in apprising investments for the following reasons:

   - The payback period may be considered roughly as the internal rate of return when annual cash flow is constant and the life of the project fairly long
   - The payback period is somewhat akin to the breakeven point.
   - The payback period also gives information about the rate at which the uncertainty associated with the project is resolved. The shorter the payback period, the faster the uncertainty associated with the project is resolved.

2) A BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. The benefit-cost ratio (BCR) represents the ratio of total benefits over total costs, both discounted as appropriate.

UNIT 3 PROJECT MANAGEMENT

Structure

3.1 Introduction

3.2 Project Management: Concept and Elements

3.3 Project Management Cycle

3.4 Project Management Techniques

3.5 Pre-requisites of Effective Project Management

3.6 Let Us Sum Up

3.7 References and Selected Reading

3.8 Check Your Progress: Possible Answer

3.1 INTRODUCTION

Project management has an important place in development as many of the urban development researchers and institutes are now days undertaking many research projects. Every project manger has to deal with different targets, different environment and different target groups. Appropriate knowledge and skill about the various aspects of project management will transform a project manger in to an excellent project manager. The project manager largely perform following roles: (i) plan the project along with other team members; (ii) prepare strategies, activities and arrange and allocate resources required for the achievement of project objectives; (iii) maintain relation between the project team, institution and the donor agency of the project; and (iv) successfully complete the project and disseminate its finding for the consumption of large audience. This unit deals in detail about the project management.

After reading this unit, you should be able to:

i) Define concept and elements of project management;

ii) Describe various steps of project management cycle;

iii) Explain various project management techniques; and

iv) Discuss different pre-requisites of effective project management.

3.2 PROJECT MANAGEMENT: CONCEPT AND ELEMENTS

3.2.1 Project Management Concept

Project management is an important concept and topic because now a days all organizations either big or small are involved in the implementation of various projects. Lewis has opined that although management of projects has been going on for thousands of years, the practice has been widely recognized as a discipline in its own rights for only about ten years.

Before going to explain project management, it is essential to known, what is a project? A project is generally described as an initiative to bring about change. This is done in order to achieve specific objectives, within a timescale and in a

given context. A project has normally an allocated budget. According to Project Management Institute "A project is any undertaking with a defined objective by which completion is identified. In practice most projects depend on finite or limited resources by which the objectives are to be accomplished." Viv Martin listed out following attributes of a project:

1) has a clear purpose that can be achieved in a limited time;

2) has a clear end when the outcome has been achieved;

3) is resourced to achieve specific outcomes;

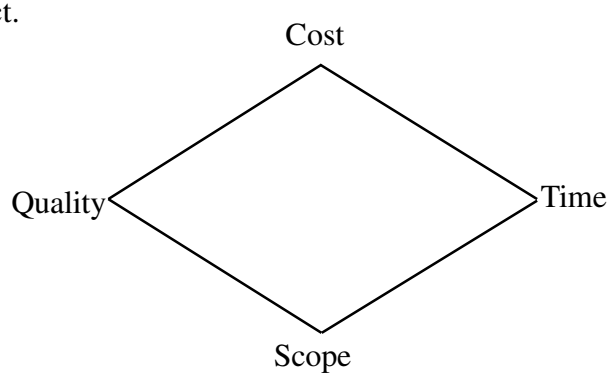
4) has someone acting as sponsor who expects the outcomes to be delivered on time; and

5) is a one-off activity that would not normally be repeated.

Project Management has been evolved one of the important areas in the area of urban development. According to Richard Newton (2008), project management has been developed over the past few decades as it has become apparent that without a structured approach, people are not very good at completing projects successfully. The principal aim of project management is to see that projects are well formulated, effectively implemented; completed in time and end result is achieved. The project management is largely encircled in four important factors i.e cost, time, scope and quality. According to PMBOK "project management is application of knowledge, skills, tools and techniques to project activities to achieve project requirements. Project management is accomplished through the application and integration of the project management processes of initiating, planning, executing, monitoring, controlling and closing."

3.2.2 Basic Elements of Project Management

The four basic elements of project management, which a project manager has to look into are: cost time, scope and quality. All these four elements are inter-connected and have to be managed effectively for the successful implementation of the project.



i) **Cost Management:** An efficient project manager is evaluated on his or her ability to complete the project within the stipulated budget. The costs include estimated cost, actual cost and variable cost. Besides, there is contingency cost which takes into account the influence of weather, supplier and design allowances.

ii) **Time Management:** Time management is one important skills for any successful project manager. Most of the project fails due to poor time management by the project managers. For the effective management of

time, a project has to broken down into number of tasks which are to be accomplished within time frame. To prepare the project schedule, the project manager has to figure out what the tasks are, how long they will take, what resources they require and in what order they should be done.

iii) **Scope Management:** The project manager at the outset need to clearly delineate scope of the project. The scope of the project will enable the project manager to judiciously plan required resources and manpower for the project. As project is time and cost bound, therefore, scope of the project needs to be appropriately framed within these constraints. Scope management comprises following main aspects such as authorizing the job, developing a scope statement that will define the boundaries of project, sub-dividing the work into manageable components with deliverables, verifying that the amount of work has been achieved and specifying scope change control procedures (Levis, 2007).

iv) **Quality Management:** Quality management is last but not least element of project management. The success of the project is judged by the yardstick of quality of work it has produced. The successful project manager maintains the balance between cost, quantity and quality. According Levis (2007) quality management includes both quality assurance and quality control. The former means planning to meet quality requirements and the later emphasises on the steps to be taken to monitor results to see if they conform to requirements.

In this section you studied the concept and elements of project management, 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 project?

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2) Time management is an important element of project management- Discuss.

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3.3 PROJECT MANAGEMENT CYCLE

Project cycle has six main phases which is given in the form of cycle wheel below. The six various phases of project management cycle are:

1) Need Identification
2) Initiation
3) Planning
4) Executing
5) Controlling
6) Closing

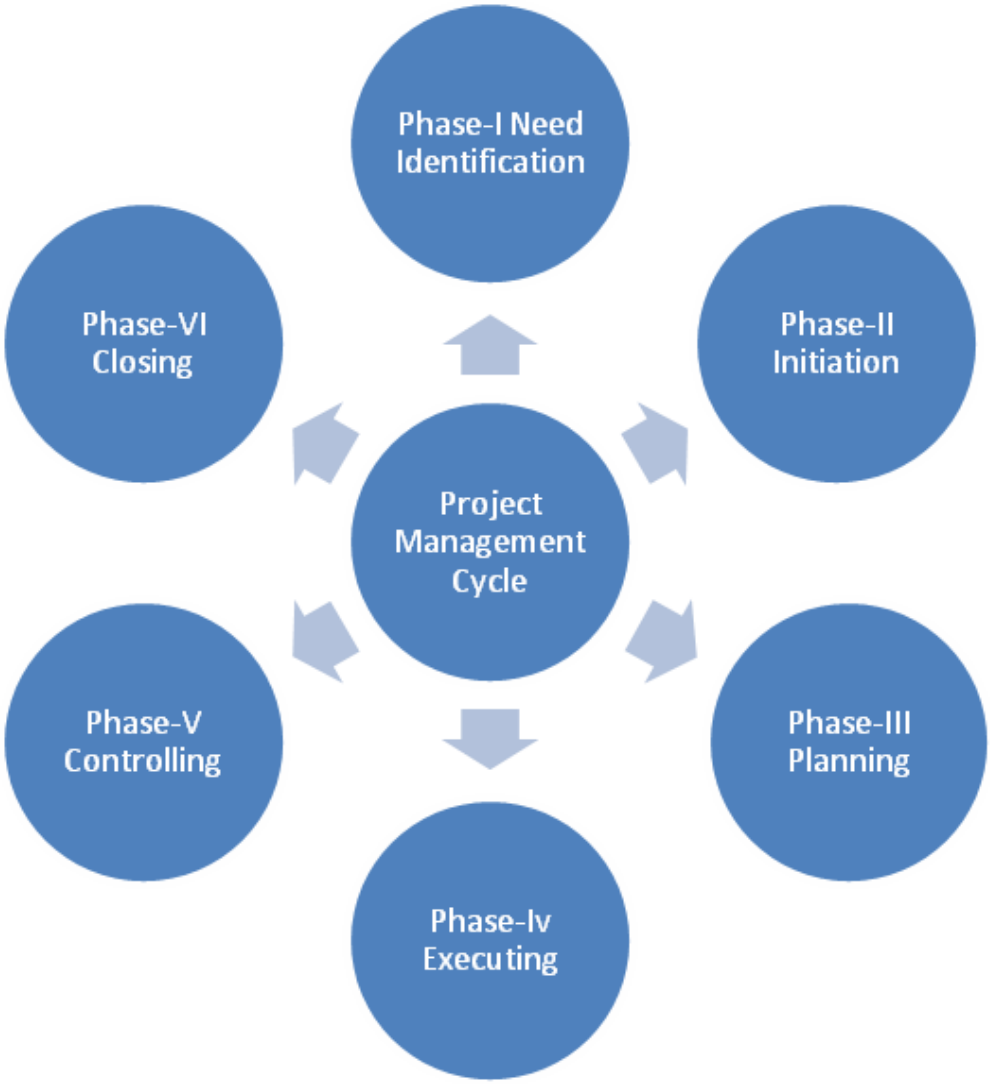

Fig. 3.1: Project Management Cycle

1) **Need Identification-** The development of project cycle begins with identification, whether there is a need of development project for a particular sector, area, community, etc. The identification usually comprises two main aspects i.e. situation analysis and problem analysis. Let us discuss these two important aspects in detail.

i) Situation Analysis

Understanding situation is the beginning of designing any development project or programme. Situation analysis broadly involves analysis of needs and assets, problem analysis and examining relevant interventions. According to Towen (2001) situation analysis is an activity which can firmly link planning to the realities in the field and thereby to the implementation of the project. The situation analysis may comprise analysis of the physical, economic, social, cultural and political environment within which the population live. Some of the development indicators to be used during the situation analysis of development of a project are: composition of population, housing, sanitation, health, employment, drinking water, education, land holding, industry, services etc. The context and type of information required is given in Table 3.1

Table 3.1: Information for Situation Analysis

Context	Type of Information
Socio-Demographic	➢ Population composition and distribution ➢ Household and family formation ➢ Education and health services ➢ Housing condition ➢ Sanitation and drinking water ➢ Access to communication / energy
Economic Activity	➢ Income ➢ Employment/workforce participation ➢ Wages ➢ Expenditure ➢ Standard of living/poverty
Socio-Cultural & Political	➢ Political structure ➢ Political participation ➢ Relevant laws, statues and policies ➢ Predominant social structure ➢ Gender role in the household ➢ Decision making pattern ➢ Condition of marginalized

ii) Problem Analysis

The second step in need identification is problem analysis. For understanding a situation to be influenced by a project, it is essential to know the problem conditions which constitute development constraints as well as their causes. Problem analysis is of prime importance to developmental project planning, as it strongly influences the design of all possible developmental interventions. Problem identification is a deductive process. It is a state of affairs or facts or figures that cause difficulties and sufferings. The problem analysis not only investigates What is wrong ? but also try to understand 'Why' and 'How' it is wrong ? in order to assign priority to the problem. It seeks to answer several questions these are:

★ What is the problem?

★ Why is this a problem?

a) What are the probable causes of the problem?

b) How serious is the problem?

★ Who are affected by the problem?

a) How many are they?

b) Where are they located?

c) What are their characteristics?

According to FAO, the problem tree is a visual problem-analysis tool that can be effectively used by both the field development staff and the community to specify and investigate the causes and effects of a problem and to highlight the relationship between them. The problem tree analysis helps to find out solutions by mapping out the anatomy of cause and effect around an issue.

The roots of the tree, is the lower part of the drawing, metaphorically represent the causes of the main problem. The tree trunk at the centre of the drawing represents the main problem and the tree branches, on the upper side of the drawing, provide a visual representation of the effects of the main problem.

Tips for Problem Analysis

★ Describe the key problem identified and its causes and effects.

★ Delineate how these problems affect the target group.

★ Explain how addressing the causes will lead to eradication of the key problem

★ The description should be clear, concise and convincing

★ For each specific problem selected, develop a problem tree

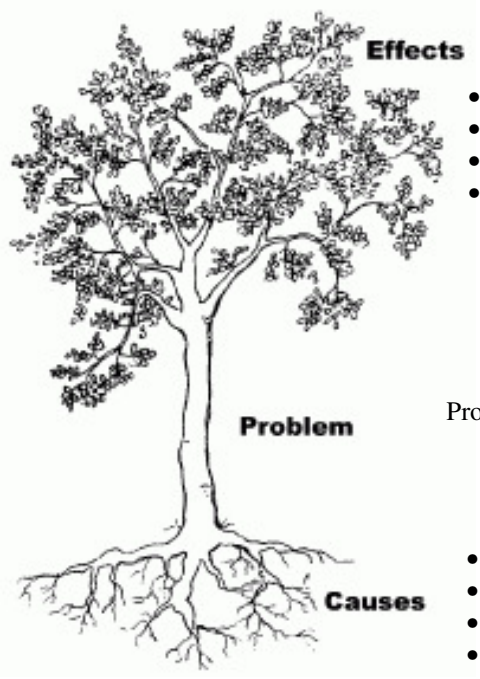

Fig. 3.2: Problem Tree of Urban Transport System

2) **Initiation-** Once the needs of the project are identified and decision is taken to do the project, the second step is to launch or initiate the project. There are number of activities associated in this stage. The project sponsor creates a project charter which delineates authorization of work on the project, define the authority, responsibility and accountability of the project team and establish scope boundaries of the project. The success of the project team veritably depends upon starting with complete and accurate information, management support and the authorization necessary to manage the project.

3) **Planning-** Planning phase is one of the important phases of the project cycle management. The project planning defines project activities that will be performed; the output that will be produced; and delineate how these activities will be accomplished and managed. Project planning defines each major task, estimates the time, resources and cost required, and provides a framework for management review and control. In other words, planning involves identifying and documenting scope, tasks, schedules, cost, risk, quality and staffing needs.

   The project manager, along with his project team prepares project plan and gets it approved from the management. The project plan is a comprehensive document that allows a project team to begin and complete the work necessary to achieve the project goal and objectives. The project plan will address how the project team will manage the project elements.

4) **Executing-** After the project plan is prepared, it gets ready for execution or implementation. The project team acquire all necessary resources required to carry out the project and ready to perform project activities. The project manger along with the project team put their energy and efforts in participating, observing and analysing the project activities so that the output is produced and goal and objectives of the project achieved. In other words one is to execute the work that must be done to come out with the product of the project. Further, executing also refers to implementing the project plan.

   In nutshell, executing refers to coordinating and managing the project resources while executing the project plan, performing the planned project activities and ensuring that they are completed efficiently.

5) **Monitoring/Controlling-** The functions of the project manger at this stage is to monitor and compare actual performance with the planned performance and take corrective measures to get the desired outcome when there are significant differences. By monitoring and measuring progress regularly, identifying variances from plan and taking corrective action if required, project control ensures that project activities are met.

6) **Closing out-** Closing out is the last but not the least phase of project cycle management. Once the output is produced to the customer's satisfaction, the project is considered finished. However, this should not be the case. A final lesson-learned review should be done before the project is considered complete. Failing to do the lessons-learned review means that future project will likely to suffer. Although project close out is a routine process, it is an important one. According to Haugey, project closure means formal acceptance of the deliverables and disbanding of all the elements that were required to run the project.

In this section you studied about the project management cycle and 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) Discuss the importance of problems analysis in need analysis?

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2) What are the functions of project manager during monitoring and controlling of the project.

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3.4 PROJECT MANAGEMENT TECHNIQUES

The project management techniques helps the project manager to complete the project activities successfully and effectively and achieve the project goal and objectives within the assigned time period and budget. Broadly project management techniques are two types:

i) Bar Charts

ii) Networks

3.4.1 Bar Chart

Bar Charts are the pictorial representation of various tasks required to be performed for accomplishment of the project objectives. The bar charts are of two types: (i) Gantt Chart and (ii) Milestone Chart

i) Gantt Chart

Henry L Gantt in 1917 developed a system of bar charts for scheduling and reporting of a project. These charts, latter were known as Gantt Charts. It is a pictorial representation specifying the start and finish time for various tasks to be performed in a project on a horizontal time scale. The Gantt chart as a tool is used:

√ To plan time scale of a project

- √ To estimate resources required for a project
- √ For graphical illustration of schedule of tasks to be completed
- √ Helps to plan coordinate and track specific tasks for project
- √ Good for small projects when the number of tasks or activities is small and not complex i.e. good for simple projects.

Table 3.2: Task and Time Line of a Gantt Chart

Task	Table	Time
1.	Planning of survey	1-3 Months
2.	Designing of Questionnaire	1-3 Months
3.	Hiring of Personnel	1-3 Months
4.	Training of Personnel	1-4 Months
5.	Collection of Data	2-6 Months
6.	Data Entry	3-10 months
7.	Data Analysis/Interpretation	3-10 Months
8.	Report Writing	11th Months

The activities formulated in Table 3.2 have to be converted in to bar diagram or chart form to be called as Gantt Chart. This is given below in graphical form. The horizontal axis depicts time and vertical axis represents tasks (Fig.3.3).

Task		Duration (Months)	1	2	3	4	5	6	7	8	9	10	11
1.	Planning of survey	1-3 Months											
2.	Designing of Questionnaire	1-3 Months											
3.	Hiring of Personnel	1-3 Months											
4.	Training of Peronnel	1-4 Months											
5.	Collection of Data	2-6 Months											
6.	Data Entry	3-10 Months											
7.	Data Analysis/ Interpretation	3-10 Months											
8.	Report Writing	11th Month											

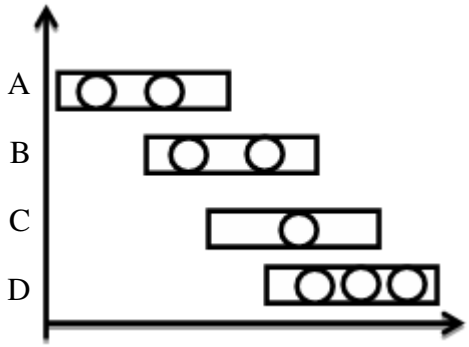
Fig. 3.3: Graphical Representation of Gantt Chart

Here the project manager has to draw bar chart as per the scheduled activities. For example activity A is project planning plotted in first bar and like wise each activity is plotted according to planned time line. Though Gnatt chart is comprehensive, convenient and very effective, it has limitation of handling complex projects.

ii) Milestone Chart

Milestone Chart is an improvisation over the Gantt Chart by introducing milestones. The milestone represents a circle over a taste in the bar chart which indicates completion of a specific phase of the task. This was used because by drawing a simple bar chart one can not monitor the progress of a particular task. In a milestone chart a task is broken down in to specific activities and after accomplishment of the specific activity a milestone is reached or in other words an event occurs.

Graph on Milestone



In this bar chart, milestones are represented in circle. For example in Task A, the milestone two can not be reached until the mile stone one is crossed and the activity between milestone one and two is over. For example in a socio-economic survey in an urban slum, the survey can not be possible unless questionnaires are prepared. Some of the weaknesses of the milestone chart are:

i) It does not show interdependence between tasks.

ii) It does not indicate critical activities.

iii) It does not consider the uncertainties associated with accomplishment of a certain task.

iii) It will be always cumbersome to draw the chart for large projects.

3.4.2 Networks

The best-known technique for network analysis is Programme Evaluation and Review Technique (PERT) developed during 1956-1958. The PERT was developed for US navy for scheduling the research and development activities for Polaris Missiles Programme. The heart of any PERT chart is a network of tasks needed to complete a project, showing the order in which the tasks need to be completed and the dependencies between them. Some of the **key features** of net work are:

√ It is a graphical depiction of project tasks and their inter-relationships.

√ The important feature of network diagram is that the ordering of Tasks is shown by connecting with it predecessor and successor tasks.

√ Net work diagramming is a Critical Path Scheduling Technique used for controlling resources.

√ **Critical Path Scheduling** is a technique whose order and duration of sequence of task activities directly affect the Completion date of a project.

A few **steps to be followed** in network analysis are:

i) Specify the individual activities:- All the activities in the project are listed and this list can be used as the basis for adding sequence and duration information in the later steps.

ii) Determine the sequence of those activities:- Sequencing is important because some activities are dependent on the completion of other activities.

iii) Estimate the completion time for each activity: - The time required to complete each activity can be estimated using past experience.

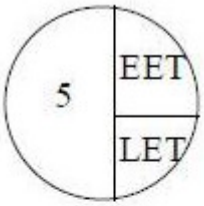
iv) Draw a network diagram:- Once the activities and their sequences have been defined, the network diagram can be drawn.

v) Identify the Critical path:- The Critical Path is the longest duration path through the network. The significance of the critical path is that the activities that lie on it cannot be delayed without delaying the project. Because of its impact on the entire project, critical path analysis is an important aspect of project planning.

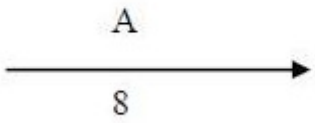
vi) Update the diagram as it progress:-As the project progress, the actual task completion times will be known and the network diagram can be updated to include this information. A new critical path may emerge and structural change made.

During the process of project implantation, some activities would be dependant on the completion of other activities. For example training of personnel for survey depends on completion of hiring of personnel, design of questionnaires and printing of questionnaire. All these activities have to be completed for achieving the milestone of training of personnel.

Symbols to be used to create a network diagram are given below:



Event



Activity

Dummy event

An **arrow** is used to represent each activity or tasks to accomplish and the duration of the activity is recorded below the arrow e.g. hours, days or months.

Each activity or task that happens, has preceding event (circle) and each circle is pre-numbered e.g. above circle '5' is used as example to how this would be the 5th event.

The **earliest event time** (EET) displays the earliest time an activity (represented by an arrow) can start, given the interdependence of other activities that would be completed beforehand.

The **latest event time** (LET) for an activity is recorded in the circle following the activity (arrow) e.g. the latest time an activity must be completed by, in order to achieve the elapsed time of the project.

A dummy activity is used when a task or activity (represented by an arrow) follows more than one preceding activity e.g. the arrow could be drawn from more than one potential circle in the diagram.

An example of network analysis is given in the tabular as well as diagrammatic form below.

Table 3.3: Project on conduction of household socio-economic survey

Activity	Duration (in Weeks)	Preceded by activity
A: Preparation of Questionnaire	5	—
B: Recruitment and Training of field investigator	4	—
C: Conduction of Survey	3	A B

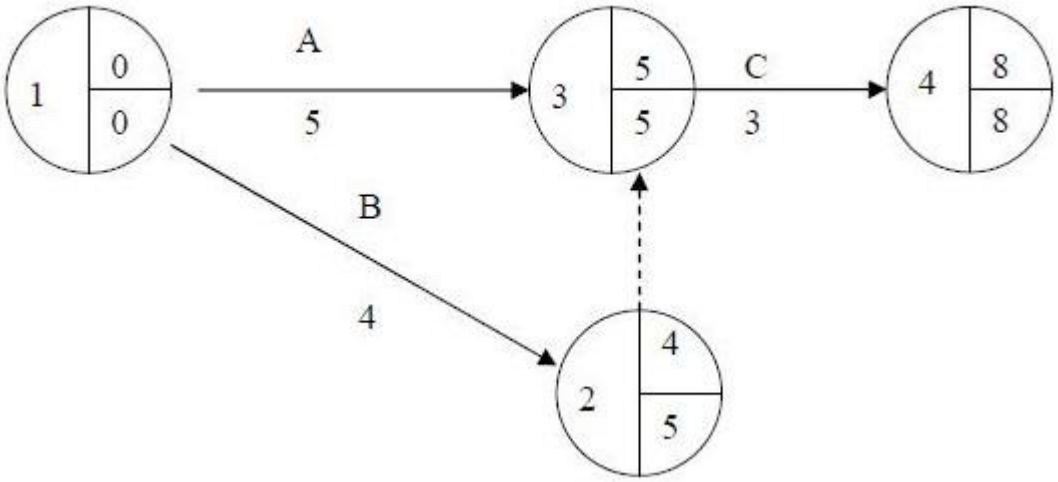


Fig. 3.3: Networking Diagram

The networking technique for the conduction of a socio-economic survey in a urban slum. Here in this project activity 'C' that is conduction of survey depends a 'A' and 'B' activities such as preparation of questionnaire and recruitment of field investigators, and their training. Whenever you see an activity with more than one preceding activity, a dummy activity (broken arrow) will be required to

preserve logic within the diagram. Here, activity B is having more than two activities.

Explanation

- The elapsed (expected completion) time of the project is 8 weeks.
- The critical path activities are A and C that is both must be completed within their predicted durations, otherwise the project will be longer in duration than 8 weeks. Notice how the EET and LET of critical activities are identical.
- Activity B is non-critical activity and would have a 'float time' of 1 week. This is because its predicted duration is 4 weeks, but it can take 5 week to complete and still leave enough time left for activity C to completed, the elapsed time of the project will still be achieved. Notice how the EET and LET of non-critical activities are different; the difference is 1 week e.g. the float time, when you deduct one from the other.
- The broken arrow (or dummy activity) preserves logic within the diagram e.g. visually you can see that both activities A and B must be completed, before C can start. Notice also that the arrow representing activity C start from circle 3 (not circle 2), this is because the earliest time for C would be 5 weeks not 4 weeks as circle 2 displays.

Some of the benefits of network technique are:

i) It provides a graphical view of the project;

ii) It predicts the time required completing the project;

iii) It shows which the activities to be started simultaneous and the activities critical to the project;

iv) It highlights 'float times' for all activities;

Definitions of a few terms required in Network analysis are given below:

i) Activity – Customarily an activity consumes time and resources. It may include paper work in preparation of project proposal, conduction of survey, etc.

ii) Critical Path – A critical activity or event is one which has to be performed by a certain time. The critical path is the longest path through a network and determines the earliest completion of project work.

iii) Events – Beginning and ending points of activities are known as events.

iv) Milestone – This is an event that represents a point in a project of special significance. Usually it is the completion of a major phase of the work.

v) Network – Networks are called arrow diagrams. They provide a graphical representation of a project plan showing the relationships of the activities.

3.5 PREREQUISITES OF EFFECTIVE PROJECT MANAGEMENT

Some of the knowledge and skill required for the effective project management are as follow:

1) **Project Integration Management:-**Project integration management ensures that the project is properly planned, executed, and controlled. In other words, every activity of the project must be well coordinated or integrated. The project is a culmination of activities and tasks and an integrated approach will enable the project to achieve its goal and objectives effectively. There must be proper coordination at each level from the management down the line workers level. It is studied that the project fails to achieve it goal at the grassroots level because of lack of people's participation. There many project findings have suggested that the community must be integrated into the whole process of project i.e planning, formulation of strategies, implementation as well as controlling of various project activities.

2) **Project Time Management:-** In time completion of project not only gives a credit to the manager of but also can ensure further projects to the organization. Project time management refers to developing a time schedule that can be met and then controlling the activities to ensure that it happens. An efficient project manager tries to effectively manage the time and achieve the project tasks within the allocated time period. Taking long time adds to the inefficiency of the project. While taking too less time sometimes put question mark on the quality of the project delivery.

3) **Project Cost Management:-** Cost management implies that project should be completed within the formulated budget. Therefore, proper estimation of the cost of resources i.e. manpower, equipment, materials and other things like travel and other miscellaneous expenses. Cost are budgeted and tracked to keep the project within the budget. The project cost must be appropriately budgeted. For example, in most of the action research project the expenditures on project interventional activities needed to be more compared to hiring of manpower. Some times good project proposals are rejected not for the technical but for the financial bid. Therefore costing is critical to project management.

4) **Project Human Resource Management:-** Human resources are key to project. It is supreme over all other resources. It involves identifying the people needed to do the job, defining their roles, and responsibilities. Acquiring efficient people as per their job requirement is critical to project management. Besides training and capacity building of the manpower is also important to human resources management. The human resource management also includes the salary packages, leisure and medical and other benefits. Sometimes project staffs are less motivated to work for poor benefits. Therefore, many organization depute its efficient staff to the project by offering them higher salary and grade.

5) **Project Quality Management:-** The balancing between the quantity and quality of project deliverables is central to effective project management. Maintenance of quality is vital to project and any compromise with the quality will lead to dissensions among the project team and the beneficiaries. The quality of input and out put of the project must be clearly visible. The qualified and experienced manpower employed in the project can effectively and efficiently manage the project then their counter parts those were less qualified and less experienced. Nepotism in selection process is a deterrent to quality.

6) **Project Communication Management:-** Communication Management refers to planning, executing, and controlling the acquisition and dissemination of all information relevant to the needs of all project stakeholders. Transparency in communication is an accountability of the project manger. Democratic way of communication where all the stakeholders participate and share their opinion regarding various aspects of project is critical to a good project proposal formulation. Communication and dissemination of findings of the project not only helps the policy makers to formulate policy but also helps the organization to fetch more projects.

7) **Project Risk Management:-** Risk Management is a systematic process of identifying, quantifying, analysis and responding to project risk. Higher is the risk lower is the efficiency and effectiveness of the project. The efficiency and effectiveness of a project is influenced by the risk factor. For example the training of Commercial Sex Workers on HIV/AIDS in urban slum depend on the identification of CSWs which is a risk factor. According to Lewis it includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of advance events to project objectives. It is an extremely important aspect of project management.

In this section you studied about the project management technique and pre-requisites of effective project management and 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) Briefly discuss Gantt Chart

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2) Cost management and time management are the important prerequisites of project management- Discuss

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3.6 LET US SUM UP

Project Management is an important area of development, as all organizations big or small are implementing one or the other projects. The viability of many organization some times solely depends on projects. Besides, the funding agencies also needed to have adequate knowledge about the project management. The present unit at the outset has described the meaning and basic elements of project management. The second aspect which has been thoroughly covered in the unit is project cycle management. Later on, the project management technique which is vital to any project management has been discussed. The two techniques customarily used in project management are Gantt chart and Networks. The technicality in dealing with the project is judged from the technique used in project formulation. The last part of the unit contains the skill required for the project manager for the effective management of project.

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2.7 CHECK YOUR PROGRESS: POSSIBLE ANSWERS

Check Your Progress 1

1) What do you mean by project?

   A project is generally described as an initiative initiated to bring about change. This is done in order to achieve specific objectives, within a timescale and

in a given context. A project has normally an allocated budget. Viv Martin lists out the following attributes of a project:

6) has a clear purpose that can be achieved in a limited time;

7) has a clear end when the outcome has been achieved;

8) is resourced to achieve specific outcomes;

9) has someone acting as sponsor who expects the outcomes to be delivered on time; and

10) is a one-off activity that would not normally be repeated.

2) Time management is an important element of project management- Discuss.

Time management is one the important skills for any successful project manager. Most of the project fails due to poor time management by the project managers. For the effective management of time, a project has to broken down into number of tasks which are to be accomplished within time frame. To prepare the project schedule, the project manager has to figure out what the tasks are, how long they will take, what resources they require and in what order they should be done.

Check Your Progress 2

1) Discuss the importance of problems analysis in need analysis?

Problem analysis is of prime importance to developmental project planning, as it strongly influences the design of all possible developmental interventions. Problem identification is a deductive process. It is a state of affairs or facts or figures that cause difficulties and sufferings. The problem analysis not only investigates What is wrong ? but also try to understand 'Why' and 'How' it is wrong ? in order to assign priority to the problem. It seeks to answer several questions these are:

- ★ What is the problem?
- ★ Why is this a problem?
  - c) What are the probable causes of the problem?
  - d) How serious is the problem?
- ★ Who are affected by the problem?
  - d) How many are they?
  - e) Where are they located?
  - f) What are their characteristics?

2) What are the functions of project manager during monitoring and controlling of the project.

The functions of the project manger at this stage is to monitor and compare actual performance with the planned performance and take corrective measures to get the desired outcome when there are significant differences. By monitoring and measuring progress regularly, identifying variances from plan and taking corrective action if required, project control ensures that project activities are met.

Check Your Progress 3

1) Briefly discuss Gantt Chart

Henry L Gantt in 1917 developed a system of bar charts for scheduling and reporting of a project. These charts, latter were known as Gantt Charts. It is a pictorial representation specifying the start and finish time for various tasks to be performed in a project on a horizontal time scale.

2) Cost management and time management are the important prerequisites of project management- Discuss

The cost and time management are important challenges before a project manager. The task which he/she has to perform are narrated one by one

i) **Project Time Management:** Intime completion of project not only gives a credit to the manager of but also can ensure further projects to the organization. Project time management refers to developing a time schedule that can be met and then controlling the activities to ensure that it happens.

ii) **Project Cost Management:** Cost management implies that project should be completed within the formulated budget. Therefore, proper estimation of the cost of resources i.e. peoples, equipment, materials and other things like travel and other miscellaneous expenses. Cost are budgeted and tracked to keep the project within the budget.

MEDS-044 MONITORING AND EVALUATION OF PROJECTS AND PROGRAMMES

BLOCK 1 : PROJECT FORMULATION AND MANAGEMENT

Unit 1 : Project Formulation

Unit 2 : Project Appraisal

Unit 3 : Project Management

BLOCK 2 : MONITORING AND EVALUATION

Unit 1 : Programme Planning

Unit 2 : Monitoring

Unit 3 : Evaluation

BLOCK 3 : MEASUREMENT AND SAMPLING

Unit 1 : Measurement

Unit 2 : Scales and Tests

Unit 3 : Reliability and Validity

Unit 4 : Sampling

BLOCK 4 : DATA COLLECTION AND ANALYSIS

Unit 1 : Quantitative Data Collection Methods and Devices

Unit 2 : Qualitative Data Collection Methods and Devices

Unit 3 : Statistical Tools

Unit 4 : Data Processing and Analysis

Unit 5 : Report Writing

MEDS-044
Monitoring and Evaluation of
Projects and Programmes

Indira Gandhi National Open University
School of Extension and Development Studies

Project Formulation and Management 1

Indira Gandhi National Open University
School of Extension and Development Studies

MEDS-044
Monitoring and Evaluation of Projects and Programmes

Block

2

MONITORING AND EVALUATION

UNIT 1
Programme Planning **5**

UNIT 2
Monitoring **16**

UNIT 3
Evaluation **29**

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BLOCK 2 MONITORING AND EVALUATION

Programme planning is a pre-requisite for any kind of development programme to: ensure what is to be done and why?; identify actions to be taken; distinguish desired/intended and undesired/unintended goals and objectives; allocate resources to achieve goals ; ensure continuity of the project, and; accomplish programme objectives in cost-effective and time-effective manner. Therefore, the purpose of this block is to make you understand the basic concepts of programme planning, monitoring and evaluation.

Unit 1, **Programme Planning,** focuses on meaning of different terms related to programme planning, importance and principles of programme planning, different phases and sub-phases in programme planning process.

Unit 2, **Monitoring,** introduces the concept and scope of monitoring in development programmes. The various elements, types, techniques, approaches and indicators of monitoring are also covered in this unit.

Unit 3, **Evaluation,** discusses the meaning, features, types, designs, methods and approaches of evaluation of development programmes.

UNIT 1 PROGRAMME PLANNING

Structure

1.1 Introduction

1.2 Meaning of Programme Planning

1.3 Objectives of Programme Planning

1.4 Need Identification in Programme Planning

1.5 Principles of Programme Planning

1.6 Programme Planning Process

1.7 Let Us Sum Up

1.8 Keywords

1.9 References and Selected Readings

1.10 Check Your Progress – Possible Answers

1.1 INTRODUCTION

The first step in any systematic attempt to promote urban development is to prepare useful programmes based on people / community needs. The development of such programmes, which harmonize with the needs of people as a whole, is an important responsibility of urban development workers. Programme planning is also a procedure of working with the people in an effort to recognize unsatisfactory situations or problems, and to determine possible solutions, or objectives or goals. This is a conscious effort to meet the needs, interests and wants of people for whom the urban developmental programmes are intended. Hence, the element of people needs should be the central concern of urban development professionals who formulate / implement development programmes.

After studying this unit you should be able to:

- discuss meaning, objectives and principles of programme planning process.
- describe the programme planning process.

1.2 MEANING OF PROGRAMME PLANNING

Before going into the details of programme planning process, let us understand the meaning of the terms like *programme, plan and programme planning* in the context of urban development.

Programme: Programme is a written statement which describes proposed developmental activities, the problems they address, the actions, and resources required.

Plan*:* Plan is schedule of development work outlining different activities in a specific period. It answers the questions like what, why, how, and when as well as by whom and where the work is to be done.

Programme planning: Programme planning is the process of making decisions about the direction and intensity of development education efforts to bring about desirable change among people /community.

Development programme: Development programme is a statement of situation, objectives, problems, strategies and solutions to development problems and issues. The development programmes formulated for the urban may be different from that of the rural areas. Development programmes varies from time to time depending on the issues and problems cropped up at that particular period.

Good programme planning is to the urban development worker what the compass is to the seaman.

Let us briefly discuss the terms / related terms used in this definition.

Situation: Situation is a statement of affairs that includes the cultural, social, economic and physical conditions in which a particular group of people find themselves at a given period of time. Please remember the situation which constitutes the environment for planning is continuously changing. The changing environment aspects that are relevant to development work are:

- Changes in technology.
- Changes in Government policy.
- Changes in overall economic activity including prices, employment of labour, raw material etc.
- Changes in social norms and attitudes of people towards development.

Aims: Aims are generalized and broad statement of directions with respect to given activities.

Example: Improvement of economic condition of urban slum women through Self Help Groups.

Objectives*:* Objectives are expression of ends towards which our efforts are directed. The dictionary meaning of objective is 'something that one's efforts or actions are intended to attain or accomplish'.

Example: Improvement of slum women's economic condition by 20 percent through Self Help Groups.

Goal: Goal is the distance in any given direction one expects to go during a given period of time.

Example: Improvement of slum women's economic condition by 20 percent through income generating activities of Self Help Groups in one year.

Problem : Problem is an issue or obstacle which makes it difficult to achieve a desired goal, objective or purpose. It refers to a situation, condition, or issue that is yet unresolved. In a broad sense, a problem exists when an individual becomes aware of a significant difference between what actually is and what is desired.

Example: In society, a problem can refer to particular social issues, which if solved would yield social benefits, such as increased harmony or productivity, and conversely diminished hostility and disruption.

Goal

If we could but know where we are now, and where we ought to go, we could better judge what to do, and how to do it.

- Abraham Lincoln

Solution: Solution is a course of proposed action to change an unsatisfactory condition to one that is more satisfying.

Example: Decrease in traffic congestion on the roads by providing good urban mass transport system under Jawaharlal Nehru National Urban Renewal Mission (JNNURM).

Calendar of Work: Calendar of work is a plan of activities to be undertaken in a particular time sequence.

Example : Pulse polio programme on first Sunday of every month in all urban slums during the year 2013.

1.3 OBJECTIVES OF PROGRAMME PLANNING

Properly planned development programme gives many benefits. Objective of any developmental programme is to influence people to make changes in their way of life and in making a living. The postulation is that, there is need for change and if people are not aware, it is necessary to make them aware of this and to develop their needs. Important objectives of having a programme planning as per Kelsey and Hearne (1966) are as follows.

i) To ensure careful consideration of what is to be done and why.

ii) To furnish a guide against which to judge all new proposals.

iii) To establish objectives toward which progress can be measured and evaluated.

iv) To have a means of choosing the important / deep rooted from incidental / minor / less important problems and the permanent from the temporary changes.

v) To develop a common understanding about the means and ends between various functionaries and organizations.

vi) To ensure continuity during changes in personnel.

vii) To help develop leadership.

viii) Avoid wastage of resources, money and promote efficiency.

ix) To justify expenditure and ensure flow of funds.

x) To have available a written statement for public use.

1.4 NEED IDENTIFICATION IN PROGRAMME PLANNING

Efforts to promote change through development programmes are successful only to the extent they are focused on the important needs of the people and are effective in helping people meet these needs. In development programmes, people participate only when they think that the programme is valuable to them in meeting personal, family, group or community needs which they themselves recognize. The element of need and need identification therefore, should be the

People concern themselves with urban development programmes only on the basis of needs as they see them, not programme planners view them.

fundamental concern in urban development programmes. In short people concern themselves with urban development programmes only on the basis of needs as they see them, not programme planners view them.

Urban programmes developed based on the needs *by* the people, *for* the people and *of* the people have best chances of success

Successful programme planning is one of identifying accurately what people want, think they need, and actually getting these items converted into a realistic well organized and concerted series of forceful developmental activities- this may properly called a programme. Effective programmes to promote change are developed through finding people's needs and arranging action that helps meet them. Hence, a clear understanding of the nature and role of people's needs in programmes is essential to the urban development workers like you.

1.5 PRINCIPLES OF PROGRAMME PLANNING

Planning of urban development programme is to be done on the basis of well recognized principles which should be clearly understood and followed. The main principles are:

i) Programme-planning should be based upon a careful analysis of a factual situation.

ii) Problems for action are selected on the basis of recognized needs of people.

iii) Objectives and solutions are to be feasible and offer satisfaction.

iv) Programme should be permanent and flexible to meet a long-term situation, short-term changes, and emergencies.

v) Programme should have both balance and emphasis.

vi) Programme should have a definite plan of work.

vii) Programme planning is a continuous and coordinating process.

viii) Programme planning should be educational and directed towards bringing about desirable change.

ix) Programme planning should have a provision for the evaluation of results.

JNNURM vs. Principles of Programme Planning

India's National Common Minimum Programme attaches the highest priority to the development and expansion of physical infrastructure. Accordingly, JNNURM was planned for urban renewal and expansion of social housing in towns and cities, paying attention to the needs of slum dwellers. The Millennium Development Goals commit the international community, including India, to an expanded vision of development as a key to sustaining social and economic progress. As a part of its commitment to meet the Millennium Development Goals, the Government of India under JNNURM proposes to: (i) facilitate investments in the urban sector; and (ii) strengthen the existing policies in order to achieve these goals. Since cities and towns in India constitute the second largest urban system in the world, and contribute over 50 per cent of the country's GDP, they are central to economic growth. For the cities to realise their full potential and become effective engines of growth, it is necessary that focused attention be given to the improvement of infrastructure under JNNURM.

Activity 1

Visit a nearby any development department and enquire about urban development programmes. Write your observations.

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Check Your Progress 1

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What do you mean by development programme planning?

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2) Do you agree that proper planning enhances the success of urban development programmes? Support your answer.

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3) Write any four principles of programme planning.

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1.6 PROGRAMME PLANNING PROCESS

Three phases involved in programme planning process are:

i) Programme formulation

ii) Programme execution

iii) Programme evaluation

These three phases have the following 8 sub-processes as shown in Fig.1.1

i) Collection of facts and analysis

ii) Identification of problems

iii) Determination of objectives

iv) Developing the plan of activities

v) Carrying out the activities

vi) Continuous checking

vii) Evaluation of results

viii) Reconsideration

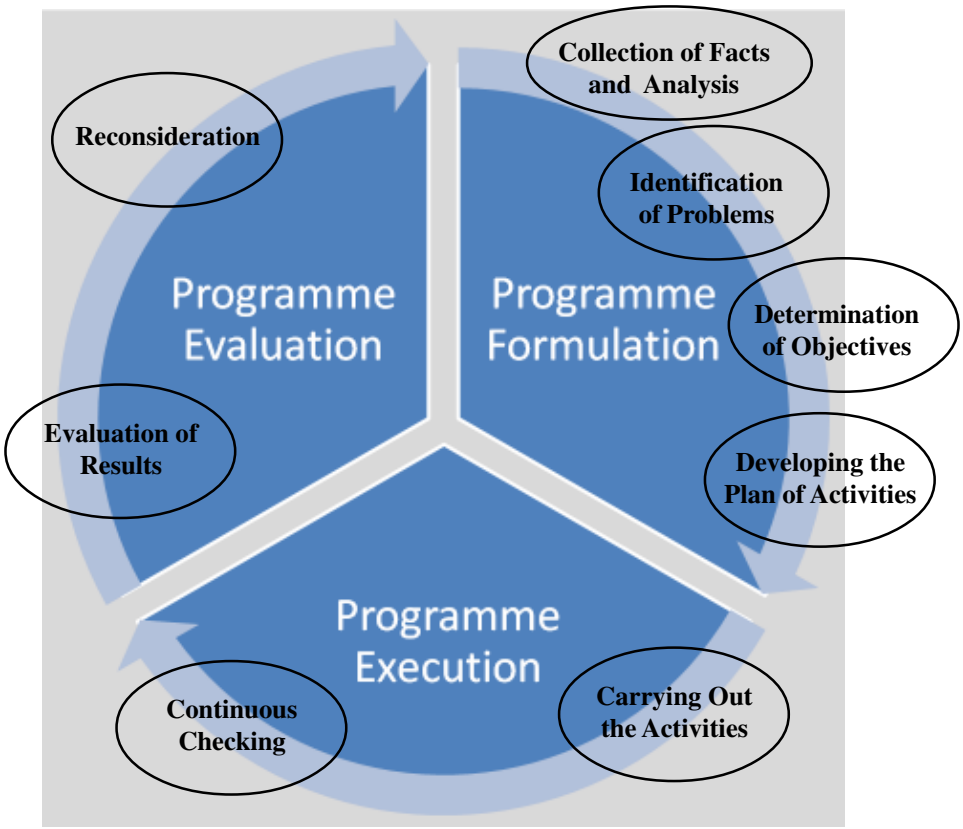


Fig. 1.1: Development Programme Planning Process

1.6.1 Collection of Facts and Analysis

Urban development workers must have adequate knowledge of socio, economic, cultural and psychological status of people and how to involve them in the process of development. In general, information on the following items should be collected.

a) Number of beneficiaries

b) Educational status of beneficiaries

c) Communication facilities

d) Socio- economic status

e) Availability of common / community facilities

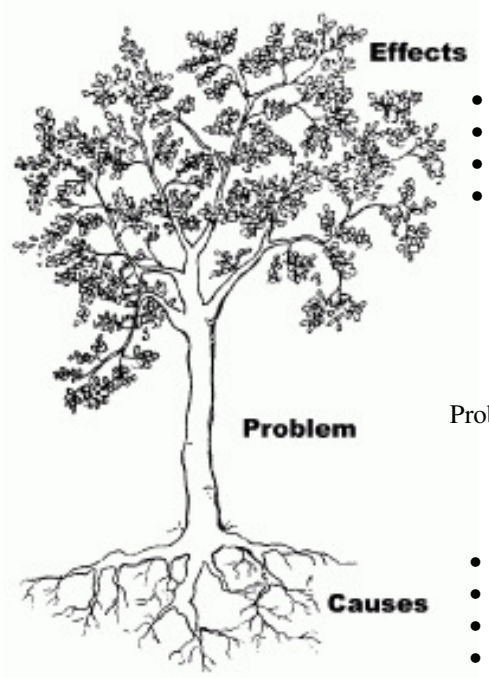
f) General health of the community

g) Customs, traditions, institutions, peoples' organizations operating in the area, etc.

The tools and techniques for collecting data include systematic observations, interviewing the people and surveys, existing governmental records, census reports, and the past experiences of the urban development workers. After collecting facts, they are analyzed and interpreted to find out the problems and needs of the people.

1.6.2 Identification of Problems

As a result of the facts analysis, the important gaps between 'what is' and 'what should be' are identified and the problems leading to such a situation are to be located. These gaps represent the people's needs. For your understanding, problem of urban transport system is given in Fig. 1.2



- Traffic congestion
- Longer commuting
- Environmental pollution
- Low safety & accidents

Problem of Urban Transport System

- High population
- Transport demand exceeding supply
- Loads of personal vehicles
- Low investments in public transport systems

Fig. 1. 2: Problem of Urban Transport System

From the Fig. 1.4, we can identify various direct and indirect causes for the problem of urban transport. Some of the interrelated reasons are: the high population is leading to exceeding of demand compared to supply and therefore people have to use personal vehicles. These are leading to traffic congestion, longer travel time, environmental pollution, low safety and increased possibility for accidents.

1.6.3 Determination of Objectives

Once the needs and problems of the people have been identified, they are stated in terms of objectives and goals. The objectives represent a forecast of the changes in the situation or change in behaviour of the people to be brought about. The objectives may be long-term as well as short-term and must be stated clearly.

Example: To solve the problem of urban transport system as identified above, the objectives for a one year 'Mitigating Urban Transport Problem' project could be:

a) To educate commuters on the benefits of using public mass transport system.

b) To reduce the number of vehicles on the roads at least by 20 % by encouraging pooling of commuters.

1.6.4 Developing the Plan of Activities

In order to achieve the stated objectives, the means and methods attaining each objective are selected and the action plan, i.e. the calendar of activities is developed. It includes the technical content, who should do what, and the time-limit within the work will be completed. The plan of work may be seasonal, short-term, annual or long-term.

Example: Prepare the following schedule of activities, print and distribute to all concerned related to above objectives.

- Developing urban transport extension literature on benefits of public mass transport system like Metro viz., :
  - Time saving for commuters
  - Reliable and safe journey
  - Reduction in atmospheric pollution
  - Reduction in accident
  - Reduced fuel consumption
  - Reduced vehicle operating costs
  - Increase in the average speed of road vehicles, etc.
- Using the above literature, conduct awareness campaigns (6-7 in a month) targeting offices (1st Monday), schools (2nd Monday) and public places (all Sundays) on the benefits of public mass transport system.
- Through individual and group contact methods, persuade at least 20 % of personal vehicles users to shift from individual to pooled vehicles.

1.6.5 Carrying out the Activities

Once the action plan has been developed, arrangement for supplying the necessary inputs, teaching aids, urban transport extension literature etc. has to be made and the specific action has to be initiated. The execution of the plan of activities is to be done through extension methods for stimulating individuals and groups to think, act and participate effectively. People should be involved at every step to ensure the success of the programme.

1.6.6 Continuous Checking

Follow-up the activities carried out at regular intervals. Keep adequate records of each activity as a base for evaluation of results.

1.6.7 Evaluation of Results

It is done to measure the degree of success of the programme in terms of the objectives set forth. This is basically done to determine the changes in situation or the behaviour of the people as a result of the programme. The evaluation is done not only of the physical achievements but also of the methods and techniques used and of the other steps in the programme-planning process, so that the strong and weak points may be identified and necessary changes made in the subsequent programmes.

1.6.8 Reconsideration

The systematic and periodic evaluation of the programme will reveal the weak and strong points of the programme. Based on these points the programme is reconsidered and the necessary adjustments and changes should be made in order to make it more meaningful and sound.

Remember that programme-planning is not the end-product of urban development activities, but it is an educational tool for helping people to identify their own problems and make timely and judicious decisions. In the above mentioned steps, it is clear that the planning of mitigating urban transport problem comprises a logical series of consecutive steps. Similarly development programmes can be formulated in any other sub-sectors of urban development. The first 4 steps form the programme planning phase. The steps 5-6 form the action-phase. The steps 7-8, joins the two phases together, where it leads to the fact-collecting step, thus beginning once again the never ending or continuous process of planning the urban development programme.

Check Your Progress 2

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Write the three phases in programme planning.

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1.7 LET US SUM UP

In this unit we started by looking into the definitions of the terms programme, plan and programme planning and understood what they mean in the context of urban development. We examined the importance and principles of programme planning. In the last section we studied different phases and sub-phases in programme planning process with a practical example.

1.8 KEYWORDS

Programme : Programme is a written statement which describes proposed activities, the problems they address, the actions, and resources required.

Plan : Plan is schedule of development work outlining different activities in a specific period.

Programme Planning : Programme planning is the process of making decisions about the direction and intensity of extension education efforts to bring about desirable change among people.

Calendar of Work : It is a time schedule of work consisting activities arranged chronologically.

Extension Programme : It is a statement of situation, objectives, problems, and solutions.

1.9 REFERENCES AND SELECTED READINGS

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1.10 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

1) Development programme is a statement of situation, objectives, problems, and solutions..

2) Yes. Proper planning of urban development programmes enhances the success by: avoiding wastage of resources; providing guidance; maintaining continuity and sequence; providing reliable information and ; facilitating institutional and local support.

3) The main principles programme planning are: careful analysis of a factual situation; selection of problems on the basis of recognized needs of people;

set the feasible objectives which offer satisfactory solutions; permanent and flexible to meet a long-term situation, short-term changes, and emergencies; educational and directed towards bringing about desirable change and provides for the evaluation of results.

Check Your Progress 2

1) The three phases involved in programme planning process are (i) : Programme formulation (ii) Programme execution and (iii) Programme evaluation.

UNIT 2 MONITORING

Structure

2.1 Introduction
2.2 Meaning of Monitoring
2.3 Monitoring: What, Why, When and by Whom
2.4 Basic Concepts and Elements in Monitoring
2.5 Types of Monitoring
2.6 Tools and Techniques of Monitoring
2.7 Indicators of Monitoring
2.8 Let Us Sum Up
2.9 References and Selected Readings
2.10 Check Your Progress - Possible Answers

2.1 INTRODUCTION

Projects are the 'cutting edge' of urban development. The most difficult single problem of project managers is the proper implementation of urban development programmes and projects. However well a project has been conceived and planned, if the implementation is not proper, it will result in inefficient and wasteful loss of scarce resources. India has been a fore runner in formulating enormous number of programmes and projects for urban development. Review of these projects suggests that monitoring and appropriate mid course corrective measures are central to achieving project goals. In the light of the above, Monitoring and Evaluation (M&E) is increasingly recognized as an indispensable tool of both project and portfolio management. There is a wide felt need to improve the performance of development projects. M&E provides a basis for accountability in the use of development resources and is an integral and important part of the project cycle. No project can be complete or successful without a proper M & E. According to World Bank (2004) M&E of development activities provide government officials, development managers and civil society with better means for learning from past experience, improving service delivery, planning and allocating resources, and demonstrate results as part of accountability to key stakeholders. Within the development community there is a strong focus on results – this helps explain the growing interest in M & E.

After studying this unit, you will be able to:

- explain what, why, when and how of monitoring.
- identify key elements in monitoring.
- discuss various types of monitoring.

2.2 MEANING OF MONITORING

The word "monitor" is derived from the Latin word meaning to 'warn' and "evaluate" stems from the word 'value'. *Monitoring* is an integral and important part of a management information system. Managers require information to keep

track of development programme, to guide its course of action. *A management information system* is a scheme by which the "right" information is obtained in the right amount, at the right time and is made available to the right person or persons. An information system is usually created in organizations to cater to the information needs of management.

Management information system include six kinds of information: (1) diagnostic information (why a situation is as it is), (2) implementation information (physical and financial or input information), (3) utilization information, (4) impact information, (5) situation information, and (6) information for review.

A monitoring system is a subsystem of a management information system and has several distinguishable components. Top management receives information from the monitoring unit and from other formal and informal sources. This influences programme implementation, leads to better programme planning, and ensures sustainability of programmes. Ultimately this leads to institutional development.

2.3 MONITORING: WHAT, WHY, WHEN AND BY WHOM

Monitoring is a continuous / periodic review and surveillance by the project management, at every level of the implementation of an activity to ensure that input deliveries, work schedules, targeted outputs and other required actions are proceeding according to plan. Availability of a 'plan' is a pre-condition for monitoring.

Another way of defining Monitoring is that it is a process of measuring, recording, collecting, processing and communicating information to assist project management decision-making. To be precise and brief, "monitoring system is an information system for management decision making".

According to Shapiro "Monitoring is the collection and analysis of information as a project progresses. It is aimed at improving the efficiency and effectiveness of a project or organization. It is based on targets set and activities planned during the planning phase of work. It helps to keep the work on track and can let management know when things are going wrong. If done properly, it is an invaluable tool for good management and it provides a useful base for evaluation."

According to PSO "Monitoring is the systematic collection, analysis and use of information from projects and programmes for these basic purposes: (i) learning from the experiences acquired (ii) accounting internally and externally for the resources used and the results obtained and (iii) taking decisions."

Thus, monitoring is a management function, which begins with the start of a project and ends with the completion of the project, but it is a continuous process during the implementation of project. The key requirement for Monitoring is an 'ACTION PLAN' without which monitoring is not possible. The whole gamut of monitoring is explained in the Table 2.1

Table 2.1: Gamut of Monitoring

What?	Check, review, overview, keep track, observe, control, guide, correct, inspect, supervise, verify, feed-back, follow-up of the	progress of programme implementation with reference to action plan.
Why?	To ensure successful implementation of the project by identifying shortfalls, deviations, problems and the reasons thereof to	take appropriate corrective/ remedial action to keep the project on track.
When?	During the implementation of the project continuously/ periodically	from inception till completion of the project (concurrently with project implementation).
Who?	By the project management team at different levels	including beneficiaries (participatory monitoring).

A project's operation, performance, and impacts are the aspects of concern in monitoring with a view to keep track on the technical and economic 'efficiency' of the project. This is carried out in terms of:

- Whether the various tasks are carried out according to schedule;
- Whether project results are likely to lead to realization of project objectives; and
- Whether project objectives / targets / execution needs adjustments.

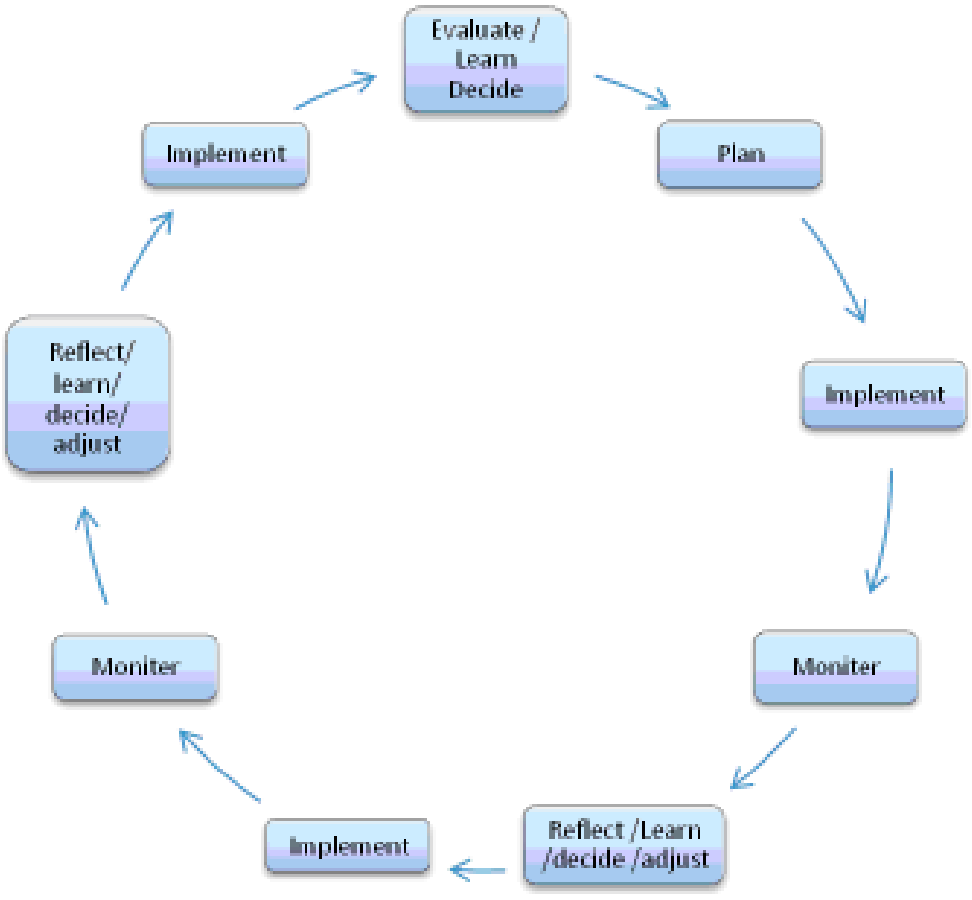

Fig. 2.1 : Monitoring and Evaluation Cycle (*Source: Shapiro, J. Monitoring & Evaluation)*

Monitoring, therefore, is an essential tool for successful implementation of a project. During the process of monitoring, we identify the shortfalls, deviations and problems and causes for the same to take appropriate remedial /corrective action.

Since monitoring is a management function, all those who are involved in the project implementations (who constitute the project management team at different levels / sectors) will do the monitoring. This may include, even the beneficiaries when local groups / organizations have been formed as part of project strategy (e.g.: Urban Forest Committees and Forest Protection Committees under JFM, Water Users Committee, Education Committees, User Groups, Self Help Groups, etc). It is important to appreciate that monitoring is not an individual's function but a collective function. When all stakeholders, including beneficiaries are involved in monitoring, then it paves way for participatory monitoring. A monitoring and evaluation cycle is given in Fig. 2.1

Till now you have read about the meaning and scope of monitoring, various gamuts of monitoring and monitoring and evaluation cycle. 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 men by monitoring?

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2) What is the role of monitoring in management information system (MIS).

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2.4 BASIC CONCEPTS AND ELEMENTS IN MONITORING

2.4.1 Basic Concepts in Monitoring

Four concepts are basic to monitoring and evaluation. They correspond, respectively, to operational investment (e.g., investment per family), operational efficiency (e.g., the number of visits, meetings, demonstrations, and trials, per development worker), technical efficiency (e.g., output, and value added), and extension-induced changes (e.g., income, and income distribution) (Ruthenburg, 1985, p. 120).

Capability, effectiveness, and efficiency fall in the monitoring domain. Impact falls in the evaluation domain.

i) **Capability** is the command that programme has over physical, financial, and human resources, enabling it to serve its clients (e.g. mothers, children). It is reflected by outreach, intensity, technical competence, and physical and financial resources.

ii) **Effectiveness** is defined as "the degree to which goals are attained". It is the adequacy of endeavor to accomplish a purpose for producing intended or expected result. Every developmental project has to take into consideration the effectiveness in order to produce desired result with the given time period. Monitoring the project effectiveness is quite crucial.

iii) **Efficiency** means functioning in the best possible manner with the least waste of time and effort. Lon Roberts defines efficiency as "to the degree of economy with which the process consumes resources especially time and money". Monitoring of efficiency is essential as it will check wastage of resources and ensure completion of project in right time.

iv) **Impact** can be measured by a simple indicator, like Infant Mortality Rate (IMR), Maternal Morality Rate (MMR), Minimum Levels of Learning (MLL), and Learning Achievement, etc. Such indicators provide ultimate tests for the success of any sectoral programmes.

2.4.2 Basic Elements in Monitoring

Let us now discuss in detail the various elements of monitoring. In the study of Monitoring and Evaluation, the following basics (structure of a project) need to be understood clearly. To begin with, the purpose of a programme is to convert a set of RESOURCES into desired RESULTS.

Resources are INPUTS and results are OUTCOMES (This term is used here in a generic sense though it has more specific connotation which will be discussed later). Inputs to outcomes happen in a sequence as detailed below:

i) **Input:** Goods, Funds, Services, Manpower, Technology and other resources provided in a project with the expectation of OUTPUTS.

ii) **Results:** Certain things happen immediately, and certain things ultimately, while certain things in between these two (intermediate). According to sequence, the result of a agriculture project can be grouped into three broad categories, such as productivity, production and income.

iii) **Output** (Immediate results)**:** Specific products or services, which an activity is expected to produce from its inputs in order to achieve the set objectives (in case of agriculture it will lead to increased irrigation, fertilizer use, health facility created etc).

iv) **Effect:** Outcome of the use of the project outputs above the realization of expected effects in a project will lead to desired impact – Intermediate results. In the recent M & E literature effects, are described as outcomes.

v) **Impact:** Outcome of Project Effects (broad long term objectives: Standard of living and reducing poverty both at individual and community level) - Ultimate results. Impact is described as the outcomes for a community or region than on individuals. It may include direct and indirect as well as primary, secondary and tertiary level.

In any project, this sequence (input - output- effect (outcomes) - impact) is inbuilt, ensuring that these steps occur is a primary 'condition' for the success of a project. Again, all projects are made on certain 'assumptions' i.e. if we provide inputs, recipients will use it properly, and produce necessary outputs so that the outputs will result in increased income and the income will boost the standard of living of people. There are also other factors like vagaries of monsoon, price fluctuation, changing political environment, etc., which are described as 'risks' that will affect the project outcomes. It is, therefore, necessary to evolve a mechanism in every project that necessary conditions prevail, assumptions come true and effects of risk are reduced by providing cushions for the shock. Such a mechanism is called 'Monitoring'.

2.5 TYPES OF MONITORING

Monitoring can be divided into two types, likely:

i) **Beneficiary Contact Monitoring:** Beneficiary Contact Monitoring is the key to successful overall project monitoring. Physical and financial monitoring — the first main component of a management information system - generally measures a project's provision and delivery of services and inputs. But project managers also need to know whether their services are being accepted and how they are being integrated into.

Beneficiary contact monitoring is taken up:

- To maintain records for each participant (feasibility of Credit, Health, Education, Nutrition and similar projects) and to analyze these periodically to monitor the penetration of the service and the establishment of a clientele.
- To establish a regular schedule of surveys to enable managers to measure the progress of a project and the responses of its beneficiaries. Formal sampling techniques must be used to get statistically significant data from these surveys.
- To use informal interviews to alert managers to outstanding success stories or problems.

ii) **Process Monitoring:** As discussed earlier, project implementation begins with deployment of inputs/ resources to realize some specific outputs. The

conversion of inputs into outputs will involve certain methods, activities, and completion of certain events. This happens in a sequence as below.

Process: It is the way in which activities are conducted. Processes are continuous and cuts across activities. For example rapport building as a process is relevant to SHG formation activities, training, etc.

Milestones: These are a series of achievements that leads to a completion of stage in an activity (an event).

Activities: These are what we do to deliver the output. Activities always have a beginning and an end and are associated with numbers linked to a budget.

Output: This is what a project delivers before the close of the project.

Process monitoring is an approach that ensures that processes are steered to achieve the desired results and that quality is maintained throughout. As long as there is a focus, not only on the inputs and outputs, but the way in which the outputs are being delivered, and quality indicators are devised and tracked, process monitoring would be useful and successful.

Process monitoring is often confused with conventional progress monitoring. Conventional progress monitoring focuses on physical, financial and logistic aspects of projects, while process monitoring deals with critical processes, which are directly related to the project's objectives. For example, progress monitoring looks at the number of training sessions held, or the / percentage of work completed on a water supply scheme; while process monitoring evaluates the quality of training or the level of community involvement in identification, design, site selection, and supervision of construction. An ideal M&E system contains elements from both progress and process monitoring.

Process monitoring informs project management of the nature of changes needed to improve project responsiveness to community demands, maximize impact and improve the likelihood of sustainable outcomes. It evaluates the quality and effect of project interventions and outcomes.

2.6 TOOLS AND TECHNIQUES OF MONITORING

2.6.1 Tools of Monitoring

Broadly, following tools are used for the purpose of monitoring:

i) Regular progress report

Progress reports submitted by field staff and records at District and Block levels should contain physical and financial progress vis-à-vis targets, coverage by blocks, composition of groups (SC/ST/ Others), activities, etc.

From the financial and physical progress report, it is often possible to make a rapid assessment of whether, and to what extent, the original activities of the scheme have been fulfilled, and whether it is working successfully within the allocated budget. Disbursement of funds for the scheme can be matched against other data/schemes.

ii) Monitoring staff performance (review)

Monitoring the staff performance can ensure that individuals are effectively employed to fulfill given tasks. Ideally, all those employed in a project should meet regularly, to discuss their progress, and match this against targets and objectives, and discuss problems and possible changes.

iii) Tour reports by field staff

Often, the most useful information about qualitative aspects of a programme are obtained from the tour reports submitted by field staff; this is especially true in the case when the project is very small and the participants may possess only low levels of education and literacy.

iv) Participant observation

The field staff may stay in the villages and observe the groups closely so as to obtain sensitive, first-hand insights.

v) Reports from visitors

The project staff ensures that all visitors to the project area (Project Director, State Level Officials, Researchers, etc) provide a short report on their impressions of the schemes. These can provide insights/information on new developments, exchange of experiences and help in further developing the programme.

vi) Interviews

Group members and community leaders should be interviewed on their attitude towards the scheme and resultant behavioral changes.

vii) Participatory Monitoring

In this latest technique, the beneficiaries themselves are made partners in monitoring and evaluation. Project staff and beneficiaries discuss and assess the performance together, in order to understand how they have performed, what the problems are and what the future holds for them. The project staff mainly plays a guiding role to formulate appropriate questions and eliciting answers. For example, the group can be prompted to draw inferences from the bank record books, savings books, etc.

viii) Key informants

In addition to our regular contacts, we must try to interact with other people who may be useful sources of information e.g. Teachers, Postmaster, Kirana Shop, SHGs etc.

ix) Complaints / grievances

Many a times, complaints and grievances petition from people in general and target group in particular may throw some light on the actual performance of the scheme. Every project should make provisions for such source of information as part of monitoring mechanism.

2.6.2 Techniques of Monitoring

Broadly following two techniques are used in monitoring:

i) Earned Value Analysis (EVA); and

ii) Critical Ratio Technique (CRT)

i) Earned Value Analysis: Is a way of measuring overall performance by using an aggregate performance measure. The earned value of work performed for those tasks in progress found by multiplying the estimated percent physical completion of work for each task by the planned cost for those tasks. The result is the amount that should be spent on the task so far. This can be compared with actual amount spent.

The methods of estimation usually used are**:**

a) The 50-50 estimate. 50% is assumed when task is begun and remaining 50% when work completed.

b) 0-100% rule: This rule allows no credit to work until task is completed. This is a highly conservative rule, which cause in delay in project work.

c) Proportional rule: This rule divides planned time-to-date by total scheduled time to calculate percent complete. This is commonly used rule.

ii) Critical Ratio Technique: is applied in large projects, in which critical ratio is calculated for all project activities. The formula used for the calculation of critical ratio is:

$$\frac{\text{Actual Progress}}{\text{Scheduled Progress}} \times \frac{\text{Budgeted Cost}}{\text{Actual Cost}}$$

If ratio is 1, everything is probably on target and if the ratio is further away from 1 it requires more investigation.

In this section you have read about the concepts, elements, types and techniques of monitoring. 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) Write the differences between effectiveness & efficiency of Monitoring?

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2) Name different techniques and types of Monitoring?

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3) What do you mean by participatory monitoring?

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2.7 INDICATORS OF MONITORING

There are different types of indicators, for example, socioeconomic indicators, development indicators, and extension indicators. They range from general to specific concerns.

Indicators can be categorized into direct and indirect or proxy indicators, single and unitary or composite indicators; quantitative and qualitative indicators; primary, core, and supplementary indicators, input and output indicators; and monitoring and evaluation indicators.

Broadly following types of indicators used in monitoring

i) Quantitative indicators

Provide numeric information about a change in a situation. For example, centimeters of rainfall last quarter, number of people using metro etc.

ii) Qualitative indicators

Are largely descriptive statements about processes and outcomes. For example, what is the level of participation in meetings? How are community needs assessed?

iii) Direct indicators

Provide information, which expressly relates to what is being measured. If, for example, information functioning of urban local bodies is required then their functioning is measured.

iv) Indirect indicators

Essential information, chosen from amongst many types of information to serve as substitutes (or proxy indicators) for answering questions or responding to statements that are difficult to measure. For example, if we are interested in measuring the level of poverty in a community, instead of choosing direct indicators for income, indirect indicators for poverty may be chosen, e.g. persons are poor if they have to hire themselves out as daily unskilled labour.

v) Process indicators

Steps involved in planning, designing, collecting funds, construction and operation and maintenance (O&M) of a water supply scheme for example, are the processes involved in developing water supply infrastructure. Examples of process indicators are level of participation and inputs of community during planning.

vi) Progress indicators

Seek to measure or monitor changes against stated targets. The number of trees planted, percentage of water supply scheme constructed, and O&M training sessions held are examples of progress indicators. Progress indicators are usually but not always expressed in quantitative terms.

Monitoring vs. Progress Reporting

Sometimes monitoring and progress reporting are misunderstood to be one and the same in view of certain common features. The similarities between the two are:

a) Both are organized and systematic flow of data of different technical/ administrative operations in progress;

b) Both can be quantitative and qualitative in their approach. But there are distinct differences between them.

Progress reports is a statement of facts giving the extent of achievements at any given point of time. The progress report may not explain how and why of deviations in achievements. When we start questioning such deviations monitoring mechanism gets activated. Thus progress reporting is an Important and initial tool in monitoring but not an end.

In this section you have read about types of monitoring indicators and differances between monitoring and progress reporting. Now try and answer the questions in Check your progress 3.

2.8 LET US SUM UP

Monitoring is an important aspect of project management system. It is a continuous activity for the project manager. This unit has dealt with in detail why, what, when and who of monitoring. Further a detailed analysis of indicators of monitoring is discussed. In the last session the differences between monitoring and progress reporting has been highlighted.

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2.10 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

1) The word "monitor" is derived from the Latin word meaning to 'warn' and "evaluate" stems from the word 'value'. Monitoring is a process of measuring, recording, collecting, processing and communicating information to assist project management decision-making.

2) Monitoring role in management information system include six kinds of information: (1) diagnostic information (why a situation is as it is), (2) implementation information (physical and financial or input information), (3) utilization information, (4) impact information, (5) situation information, and (6) information for review.

Check Your Progress 2

1) Effectiveness is the degree to which geals are attained whereas efficiency means functioning in the best possible manner with the least waste of time and effort.

2) The following techniques are used for the purpose of monitoring. Like, regular progress report, monitoring staff performance, tour report, participants' observation, and reports from visitors, interviews, participatory monitoring, key informants and complaints or grievances petitions.

   Monitoring are of two types. (i) Beneficiary contact monitoring and (ii) process monitoring

3) In this latest technique, the beneficiaries themselves are made partners in monitoring evaluation. Project staff and beneficiaries discuss and assess the performance together, in order to understand how they have performed, what the problems are and what the future holds for them. The project staff mainly plays a guiding role to formulate appropriate questions and eliciting answers.

UNIT 3 EVALUATION

Structure

3.1 Introduction

3.2 Evaluation: Meaning and Features

3.3 Types of Evaluation

3.4 Evaluation Design (How to do Evaluation?)

3.5 Various Aspects of Evaluation

3.6 Methods and Approaches of Evaluation

3.7 Let Us Sum Up

3.8 References and Selected Readings

3.9 Check Your Progress – Possible Answers

3.1 INTRODUCTION

Literally, 'evaluation' means 'assessing the value of'. Evaluations are undertaken in all spheres of life, in informal or formal ways, whenever, one wishes to know and understand the consequences of some action or event. The acquired knowledge and understanding are commonly used by the evaluator to perform some activity in a better manner in the future; that is, one tries to learn from one's experiences in order to improve one's performance.

Evaluation of development work may be undertaken during the implementation of the development programme or project or after it has been completed. In evaluation of development work, people are in focus. The overall purpose of such evaluation is usually to document the results and the utility of the work for individuals or groups of people in the respective society or societies as well as to explore how the results have been created. Evaluating planned development work means that features and processes will have to be described and explained in relation to the plan or plans for that work. A good plan will also guide the evaluation and facilitate collection and analysis of the information that is needed for it.

Evaluation is an assessment of end results or impact of a project with reference to the objectives set in the project. Knowing why a programme succeeds or fails is more important than knowing what it has done. Evaluation provides answers to this crucial question and helps us to identify the strengths and weaknesses, merits and demerits. A good and comprehensive evaluation should bring out what is good/ bad about the project, what are the direct and indirect benefits and what are the intended and un-intended outcomes. The evaluation should also establish cause-effect relationship of project outcomes. By virtue of this, evaluation is, generally, undertaken after the completion of a project. Evaluation helps to refine our planning tools and future programmes.

After going through this unit, you will be able to:

- explain meaning and features of evaluation
- discuss various types of evaluation
- describe methods and approaches of evaluation

3.2 EVALUATION: MEANING AND FEATURES

3.2.1 Meaning of Evaluation

Evaluation is a process for determining systematically and objectively the relevance, efficiency, effectiveness and impact of project activities in the light of their stated objectives. Since objectives and unbiased assessment of project outcomes are the essential ingredients of an evaluation, generally, an independent agency is assigned the job of evaluation. It is also an organizational process for improving activities still in progress and for aiding management in future planning/programming and decision making. Evaluation provides information about past or ongoing activities as a basis for modifying or redesigning future strategies.

According to Shapiro "Evaluation is the comparison of actual project impacts against the agreed strategic plans. It looks at what you set out to do, what you have accomplished and how you accomplished it." According to PSO "Evaluation is assessing as systematically and objectively as possible an ongoing or completed project, programme or policy. The objective is to be able to make statements about their relevance, effectiveness, efficiency, impact and sustainability".

3.2.2 Features of Evaluation

Some of the basic features of evaluation are as follows:

- It is always with reference to stated criteria
- It is always with reference to a point of time
- It starts where progress reporting/monitoring/estimation surveys end
- It establishes relationship between policies/methods and results
- It investigates and find out factors for success/failure and suggest remedies
- More qualitative in approach and emphasis is on variability than standardization
- More purposive and less aggregative
- Its focus is - policy issues, problem formulation, organizational forms, administrative practices, and extension of technical contents of the programmes, people cooperation, attitude and impact

3.2.3 Difference between Appraisal, Monitoring and Evaluation

Before going to do evaluation, it is important to know the differences between these three concepts 'appraisal', 'monitoring' and 'evaluation'. Although they are interchangeable yet distinction can be established among these three concepts. In development terminology, appraisal is usually taken to mean a critical examination of a proposal of a programme or project, normally before the latter is approved for implementation and funding. Sometimes, evaluation and appraisal are used interchanging as if they are synonymous. Appraisal deals with economic viability, technical feasibility and social desirability of a project that is being contemplated. It is generally undertaken for large but concentrated investment project. Thus, appraisal is basically a planning and project formulation activity. Appraisal may be guided by evaluation findings of similar projects / components, which have already been implemented.

As far as distinction between monitoring and evaluation is concerned, both monitoring and evaluations are undertaken to find out how a programme or project performs or has performed. The basic difference between monitoring and evaluation is given in Table-3.1.

Table 3. 1: Basic Differences between Monitoring and Evaluation

Monitoring	Evaluation
Continuous: Starts and ends with a programme.	One shot operation: At a point of time (usually at completion or mid way of programme)
Required for immediate use and mid-course correction	Used for future planning/ replication/ expansion
Done by implementing personnel	Usually by outside agency
Quick but covers all units	In-depth; covers a sample
Correcting / managing	Learning process
Symptomatic, early warning system	Diagnostic

The concept of evaluation can broadly be defined as a more thorough examination, at specified points in time, of programmes or projects or parts of them, usually with emphasis on impacts and additionally commonly on efficiency, effectiveness, relevance, reliability and sustainability. Generally appraisal is undertaken before the initiation of the project, monitoring during the implementation of the project and evaluation at the end of the project. However, there are no water-tight differences among these three concepts.

3.3 TYPES OF EVALUATION

Customarily, the evaluation can be categorized as: (i) evaluation by focus; (ii) evaluation by agency; (iii) evaluation by stage; (iv) longitudinal evaluation; and (v) ongoing evaluation.

i) **Evaluation by Focus:** It is of two types viz., formative and summative evaluations.

Formative Evaluation: Done during the programme development stage (Process evaluation: Mid term appraisals)

Summative Evaluation: Taken up once the programme achieves a stable state of operation (outcome evaluation, ongoing or ex-post evaluation). Usually conducted at the end of the project.

ii) **Evaluation by Agency:** It is done by internal agency as well as independent external agency appointed by donors.

iii) **Evaluation by Stage**

Ongoing : During the project

Terminal: Immediately after completion of project

Ex-Post: After sometime from completion of project

iv) **Longitudinal Evaluation:** It is a repeat evaluation to study the sustainability of results/outcomes.

v) **Ongoing Evaluation (Concurrent Evaluation):** When the monitored information is further analyzed and examined by the project management (with the help of some ad-hoc or special studies) on a continuing basis, with a view to determine the casual relationship between project input or activities and outputs and the influence of external constraints on project performance, it is classified as ongoing evaluation. More aptly, this is the effect and impact monitoring exercise in programmes, which are long term in nature. The idea here is to adjust or redefine policies, objectives, institutional arrangements and resources affecting the project during implementation. Since the main purpose here is to do mid- course correction, it can be taken by the project staff also and therefore it can also be called as internal evaluation. Such evaluation is also termed as concurrent or mid-term evaluation. Generally, this type of evaluation is undertaken in long-term projects.

3.4 EVALUATION DESIGN (HOW TO DO EVALUATION?)

Since the primary focus of evaluation is assessment of results with reference to objectives i.e., end results or impact, evaluation would necessarily mean comparison of current situation after the project intervention with the situation that existed prior to project. The evaluation designs are of two types:

3.4.1 "Pre - Project" Versus "Post-Project" Evaluation

For obtaining pre and post-project situation, two methods could be adopted:

i) Carryout a sample survey at the end of the project and enquire from the project beneficiaries simultaneously their present situation and the conditions that existed prior to the project. This method, however, suffers from 'memory or recall bias' of the respondents.

ii) To overcome the memory or recall bias, it is always preferable and necessary that a 'baseline' or 'bench mark' study is carried out at the beginning of the project on selected parameters of likely impact. A similar baseline at mid term and at the close of project will provide us the changes brought about by the project overtime. Unfortunately in most projects baseline studies are not undertaken or when available it is inadequate. Hence the pre-post (before-after design) may not give us reliable information.

3.4.2 With Project and Without Project Evaluation

Under the circumstances of ambiguity in pre-project and post-project evaluation an alternative evaluation design needs to be adopted. This method is called "with and without", also called as "beneficiary - non beneficiary (Control Group)" design. For this purpose, a comparable typical sample of beneficiaries and non-beneficiaries can be selected and studied within the project area. Alternately, a comparable typical area adjoining the project area where project has not been implemented can also be studied along with project area. The key to both the approaches is selection of comparable / typical sample.

In order to obtain the best results in evaluation, a combination of both the designs will be the most appropriate method.

Till now you have read about the meaning and features of evaluation, types of evaluation and evaluation design. Now you try and 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 Evaluation?

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2) Name different types of evaluations.

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3) What is evaluation design?

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3.5 VARIOUS ASPECTS OF EVALUATION

It is pertinent to know some of the important aspects which are evaluated when an evaluation is carried out by any individual or an organization. Some of the aspects of evaluation are discussed below:

i) Efficiency Evaluation

This may be defined as the amount of outputs created and their quality in relation to the resources (capital and personnel) invested. It is, then, a measure of how productively the resources (as converted into inputs) have been used.

The main problem in evaluating efficiency is deciding on the amount of various inputs which the evaluator considers to be reasonable for producing the outputs which may have been documented in the project proposal. Specific criteria for making such judgments are rarely given in the plan documents. The evaluator may therefore have to make his or her own judgment about relations between the magnitude of inputs of different kinds and the amount and quality of outputs. Measuring the efficiency is one of the intricate tasks before the project manager, which sometimes may convince or may not convince the donor agencies of the project.

ii) Effectiveness Evaluation

This expresses to what extent the planned outputs; expected effects (immediate objectives) and intended impacts (development objectives) are being or have been produced or achieved. In practice, in effectiveness analysis, it may be appropriate to focus mainly on the effects on the outcome side, for two related reasons:

- the effect level is the first level at which benefits for the intended beneficiaries are expressed, making effects a much more significant measure of achievements than outputs; and
- being more directly derived from the inputs and activities of the respective developmental scheme than are impacts, the effects will normally be less influenced by intervening external factors and can, therefore, usually be assessed quickly and more reliably.

If the immediate objectives (intended effects) have not been precisely stated in the programme or project document, the evaluator may have to make such further specifications by himself or herself which he or she considers to be necessary for an effectiveness analysis, according to the evaluator's own best judgment.

iii) Impact Evaluation

Impact means long-term effect-positive and negative, intended and unintended. These are the longer-term, largely indirect consequences of the programme or project for the intended beneficiaries and any other people. The main impacts are, of course, expected to be positive. However, there may be negative impacts as well, on beneficiary groups or others. These should also be analysed. Sometimes, negative impacts on some people may have been suspected or even expected at the planning stage. These might then have been mentioned and even specified in the plan documents, with or without counteracting measures. In other cases, they may have been entirely unforeseen. They may then be more difficult to trace for evaluators. Impacts are normally generated through complex relations and processes and they, therefore, need to be analysed through broad-focusing investigations. Impact evaluation can use quantitative or qualitative methods or both.

iv) Evaluation of Sustainability Aspect

This means the maintenance or augmentation of positive changes induced by the programme or project after it is terminated. Sustainability may relate to all the levels of the project intervention framework. In case of action research project the sustainability aims at continuation of interventional activities at all levels. In more specific terms, sustainability may mean:

- maintenance of physical facilities produced (for instance, a road);
- continued use of physical facilities (for instance, a road) or intangible qualities (for instance, knowledge);
- continued ability to plan and manage similar development work (by organisations which have been in charge of the programme or project or any other organisations);
- continued production of the kinds of outputs created (for instance, teachers from a teachers' training college);
- maintenance of impacts created (for instance, continued improved health due to new sanitation practices or continued ability to compete more effectively in labors markets due to training given); and
- multiplication of effects and impacts (of the same kinds or of other kinds, through inducements from facilities or qualities created by the programme or project).

v) Evaluation of Quantitative and Qualitative Aspect

In the social sciences, it has become common to distinguish broadly between two major approaches: quantitative and qualitative. The most obvious distinction between the two is that quantitative methods produce *numerical data* and qualitative methods produce information which is expressed in *words*. In simple terms, the quantitative evaluation are made by using scientific tools and measurements. The result can be measured and counted. Compared to this, qualitative evaluations are more subjective in nature and become harder to reproduce with accuracy.

vi) Evaluation of Result Oriented Aspects

The five main aspects in project operation and evaluation are input - activities - output - effect (outcomes) -impact sequence and their need for monitoring at different stages of the projects' progress. There is change in approach, in recent times; new approach is called Result Oriented/ Result based evaluation, an improvement over the activities to outputs in impact approach is used. The focus here is to ensure that resources 'invested' in any development activity generate their intended results objectively as possible. Projects are now only deemed successful, if the measured results achieve the projected quantified indicators. This approach lays emphasis on 'results' and benefits at every stage. The concept is to link development resources to the objective of societal benefits, along with the means of achieving them, impact measures and the risks involved in the process. This involves an integrated methodology package to strengthen all components of the project cycle. The important tools used are Logical Framework, problem analysis; GTZ objective oriented analytical framework, etc.

3.6 METHODS AND APPROACHES OF EVALUATION

The monitoring and evaluation is one of the important components of any project and programme. The funding agencies always want that the money which they sanction to the project and the purpose for which it is spend are utilized for the purpose for which it is intended. Some of the methods and approaches used by the World Bank (2004) for evaluation of projects are:

i) Logical Framework Approach

ii) Formal Survey Method

iii) Rapid Appraisal Method

iv) Public Expenditure Tracking Survey Method

v) Cost-Benefit and Cost-Effectiveness Analysis

vi) Participatory Method

3.6.1 Logical Framework Approach

The Logical Framework is simply a tool, which provides a structure for specifying the components of any activity, and the logical linkages between a set of means and a set of ends. It places the project in its larger framework of objectives within the programme. It serves as a useful tool for defining inputs, time-tables, assumptions for success, outputs and indicators for monitoring and evaluation performance. The structure of the Log Frame is deceptively simple. It consists of a 4 × 4 matrix in which the rows represent the levels of project objectives, including the means required to achieve them (the vertical logic), while the columns indicate how the achievement of these objectives can be verified (the horizontal logic). The full matrix is shown in Table 3.2.

Table 3. 2: A Logical Framework Matrix

Narrative Summary	Objectively Verifiable Indicators (OVI)	Means of Verification (MOV)	Important Assumptions
GOAL	Measures of Goal Achievement	Sources of Information Methods Used	Assumptions Affecting Purpose-goal Linkage
PURPOSE	End Project Status	Sources of Information Methods Used	Assumptions' Affecting Output-Purpose Linkage
OUTPUTS	Magnitudes of Outputs Planned, Completion Data	Sources of Information Methods Used	Assumptions' Affecting Inputs-Output Purpose Linkage
INPUTS	Nature and Level of Resources, Necessary Cost, Planned Starting Data	Sources of Information	Initial Assumptions about the Project

The two important component of logical frame work technique are (a) the vertical logic and (b) the hierarchy of project objectives.

a) **The Vertical Logic:** The vertical logic identifies what the project intends to do, clarifies the relationship between project means and ends, and specifies the uncertainties concerning both the project itself and the social/physical/ political environment within which the project is located.

b) **The Hierarchy of Project Objectives:** Four levels are specified in the Log Frame:

Goal: The reason for undertaking the project: the ultimate objective of the programme to which the specific project will contribute.

Purpose: What the project is expected to achieve in development terms once it is completed within the allocated time. The purpose is the motivation behind the production of the outputs.

Outputs: The specific results to be produced by the management of inputs.

Inputs: The activities to be undertaken and the resources available to produce the outputs.

Some of the advantages of logical framework are:

a) It forces the project analyst to trace out the inter-locking components of a project in a Logical manner right from the start. Shifts the emphasis from inputs and outputs to objectives of the project.

b) It forces the project analyst to ask himself, from the very outset, the question "How can I check whether or not progress is being made towards achievement of objectives?"

c) It forces the project analyst to record systematically the risks and assumptions inherent in the whole enterprise. Helps to minimise risk, keep a check if assumptions are coming true.

d) Handing over to others is made easy.

e) Logical Framework is the intellectual baggage of Monitor and Evaluator.

3.6.2 Formal Survey Methods

Formal Surveys can be conducted from time to time during the project or programme implementation period. The survey must try to collect information with the help of a standardized tool from a carefully selected sample of people or households. Surveys sometimes used to often collect comparable information for a relatively large group of people in particular target groups in a project area. The survey is intended to serve following purpose:

a) Providing baseline data against which the performance of the strategy, programme or project can be compared.

b) Comprising different groups at a given point of time.

c) Comparing changes over time in the same group.

d) Comparing actual conditions with the changed condition of the target established in a programme or project design.

e) Describe prevailing conditions in a particular community or group.

Some of the advantages of this method are: (a) Its findings can be applied to longer group (b) quantitative establishments can be made for the distribution of impacts.

3.6.3 Rapid Appraisal Methods

Rapid Appraisal Methods are quick and low-cost means to gather information from the beneficiaries or other stakeholders of the project area for providing information to decision-makers. The rapid appraisal method falls between very informal methods such as casual conversations or short-site visits and highly formal methods such as Census, Sample Surveys or experiments.

Some of the popular methods of rapid appraisal are:

a) Key information interview

b) Focus group discussion

c) Community group interview

d) Direct observation

e) Mini-survey

The advantages of rapid appraisal method are they are low cost, can be conducted quickly and provide flexibility to explore new ideas. As rapid appraisal methods are short-term, they neither provide sound survey data nor do they provide in-depth understanding of the survey.

3.6.4 Public Expenditure Tracking Survey (PETS) Method

Public Expenditure Tracking Surveys tracks the flow of public funds and determine the extent to which resources actually reach the target groups for which it is intended. The surveys examine the process, quantity, and timing of the release of resources to different levels of government for example central, state, district and local self-government institutions, particularly to the units responsible for delivery of services. PETS is implemented as part of longer service delivery and facility surveys which focus on the quality of service, characteristics of the facilities, their management, incentive structure, etc.

PETS also intend to provide local communities with information about the level of resources allocated to particular services in their area for example to the local school or health clinic, etc and their pattern of utilization. PETS are widely used by the International donor agencies in evaluating their social development projects in African Countries.

The two important advantages of this method are:

a) Supports the pursuit of accountability

b) Improves management by pinpointing bureaucratic bottlenecks

3.6.5 Cost-Benefit and Cost-Effectiveness Analysis Method

The cost benefit and cost effectiveness analysis are tools used for assessing whether or not the costs of an activity can be justified by the outcomes and outputs. Cost benefit analysis measures both inputs and outputs in monitary terms.

On the other hand, cost effectiveness analysis estimates inputs in monetary terms and outcomes in non-monitary quantitative terms. The unique feature of cost benefit analysis is that it can indicate explicitly whether benefits outweigh costs. While the cost-effectiveness compare programme with similar outcomes. The calculation of cost effectiveness is done with the help of cost-effectiveness ratio, which is as follows:

$$\text{Cost Effectiveness Ratio} = \frac{\text{Total Cost}}{\text{Unit of Effectiveness}}$$

The benefit-cost ratio (BCR) represents the ratio of total benefits over total costs, both discounted as appropriate. The formula for calculating BCR is:

$$BCR = \frac{PV_{benefits}}{PV_{cost}}$$

Where:

$PV_{benefits}$ – Present Value of benefits

PV_{cost} – Present value of cost

The steps followed in the cost benefit and cost effectiveness analysis are follow:

1) set the framework for the analysis
2) decide whose cost and benefit to be recorded
3) identify and categorize costs and benefits
4) calculate project costs and benefits over the life of the programme
5) monetize
6) quantify benefits in terms of units of effectiveness
7) discount costs and benefits to obtain present values
8) compute a effectiveness ratio
9) compute cost benefit ratio

One of the important advantages of cost effective method is that it is useful for convincing policy-makers and funders that the benefits justify the activity. While the benefit cost ratio is most suitable for the evaluation of single project.

3.6.6 Participatory Methods

Participatory Monitoring and Evaluation (PM&E) has emerged because of recognition of the limitations of the conventional approach to M&E. It is attracting interest from many quarters since it offers new ways of assessing and learning from change that are more inclusive, and more in tune with the views and aspirations of those most directly affected by the project interventions. PM&E provides an opportunity for development organizations to focus better on their ultimate goal of improving poor people's lives. By broadening involvement in identifying and analyzing change, a clearer picture can be gained of what is really happening on the ground. It allows people to celebrate successes, and learn from failures. For those involved, it can also be a very empowering process; since it puts them in-charge, helps develop skills, and shows that their views counts.

a) What is PM&E?

PM&E is not just a matter of using participatory techniques within a conventional monitoring and evaluation setting. It is about radically rethinking who initiates and undertakes the process, and who learns or benefits from the findings. There are many different forms depending on who is participating, at what stages they are involved and the precise objectives. Community-based versions, where local people are the primary focus, sit alongside other forms geared to engaging lower level staff in assessing how it can be improved. PM&E has created new ways of measuring change, while helping build the monitoring and evaluation capacity of the people involved. Distinction between the conventional M&E approaches and participatory M&E approached is given in Table-3.3 below.

Table 3.3: Conventional M & E approaches Vs. Participatory M&E Approaches

Parameter	Conventional M&E	Participatory M&E
Who plans and manages the process	Senior managers, or outside experts.	Local people, project staff, managers and other stakeholders, often helped by a facilitator.
Role of 'primary stakeholders' (the intended beneficiaries) How success is measured	Provide information only. Externally-defined, mainly quantitative indicators.	Design and adapt the methodology, collect and analyses data, share findings and link them to action. Internally-defined indicators, including more qualitative judgments.
Approach	Predetermined.	Adaptive.

b) The Principles of PM&E

PM&E provides the opportunity to analyse both the qualitative and quantitative information, thus providing more complete information on which to base decisions. Often, an information system focuses on only (quantitative) information, but numbers alone produce an incomplete picture of which is really taking place in the community. If the "story behind the numbers" is available to people, a different evaluation may be possible. PM&E has been built on a number of overall principles which will help understand the PM&E approach (Table 3.4).

Table 3.4: Participatory Monitoring and Evaluation Approach

Tools chosen to fit community: PM&E seeks to find the appropriate tool for each unique community.	Information that is useful rather than perfect: It is often only necessary to have information that shows trends rather than statistically exact information. Information showing trends and delivered on time is often more useful to decision-making than precise information delivered late.
Outsiders help community to focus on a specific issue: Outsiders facilitate but do not direct.	Supports existing community skills: PM&E builds on existing community skills.
Attitude of partnership: Insiders and outsiders can both contribute to community development.	

Essential information: PM&E seeks to identify information that is "necessary to know" rather than "nice to know". This ensures that the information system is not overloaded with unnecessary information.	The community is the final evaluator: Since it is the community alone who decides whether or not to continue the project, they are the final and most important evaluators.
Two way communication and clear messages: PM&E is built on ideas, methods and tools that support equal and clear communication between insiders and outsiders.	People who make decisions need timely, reliable and useful information: The right information at the right time will facilitate better decisions.

c) What are the Steps or Stages of PM&E?

There are four major steps or stages of applying PM&E in practice:

- Planning or establishing the framework for a PM&E process, including identification of objectives and indicators
- Gathering data
- Data analysis
- Documentation, reporting and sharing of information

d) PRA and PRA - related techniques

Participatory assessment also known as 'participatory rural appraisal' (PRA) and 'participatory rapid assessment' (PRA), comprises a range of visualization, interviewing and group work methods. These techniques have proven valuable in enabling people to express their views and share information, in uncovering their realities and priorities, and in stimulating discussion and analysis. Following methods are used:

i) Methods used in participatory rural appraisal (PRA) Visualized Analysis:

Participatory mapping and modeling	Time lines and chronologies
Aerial photograph analyses	Matrix scoring and preference ranking
Transect and group walks	Venn and network diagramming
Seasonal calendars	Flow diagrams on systems and impact
Daily and activity profiles	Pie diagrams
Historical profiles and trend analyses	

ii) Interviewing and sampling methods:

Semi-structured interviewing	Ethno-histories
Direct observation	
Focus group	Well-being and wealth ranking
Key informants	Social maps

iii) Group and team dynamics method:

Team contracts

Team review sessions

Interview guides

Rapid report writing

Work sharing (taking part in local activities)

Villager and shared presentations

Process notes arid diaries

Some of the advantages of participatory evaluation method are:

a) Examines relevant issues by involving key players in the design process

b) Establishes partnership and local ownership of the project

c) Enhances local learning, management capacity and skills.

In this section you have read about the various aspects of evaluation and techniques of evaluation. 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 is participatory evaluation?

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2) Name different aspects of evaluation?

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3.7 LET US SUM UP

The basic meaning, principles, design and use of evaluation have been briefed and discussed in this unit. Evaluation has been neglected and mistakenly seen as a 'fault finding' mechanism. It is to be understood evaluation as a 'learning process' and our past experiences guide us to a better future. Unless we know our strengths and weaknesses of actions and outcomes, which an evaluation helps to bring out, we cannot build a better tomorrow. Over the years, evaluation has evolved into a community based participatory exercise than being an externally guided activity. Several illustrations have been given in this unit to facilitate easy understanding of the concept.

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3.9 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

1) Evaluation is a process for determining systematically and objectively the relevance, efficiency, effectiveness and impact of project activities in the light of their stated objective.

2) Customarily the evaluation can be categorized as (i) evaluation by focus – it is 2 types' formative and summative evaluation (ii) evaluation by agency – it is 2 types like: internal and independent evaluation (iii) evaluation by stage – ongoing, terminal and ex-post evaluation; (iv) longitudinal evaluation; and (v) ongoing evaluation.

3) The primary focus of evaluation design is assessment of results with reference to objectives i.e., end results or impact; evaluation would necessarily mean comparison with situation that existed prior to project. The evaluation designs are of two types: "Pre - Project" Versus "Post-Project" Evaluation and With-Without Project design. In other words, the evaluation design aims at measuring what evaluation intends to measure.

Check Your Progress 2

1) Participatory evaluation is a means of achieving the wider objectives of community participation projects. Community involvement will enable evaluation to be used as a learning device – a form of fundamental education which can contribute to empowerment and partnership. Evaluation needs to be seen in a changing light: from being commonly a tool for judging project managers, it can be transformed into a shared process of community self – assessment and project improvement.

2) It is pertinent to know some of the aspects which are evaluated when an evaluation is carried out by any individual or an organization. The various aspects of evaluation are: efficiency evaluation, effectiveness evaluation, impact evaluation, evaluation of sustainability aspect, evaluation of qualitative and quantitative aspect, and last one is evaluation of result oriented aspect.

MEDS-044 MONITORING AND EVALUATION OF PROJECTS AND PROGRAMMES

BLOCK 1 : PROJECT FORMULATION AND MANAGEMENT

Unit 1 : Project Formulation

Unit 2 : Project Appraisal

Unit 3 : Project Management

BLOCK 2 : MONITORING AND EVALUATION

Unit 1 : Programme Planning

Unit 2 : Monitoring

Unit 3 : Evaluation

BLOCK 3 : MEASUREMENT AND SAMPLING

Unit 1 : Measurement

Unit 2 : Scales and Tests

Unit 3 : Reliability and Validity

Unit 4 : Sampling

BLOCK 4 : DATA COLLECTION AND ANALYSIS

Unit 1 : Quantitative Data Collection Methods and Devices

Unit 2 : Qualitative Data Collection Methods and Devices

Unit 3 : Statistical Tools

Unit 4 : Data Processing and Analysis

Unit 5 : Report Writing

MEDS-044
Monitoring and Evaluation of
Projects and Programmes

Indira Gandhi National Open University
School of Extension and Development Studies

Monitoring and Evaluation

2

Indira Gandhi National Open University
School of Extension and Development Studies

MEDS-044
Monitoring and Evaluation of Projects and Programmes

Block

3

MEASUREMENT AND SAMPLING

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Measurement **5**

UNIT 2
Scales and Tests **19**

UNIT 3
Reliability and Validity **37**

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BLOCK 3 MEASUREMENTS AND SAMPLING

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. 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, three important methods for assessing the reliability of measuring instruments, the concept of validity, four approaches of validation of measuring instruments, three 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 Levels 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 Keywords

1.11 References and Selected Readings

1.12 Check Your Progress – Possible Answers

1.1 INTRODUCTION

The first principle of a scientific study is to describe objectively what a scientist observed, under what circumstances, and to communicate the same as precisely as possible. A scientist reports not only what has been observed, but states the circumstances and the methods used, too. 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 in 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 precise and accurate measurement in these fields. Biological sciences, of late, have established principles that are nearly at par with those found in physical sciences. Social sciences lag far behind as compared to physical and biological sciences. Measurement is the key to all sciences.

After studying this unit you will be able to:

- explain the meaning, concepts and importance 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.

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 in a set of events or an object possesses 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.

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, of 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 condition 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 in urban areas.

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 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, that is stronger than, and soon. Most measurement in psychology and education depends on this postulate. It must be possible to assert ordinal-a 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.

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) Name different postulates of measurement.

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1.5 LEVELS OF MEASUREMENT

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. 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.

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 carat (>), 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.

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 can not 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 ordinality. 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.

In interval scale has all the properties of a nominal scale (equivalence relation), an ordinal scale (greater then or transitivity relation) and an ordered metric scale (transitively 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 to 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? 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? Excellent-1 Very Good -2 Good-3 Average-4 Poor-5
3.	Interval Scale	In the past twelve months, how many times have you gone for check up to the primary health centre? <5 times – 1 6-10 times – 2 11-15 times – 3 >16 times – 4
4.	Ratio Scale	In the past twelve months, how much of money have you spent on health care? 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 variate 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. Non-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 with 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. Measurement is assigning numbers to objects or events according to rules.

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 KEYWORDS

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 are:

   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 ordinality. 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 Keywords

2.11 References and Selected Readings

2.12 Check Your Progress – Possible Answers

2.1 INTRODUCTION

Measurement plays an important role in any development research including urban development research. 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 urban development programmes. Technically speaking these reporting measurement instruments are popularly called as scales and tests. The scales and tests are the most popular methods of observation and data collection in behavioural sciences and more particularly in development studies.

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 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 numerical assigned to them.

The rating scale is very useful device in assessing quality – especially when quality is difficult to measure objectively in the programmes of development.

Example: How good is the Jawaharlal Nehru National Urban Renewal Mission 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 National Urban Employment Programme?

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 National Urban Employment Programme?

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 National Urban Employment Programme.

Activity 1

Visit a nearby any 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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Check Your Progress 1

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What do you mean by tests and scales in the context of development research?

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2) What do you mean by a rating scale?

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3) Write the difference between comparative and non-comparative scaling techniques.

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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)
   - excellent – good- average – below average - poor (5 categories)
   - always – often – occasionally – rarely – never (5 categories)
   - 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 (v) 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 Obstructive Always willing to work with others)

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 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 behavior.

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 Somewhat	Neutral	Dislike somewhat	Dislike very much
Institutional Sources					
BDO					
VDO					
Extension Personnel					
Any other (Please specify)					
Non Institutional Sources					
Other Beneficiaries					
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 Scale

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. But is 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 than 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 individual who belong to that group too higher 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.

Check Your Progress 2

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Write the examples for the following categorization of rating scales

3 divisions: .....

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5 divisions: .....

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2) Name the four important types of rating scales.

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3) 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) Intelligent 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 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 (1962) 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 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 which will create confusion in the minds of respondents. One example of fill in the blanks is given below:

Example: The JNNURM started in the year ————————

Matching: In the matching 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 which 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 tryout them. 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 the tests 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 follow:

- Helps to indicate the difficulty level of the item such as which is more difficult, moderately difficult or easy.
- Help 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 examiness, 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_C=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 trait 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 either of the 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 80 and right responses in the lower group is 60, then the item discrimination index is:

$$DI = \frac{80-60}{100} = 0.20$$

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: Finally test is administered to find out their reliability. Reliability is the degree to which a test measure whatever it actually measures.

Validity of the Test: Validity means what the test measures. 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 has to produce a manual which will give a clear cut instruction regarding the procedures of the test administration, the scoring methods, time limit, etc.

Check Your Progress 3

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What do you mean by test ?

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2) Name the various types of objective tests.

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3) Name the various types of objective test questions.

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4) Write the objectives of item analysis.

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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 in the programmes of development. 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 numerical assigned to them.

Index : Indexes 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 (v) 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 and 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 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.

2.11 REFERENCES AND SELECTED READINGS

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Patten M.L. (2005). Understanding Research Methods – An Overview of the Essentials. Pyrczak Publishing, USA.

Reddy, S.V., and Praveena, C. (1985). An Invitation to Research Methodology in Behavioural Sciences, EEI, Hyderabad.

2.12 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

1) In the context of development research, scales and tests are the self reporting measuring instruments to assess people's knowledge, opinion, perceptions, attitudes etc.

2) 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.

3) With comparative scaling, the items are directly compared with each other and in non-comparative scaling, each item is scaled independently of the others.

Check Your Progress 2

1) Three divisions : above average – average – below average

   Five divisions : like very much – like somewhat – neutral – dislike somewhat – dislike very much

2) The four important types of rating scales are: graphic; descriptive; numerical and itemized rating scales.

3) 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 3

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 urban 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 urban 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.

Check Your Progress 1

Note: a) Use the spaces given below for your answers.

b) Check your answers with those given at the end of the unit.

1) What is the common name for any type of measurement device?

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2) What do you mean by reliability?

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3) Write the synonyms for reliability.

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4) How can you improve the reliability of measuring instruments?

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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 in time.
- Expensive to conduct test and retest and some time 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, devotion by the research worker. Because, behaviour changes and personal characteristics may likely to influence the re-test as they are 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 tests 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

$$r = \frac{2\,r}{1+\,r}$$

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 over come this limitation, it is recommended that, randomly divide a large collection of items in half to have two test administrations.

Check Your Progress 2

Note: a) Use the spaces given below for your answers.

b) Check your answers with those given at the end of the unit.

1) Write the three basic methods of determining the reliability?

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2) 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 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 persons, 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 centimeters or inches. The weight of the child can be measured in pounds and kilograms. On the other hand, if a child development extension professional wish 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 there 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. But, 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 it 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, pediatrician, clinical psychologists, social worker 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, however, rather than from their specific expertness. 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 favorable 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

This is an ideal technique abstractly speaking 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 the extent to that 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.

Check Your Progress 3

Note: a) Use the spaces given below for your answers.

b) Check your answers with those 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 representative ness 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 the test content against of 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 help 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 in 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 extension and 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.

Check Your Progress 4

Note: a) Use the spaces given below for your answers.

b) Check your answers with those 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 in 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.

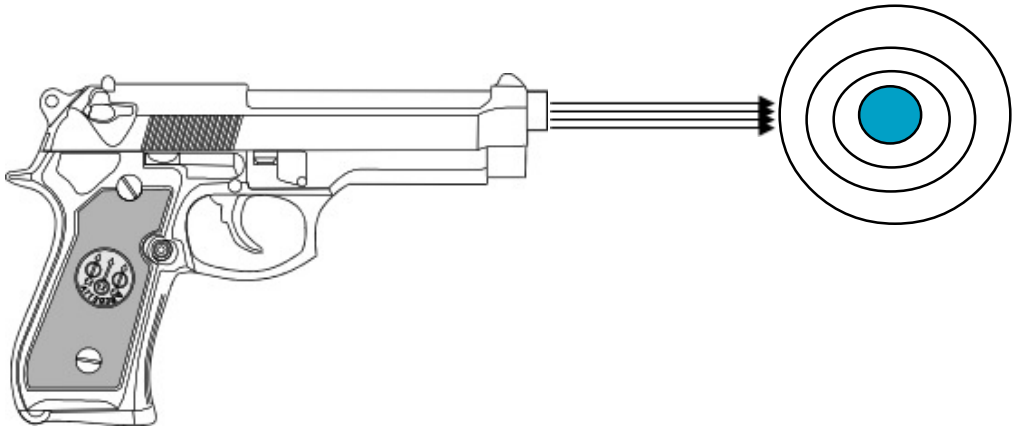

Fig. 3.1: Reliable and valid

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.

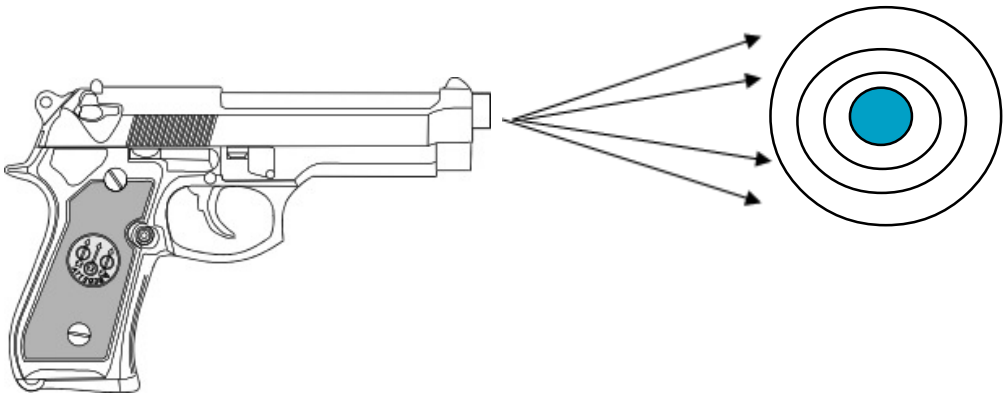

Fig. 3.2: Unreliable which undermines the valid aim of the gun – Not usefull

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).

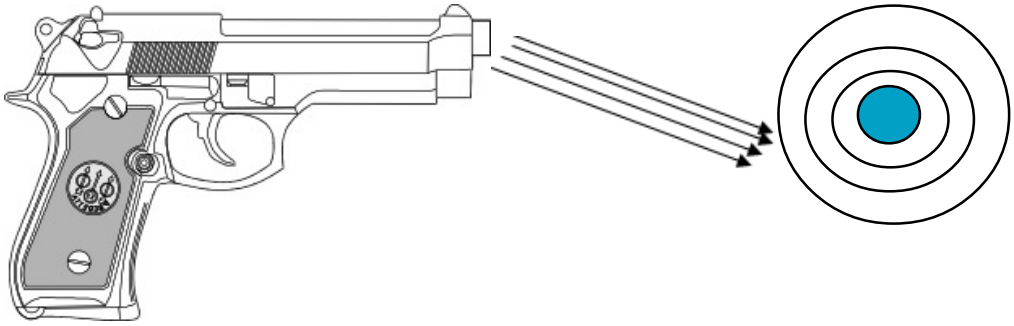

Fig. 3.3: Reliable but invalid – Not useful

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.

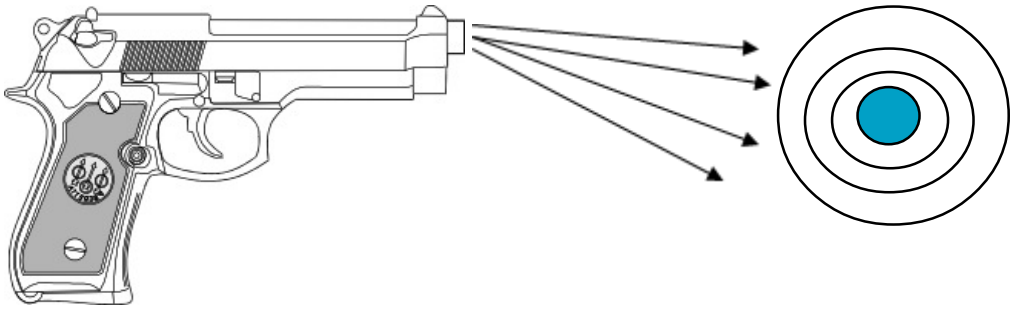

Fig. 3.4: Unreliable and invalid – Not useful

We may arrive at a conclusion that Fig. 3.1 represents the ideal in measurement. However, due to the limitations of measuring instruments in extension and 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.

Check Your Progress 5

Note: a) Use the spaces given below for your answers.

b) Check your answers with those 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 deserves 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 extension and 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 KEYWORDS

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 : The validity is implied from the known attitudes and other characteristics of analytical groups, however, rather than from their specific expertness.

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 in 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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3.10 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

1) The common name for any type of measurement device is 'instrument'.

2) 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.

3) The synonyms for reliability are : dependability; stability; consistency; predictability; accuracy and equivalence .

4) The reliability of measuring instruments can be improved by (i) by standardizing the conditions under which the measurement takes place and (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.

Check Your Progress 2

1) The three basic methods of determining the reliability are : test – retest method; alternative form method and split-half method.

2) 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 3

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 4

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 5

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 Concept
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 Keywords
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 a part of the population is only surveyed and inference is drawn about the whole population, the results 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 great extent by employing properly trained persons in surveys. The other advantage 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 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 population 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 Advantages of Sampling

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 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 than $n_1 + n_2 + ... + n_k = n$

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 exactly 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 in to 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 Proportion 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 Proportion 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 4.1: Village population Size

Sl.No.	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 + ...……. + 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

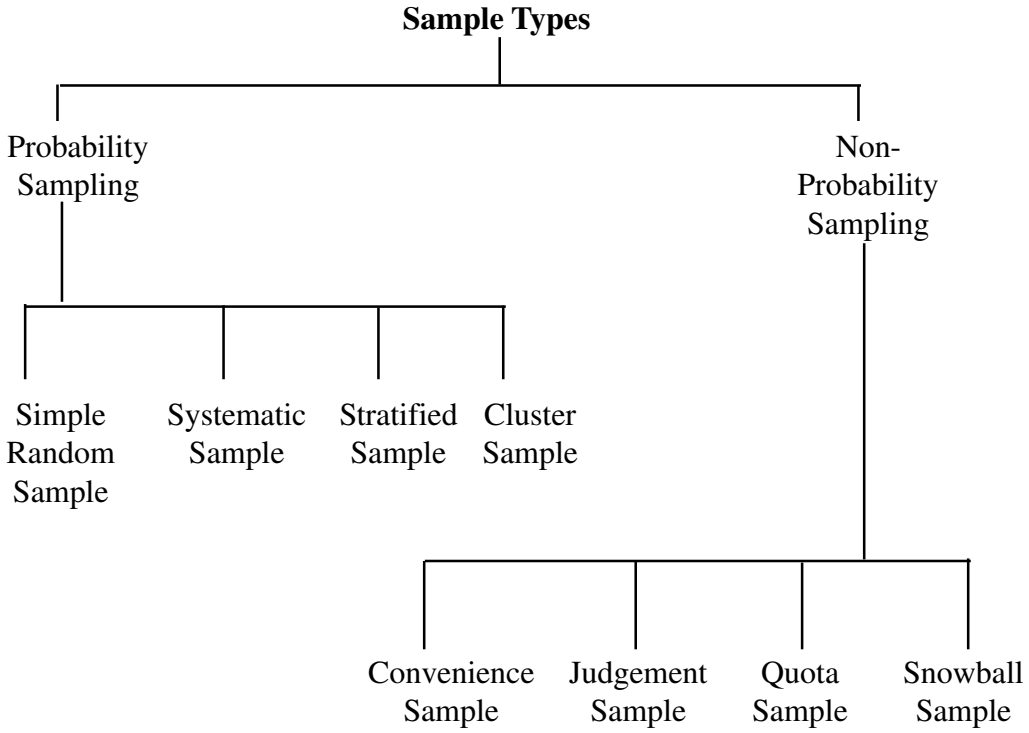
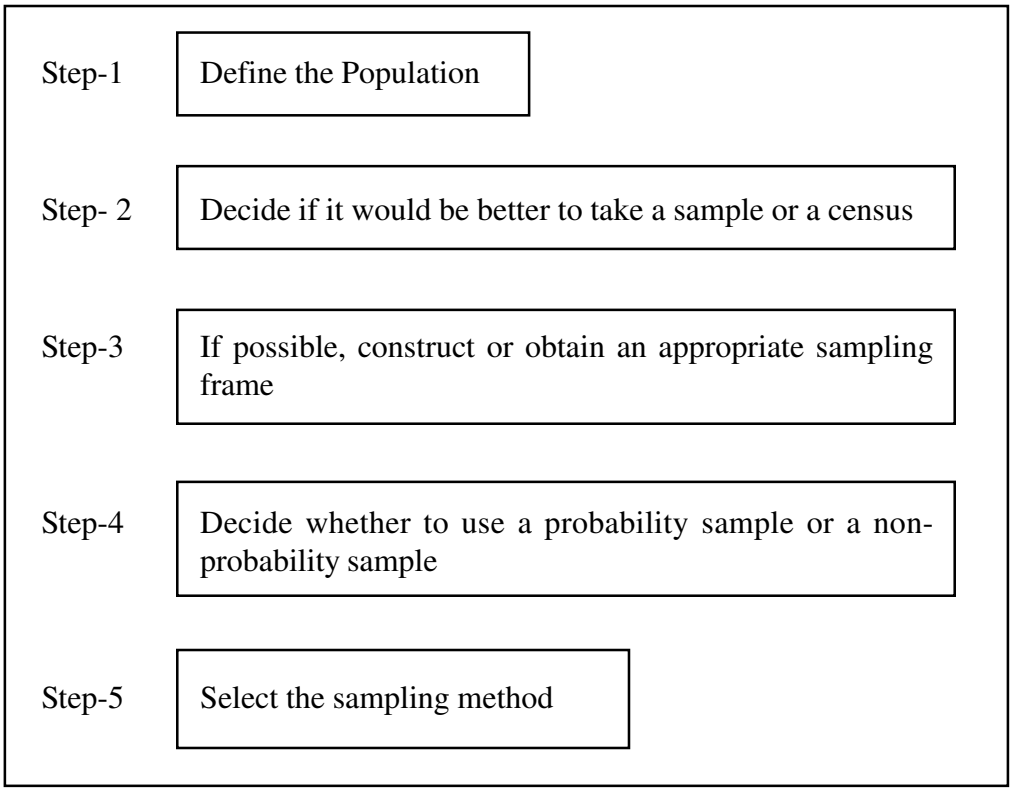


Fig. 4.1: Types of Sample

4.4 SAMPLE DESIGN PROCESS

The sample design process follows five steps as given in Box-1

Box 4.1: Sample Design Process



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?

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3) What do you understand by a quota sample?

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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:

$$\text{Standard error} = \sqrt{\frac{Variance}{n}} = \frac{\text{sd}}{\sqrt{\text{n}}}$$

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:

Standard error = $\sqrt{\frac{p \times (1-p)}{n}}$

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 a news article that reports the results of a national poll, the error in the estimates is always listed, derived, generally speaking, from Equation 6.2. 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 6.1 and Equation 6.2 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

(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

Exaple: (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

$$n = \frac{(1.96)^2\ (.50\times.50)}{(0.05)^2}$$

$$= \frac{3.84\times0.25}{(.0025)}$$

$$= \frac{0.96}{0.0025}$$

$$= 384$$

If we use the more convenient 2.0 for the Z statistic, then the sample size will be smaller.

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= 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 4.1: 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=.10 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?

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2) How the sample size is determined using the formula?

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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 KEYWORDS

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.

4.9 REFERENCES AND SELECTED READINGS

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4.10 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

1) What do you mean by sampling? What are the advantages of sampling?

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) What is the difference between a parameter and an estimator?

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) What is stratified sampling?

In *stratified sampling*, the target population of N units is first divided into k subpopulations of units. These populations are non-overlapping and together they comprise the whole population, so that

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 respectively If the total sample size n is to be drawn from the target population then

If a simple random sample is drawn in each stratum, the whole procedure is described as *stratified random sampling*.

2) What is cluster sampling and when is it best used?

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) What do you understand by 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 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) What is 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 unbiased estimate of the population parameter. This error is called sampling error.

2) How is the sample size determined using the formula?

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:

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.

MEDS-044 MONITORING AND EVALUATION OF PROJECTS AND PROGRAMMES

BLOCK 1 : PROJECT FORMULATION AND MANAGEMENT

Unit 1 : Project Formulation

Unit 2 : Project Appraisal

Unit 3 : Project Management

BLOCK 2 : MONITORING AND EVALUATION

Unit 1 : Programme Planning

Unit 2 : Monitoring

Unit 3 : Evaluation

BLOCK 3 : MEASUREMENT AND SAMPLING

Unit 1 : Measurement

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Unit 3 : Reliability and Validity

Unit 4 : Sampling

BLOCK 4 : DATA COLLECTION AND ANALYSIS

Unit 1 : Quantitative Data Collection Methods and Devices

Unit 2 : Qualitative Data Collection Methods and Devices

Unit 3 : Statistical Tools

Unit 4 : Data Processing and Analysis

Unit 5 : Report Writing

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Measurement and Sampling

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MEDS-044
Monitoring and Evaluation of Projects and Programmes

Block

4

DATA COLLECTION AND ANALYSIS

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BLOCK 4 DATA COLLECTION AND ANALYSIS

Block 4 on **'Data Collection and Analysis'** with five units gives an overview of various tools and techniques of data collection and analysis needed for conducting Extension and 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 '**Statistical Tools**' provides information about various measures of central tendency and dispersion. It also discusses correlation and regression and also hypothesis testing.

Unit 4 on '**Data Processing and Analysis**' discusses about data processing particularly tabulation and graphical presentation. It also briefs about data coding, editing and feeding.

Units 5 on '**Report Writing**' discuss about various types of research reports and detail the various components of a research report.

UNIT 1 QUANTITATIVE DATA COLLECTION METHODS AND DEVICES

Structure

1.1 Introduction

1.2 Primary Data Collection: Meaning and Methods

1.3 Questionnaire Method of Data collection

1.4 Interview Schedule

1.5 Secondary Data Collection 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 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 administer questions. This method is largely followed in research 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 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 expensive as well.

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
	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 follow.

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 needed 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 provide 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 freer 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 Questionnaire

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 and provide incorrect information

iv) there is the chance that information may be manipulated.

Sample Questionnaire

Indira Gandhi National Open University
School of Extension and Development Studies
PG Diploma in Urban Planning and Development

Title: Functioning of Primary School in Municipality

1) Name of the State .....

2) Name of the District .....

3) Name of the Block .....

4) Name of the Municipality .....

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 municipality in your school management

Good .....

Average .....

Poor .....

19) Functioning of the Education Committee

Good .....

Average .....

Poor .....

Areas of their involvement .....

20) In your opinion, who are the real beneficiaries of 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?

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.....

.....

2) What are the advantages of a questionnaire?

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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 become 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 investigator before sending them for data collection.

iii) **Method of Conducting an Interview:** The field investigator 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 exist must be shared before sending it for final data entry and tabulation.

Sample Interview Schedule
Title: Socio-Economic Study of Households in an Urabn Slum
(To be filled by the Head of the Household Or Any Adult Member of the Family)

Name of the Respondent: .....

I) Identification of slum:

1) Name of the slum .....

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 (…..)

4A) Main source of light;

i) Electricity (…..)

ii) Kerosene/Oil (…..)

iii) Gas (…..)

iv) Any other (…..)

4B) 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 in their village

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**

Sr. 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……..-10.

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

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 steps need to be taken while preparing an interview schedule?

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1.5 SECONDARY DATA COLLECTION 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 publications 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 few sources of secondary data?

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2) What precautious have to be taken 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 envisaged in the unit. The unit also narrates the precautions one has to take care up while collecting the primary and secondary data.

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1.8 CHECK YOUR PROGRESS-POSSIBLE ANSWERS

Check Your Progress 1

1) What do you mean by primary data?

   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) What are advantages of a questionnaire?

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) What are the advantages of the interview schedule?

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) What precautious have to be taken care of while preparing an interview schedule?

The precautions that have to be taken care of during the preparation of the interview schedule are**:**

- 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) What are a few sources of secondary data?

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) What precautious have to be taken care of while using secondary data?

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 Keywords

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.
- 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 as 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 it is

iii) 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 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 telephone 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 following 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 object of the case study method is to locate the factors that account for the behaviour patterns of the given unit as an integrated totality.

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 complex 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 I 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.

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 been adopted by fields outside of 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 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

The last 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.

ii) **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, county 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.

iii) **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).

iv) **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.

v) **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, Australia Pvt Ltd, 2005.

Check Your Progress2

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 focus group?

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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.

The researcher must decide in advance of collection and analysis of data as to which design would prove to be more appropriate for his research project. He/she 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, the desired standard of accuracy, and the like, when taking a decision in respect of the design for the research project.

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.

2.6 KEYWORDS

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 v 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) What is the difference between the interview method and the questionnaire method?

   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) List the important assumptions of the case study method.

   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) Focus group combine elements of both interviewing and participant observation capitalizing on group dynamics.

UNIT 3 STATISTICAL TOOLS

Structure

3.1 Introduction

3.2 Data: Meaning and Types

3.3 Variables and Tests

3.4 Measures of Central Tendency

3.5 Measures of Dispersion

3.6 Correlation and Regression

3.7 Hypothesis Testing and Inferential Statistics

3.8 Statistical Tests

3.9 Let Us Sum Up

3.10 Keywords

3.11 References and Selected Readings

3.12 Check Your Progress – Possible Answers

3.1 INTRODUCTION

Why a learner of urban planning and development needs to know about statistical tests is simply because statistical tests will help him/her in analyzing data and drawing up inferences about the data. Those who are middle as well as at the decision making level need some understanding of statistical analysis to understand the strengths and weaknesses of published data to take decisions on whether to apply it in decision making. With the availability of several user friendly software, use of statistical tests has now become a reality, even for non-statisticians, provided they are computer literate and understand the basic principles of statistical analysis. This unit will help you to acquire knowledge about some basic statistical tools which you can use in data analysis.

After reading this unit you will be able to:

- define data, types of data and variables
- explain measures of central tendency
- calculate measures of dispersion, correlation and regression
- describe various inferential statistical tools.

3.2 DATA: MEANING AND TYPES

You know that some basic statistical tools need to be applied for the analysis of data while writing a report of urban development studies. Before describing the meaning of data, let us, know what we mean by statistics. According to Netter and Wasserman "statistics refers to the body of technique or methodology which has been developed for the collection, presentation and analysis of quantitative data and for the use of such data in decision-making". Statistical tools and techniques are used by the researchers to analyse and interpret data. Thus 'data' is a fundamental requirement for any decision making. Data is generally defined

as the evidence of fact which describes a group or a situation and from which conclusion is drawn. The data is the plural from the word 'datum', which means fact? Data is usually classified into two types:

i) Primary data and Secondary data

ii) Discrete data and continuous data

i) **Primary data and Secondary data:** Primary data is the first hand information gathered by an investigator or observer regarding a situation. Researcher collects primary data keeping problems in mind. According to P.V. Young, there are two types of sources of primary data i.e. direct primary sources and indirect primary sources. In direct primary sources, researchers have direct interaction of first hand filed work observation through interview schedule and questionnaire. While in indirect primary sources, he uses the medium of radio broadcasting, television appeal and other valuable documents for gathering information. Some of the advantages of primary data are: (i) Flexibility in collecting data; (ii) more appropriate for large area.

   The secondary data are gathered from personal or public documents. The various sources of secondary data are books, journals, reports, letters and diaries etc.

ii) **Discrete Data and Continuous Data:** Discrete data can take only a discrete value, that can be divided into categories or group such as male and female, white and black; boys and girls, etc.

   On the other hand, the continuous data can take any value including decimal. This is a type of data usually associated with some sort of physical measurement. The height of trees in a nursery is an example of continuous data.

3.3 VARIABLES AND TESTS

While dealing with the statistical tools and data you have to acquire knowledge about two important concepts i.e. variables and tests. Let us discuss them one by one.

i) **Variables:** Variables represents persons or objects which can be manipulated, controlled or measured for the sake of research. There are two types of variable in research such as independent and dependent variables.

   The independent variable is the variable that is varied or manipulated by the researcher. On the other hand, dependent variable is the response that is measured. In other words, an independent variable is the presumed cause; where as the dependent variable is the presumed effect. For example diseases among children are the independent variable, while infant mortality is the dependent variable.

ii) **Statistical Test:** Generally these are two types of tests applicable for statistical interpretation of data for testing hypothesis and drawing inferences, i.e. parametric test and non-parametric test. A parametric test is a test whose model specifies certain conditions about the parameters of the parent

population from which the sample was drawn. On the other hand, non-parametric test is a test whose model does not specify conditions about the parameters of the parent population from which sample was drawn.

In this session you read about data, variables and statistical tests, 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 progress with possible answers given at the end of the unit.

1) What are the important types of data?

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2) What do you understand by non-parametric test?

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3.4 MEASURES OF CENTRAL TENDENCY

Measures of central tendency help the researcher to provide quantitative description of objects and events. Here numbers are assigned as per the rules and after the assignment of numbers, the individual score are compared with the average score to know the position of the individual in the group. Here average is called as the "Central Value". The score which represents the average performance of a group is known as central tendency. The main benefits to study the measures of central tendency are: (i) to get a single value that describe the characteristics of the entire group; (ii) to get a clear idea about the entire data; and (iii) lastly, it facilitates comparison.

There are three common measures of central tendency:

i) Mean or Arithmetic mean

ii) Median and

iii) Mode

3.4.1 Mean

Generally mean of a distribution is called as arithmetic mean. It is the average value of the group. Mean is the sum of the scores divided by the number of

scores. It is defined as the point on the scale of measurement obtained by dividing sum of all scores by the number of scores.

Mean is calculated from two types of data. (i) Ungrouped Data and (ii) Grouped Data

i) **Calculation of Mean from Ungrouped Data:** the formula for calculation of mean for ungrouped data is:

$$\overline{X} = \frac{\Sigma X}{N}$$

$\overline{X}$ = Mean

X = Individual score

N = Total number of scores

Ó = Indicates "sum of"

Example: The following marks 70, 30, 20, 90, 40 are secured by the 5 candidates in a term end examination conducted by a Municipality School. Calculate Mean.

Calculation of Mean

Candidates	Marks
A	70
B	30
C	20
D	90
E	40
N=5	Óx=250

$$\text{Mean} = \frac{\Sigma x}{N}$$

=

Mean = $\overline{X}$ = 50

ii) **Calculation of Mean from Grouped Data:** The mean from grouped data is calculated by applying following formula:

$$\text{Mean} = \overline{X} = \frac{\Sigma fx}{N}$$

Ó = stands for "sum of"

f = Stands for frequency

X = Stand for the mid point of class intervals

N = Total number of cases

Calculate mean value of the following group data:

Calculation Mean Value

Class Interval	Frequency
30-34	2
25-29	3
20-24	6
15-19	4
10-14	5
	N=20

At first you have to calculate the mid point of the class interval. The method of calculating mid point is

$$\text{Mid Point} = \text{LL} + \frac{\text{UL} - \text{LL}}{2}$$

LL = Lower Limit

UL = Upper Limit

$$\text{The Mid Point} = 30 + \frac{34 - 30}{2} = 32$$

For the first class interval 30-34

Class Interval	Frequency	X	fx
30-34	2	32	64
25-29	3	27	81
20-24	6	22	132
15-19	4	17	68
10-14	5	12	60
	N=20		Ófx= 405

$\overline{X} = \frac{\Sigma fx}{N}$

Now by using the formula you can calculate the mean of data given you.

Mean =

$$= \frac{405}{2} = 20.25$$

Let us know some of the important properties of mean.

Following are some of the important properties of mean:

i) The mean is used when a reliable and accurate measure of central tendency is needed.

ii) The mean is used when scores are distributed symmetrically around the central point.

Merits

i) It is easy to compute

ii) It is the best representative of the group.

iii) It is reliable.

Demerits

i) The value of mean depends on value of each item in the series.

ii) When scores are widely discrepant this measurement cannot be used.

iii) When scores are skewed mean can not be used.

3.4.2 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 value. 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, (50th percentile, i.e., 50% value below median value, and 50% above it) 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 {i.e., (n+1)/2} and the mean of two middle values, if n is even {i.e., (n/2) and the next value}

i) Calculation of Median from ungrouped data

Below we have given a few examples of how to calculate Median.

Example :

Case 1: The weights of 7 women are given in Table below, then calculate median value.

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: If there are 8 observations as given in Table below then what will be median:

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 43.5 kg {the average of '(n/2=8/2) 4th value i.e. 43' and 'next value, i.e., 44'}; the median in this case would be (43+44)/2 = 43.5 kg}.

ii) Calculation of Median from Grouped Data

Let us calculate median for a grouped data given in below table.

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	

$$L+\left[\left(\frac{N}{2}-F\right)\times d\right]/f$$

The steps for calculation of median from grouped are as follows:

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 Median =

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) × 20] / 19 = 80 + 6.32 = 86.32 patients.

Merits and Demerits

Merits

i) It is rigidly defined

ii) It is easily understood and easy to calculate. In some cases it can be located merely by inspection.

iii) It is not at all affected by extreme values.

iv) It can be calculated for distribution with open end classes.

Demerits

i) In case of even member of observation, median cannot be determined exactly. We merely estimate it by taking the mean of two middle terms.

ii) It is not based on all the observation for example the median of 10,25,50,60 and 65 is 50. We can replace the observations 10 and 25 by any two values which are smaller than 50 and the observation 60 and 65 by any two values greater than 50, without affecting the value of median. This property is sometimes described by saying that median is insensitive.

iii) It is not amenable to algebraic treatment.

iv) As compared with mean, it is affected much by fluctuations of sampling.

Uses

i) Median is the only average to be used while dealing with qualitative data which cannot be measured quantitatively but still can be arranged in ascending on descending order of magnitude, e.g. to find the average intelligence and average honesty among a group of people.

ii) It is to be used for determining the typical value in problems concerning wages, distribution of wealth, etc.

3.4.3 MODE

Let us consider the following statements.

i) The average height of an Indian (male) is 5’6”.

ii) The average size of the shoes sold in a shop 7.

iii) An average student in a hostel spends Rs. 150 p.m.

In all above cases, the average referred to its mode.

Mode is the value which occurs most frequently in a set of observations and around which the other items of the set, cluster densely. In other word, mode is the value of the variable which is predominant in the series. According to AM Tuttle “mode is the value which has the greatest frequency density in this immediate neighborhood”. Thus in case of dissent frequency distribution mode is the value of X corresponding to maximum frequency. Let us calculate mode from the data given below.

X:	1 2	3	4	5	6	7	8
F:	4 9	16	25	22	15	7	3

The value corresponding to the maximum frequency, viz 25 is 4. Hence mode is 4

Let us calculate mode of a grouped data given in the table below:

Class Interval	Frequency
30-34	2
25-29	3
20-24	6
15-19	4
10-14	5
	N=20

Following step will be used in the calculation of mode:

Step-1 Formula for calculating mode

Mode = L +

$$\frac{(f_1 - f_0)}{2(f_1 - f_0 - f_2)} \times h$$

L = (20) Lower limit of the model class

F_1 = (6) frequency of the modal class

F_0 = (3) frequency of the class proceeding modal class

F_2 = (4) frequency of the class succeeding modal class

h = (4) magnitude of class interval

Step-2 Replace the symbol values with the numeric values as noted in the step-1 in the formula

The calculated value of mode is:

$$\text{Mode} = 20 + \left[\frac{4-3}{2\times 20-4-3}\right]\times 4$$

$$= 20 + 1.08 = 21.08$$

If the distribution is moderately asymmetrical, the mean, median and mode obey the following empirical relationship:

Mode=3 Median – 2 Mean

Merits and Demerits of Mode

Merits:-

i) Mode is relatively comprehensible and easy to calculate.

ii) Mode is not at all affected by extreme values.

iii) Mode can be conveniently located even if the frequency distribution has class intervals of unequal magnitude classes proceeding and succeeding it are of the same magnitude.

Demerits:

i) Mode is ill defined. It is not always possible to find an early defined mode. In some cases, we may come across distribution with two modes, such distribution are called bimodal. If a distribution has more than two modes it is said to be multimodal.

ii) It is not based upon all the observation.

iii) It is not capable of further mathematical treatment.

iv) As compared with mean, mode is affected to a greater extent by fluctuation of sampling.

3.5 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 module 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. Those are discussed below:

3.5.1 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 : If the weights of 7 women are as given in Table below, then what is the range?

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.

3.5.2 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.

3.5.3 Mean Deviation

It is the average of deviation from arithmetic mean , where | | denotes

Mod, considering all differences 'as positive' or 'in absolute value'.

a) Calculation of Mean Deviation (A.D.)

i) Ungrouped Data- The formula used for calculation y mean deviation is:

$$\text{Average Deviation} = \frac{\text{Sum of all deviations}}{N}$$

$$\sum \frac{|X_i - \bar{X}|}{n} \qquad \text{A.D.} = \frac{Ó\,|x|}{N}$$

X = deviation of the raw score Mean

|x| = absolute deviation (disregarding the positive and negative sign)

N = Number of scores

Ó = sum total

Example: Calculate Mean Deviation (A.D.) from the following scores

10, 20, 30, 40, 50

Table: Calculation of Mean Deviation form ungrouped data

Score	Deviation (Raw Score –Mean)	x	|x|
10	10-30	-20	20
20	20-30	-10	10
30	30-30	0	0
40	40-30	10	10
50	50-30	20	20
Ó x=150			Ó|x|=60

$$\text{Mean} = \frac{Ó|x|}{N} = \frac{150}{5} = 30$$

$$\text{A.D.} = \frac{Ó|x|}{N} = \frac{60}{5} = 12$$

Thus A.D. = 12

3.5.4 Standard Deviation (S.D.)

Standard deviation is the only measure of dispersion which has algebraic treatment. It is the most stable measure of variability. The concept of S.D. was first suggested by Karl Pearson is 1893. Here all the deviations of the scores from mean are taken into account. In short it is considered as 'Root-Mean-Squarer-Deviation from Mean'. When the deviation are squared positive and negative signs become positive. When we take positive square root of the deviations, it is known as S.D. It is usually known as ó (sigma).

The formula used to calculate standard deviation is

$$\text{S.D.} = \sqrt{\frac{\Sigma\left(X - M\right)^2}{N}}$$

$$= \sqrt{\frac{\Sigma d^2}{N}}$$

ó =

Where,

Ó = sum total

d = deviation (score-mean)

N = total number of cases

a) Calculation of S.D. from Ungrouped Data

The formula to calculate S.D. from ungrouped data is

ó =

Example. Find out the S.D. of the following scores:

8, 9, 10, 11, 12, 13, 14, 15

Procedure for the calculation of S.D are as follows.

- Calculate Mean
- Calculate deviation against each score
- square the deviations
- find the total or sum of squared deviations
- divide sum of squared deviation by N
- Find the square root of the division.

Table: Calculation of S.D from Ungrouped Data

Score (X)	Deviation d(X-M)	d	d^2
8	8-12	-4	16
9	9-12	-3	9
10	10-12	-2	4
11	11-12	-1	1
12	12-12	0	0
13	13-12	1	1
14	14-12	2	4
19	19-12	7	49
Ó x=96			Ód²l=84

Mean = $\frac{\Sigma x}{N} = \frac{96}{12}$ = 8

$$\text{S.D.} = \sqrt{\frac{\Sigma d^2}{N}} = \sqrt{\frac{84}{12}} = \sqrt{7} = 2.64$$

b) Calculation of S.D. from Grouped Data

In grouped data, deviations are taken from the mid points of the class intervals. The deviations are squared and multiplied by frequency of the said class interval. Then the root, mean of square deviations is to be calculated.

The formula to calculate S.D. is

$$ó = \sqrt{\frac{\Sigma d^2}{N}}$$

Where,

Ó = sum total

f = frequency

d² = Square of deviation

N = total number of frequencies

Table: Calculation of Standard Deviation from Grouped Data

Class Interval (C.I)	Frequency (f)
10-14	2
15-19	3
20-24	4
25-29	5
30-34	6
	N=20

Computation of S.D. is given below.

C.I.	f	X	fx	X-M	d	d^2	fd^2
10-14	2	12	24	12-20.5	-8.5	72.25	144.50
15-19	8	17	136	17-20.5	-3.5	12.25	98.00
20-24	6	22	132	22-20.5	1.5	2.25	13.50
25-29	2	27	54	27-20.5	6.5	42.25	84.50
30-34	2	32	64	32-20.5	11.5	132.25	264.50
	N=20		Óf x=410				Ófd²=605.00

Mean =

$$= \frac{410}{20} = 20.5$$

S.D. =

$$= \sqrt{\frac{605.00}{20}} = \sqrt{30.25}$$

$$= 5.5$$

The standard deviation is 5.5

3.5.5 Coefficient of Variation

100 times the coefficient of dispersion based upon standard deviation is called coefficient variation (c.v), i.e.,

$$C.V. = 100 \times \frac{\sigma}{X}$$

According to profession Karl Pearson who suggested this measure, C.V.is the percentage variation in the mean, standard deviation being considered as then total variation in the mean.

Fun comparing the variability of two series, we calculate the co-efficient of variations for each series. The series having greater c.v. is said to be more variable than the other and the series having lesser c.v. is said to be more consistent than the other.

In this session you read about measures of central tendency and measures of dispersion, 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 progress 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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3.6 CORRELATION AND REGRESSION

3.6.1 Correlation: Concept and Meaning

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 (Figure 1) below.

Correlation analysis is important because it can be used to predict values of one variable on the basis of value of other variable. A correlation does not mean causation but it also does not mean absence of causation, that is, if two variables exhibit strong correlation, then, one of the variables may cause the other. Correlation data is, therefore, not sufficient evidence for causation.

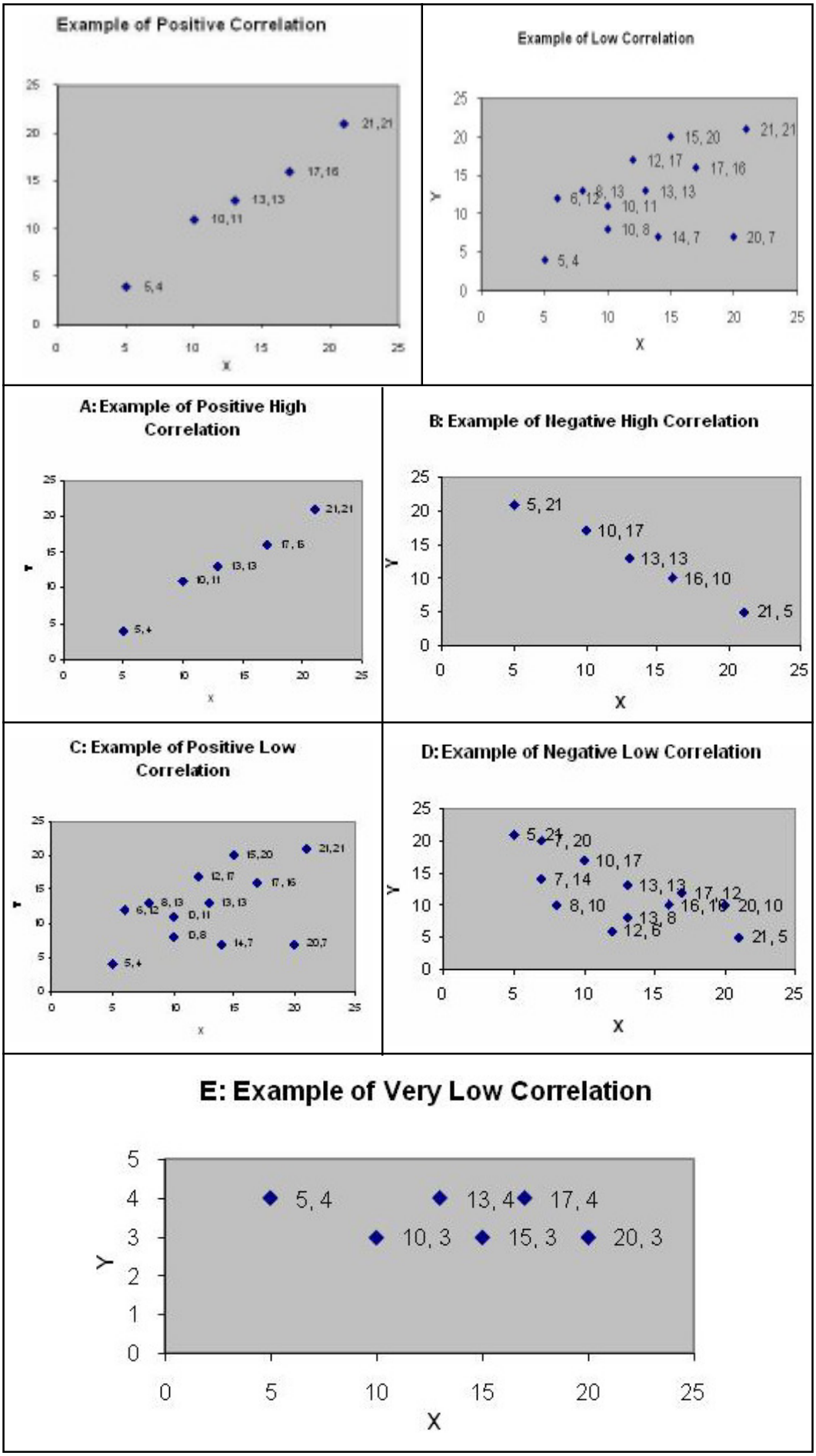

Fig. 3.1 : Scatter Diagram showing relation between two variables

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 by hand or the value of r can be obtained using either a calculator with built in capability to do the calculation or a variety of computer software programs. 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 regression 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 regression 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.).

$\frac{\Sigma xy}{N\sqrt{\frac{\Sigma x^2}{N}}\sqrt{\frac{\Sigma y^2}{N}}}$

Calculation of the Pearson's Correlation Coefficient

Formula for calculation of Karl Pearson's correlation co-efficient is:

$$r = \quad =$$

$$= \frac{\Sigma xy}{N\sqrt{\frac{\Sigma x^2}{N}}\sqrt{\frac{\Sigma y^2}{N}}}$$

$$=$$

r = correlation coefficient

x = deviation from $\bar{x}$ (Arithmetic mean) of the first set of variables

y = deviation from $\bar{y}$ (Arithmetic mean) of the second set of variable

Ó = sign of summation

S_1 = standard deviation of the first set of variables

S_2 = standard deviation of the second set of variables

N = number of items in each set of variables

Example: Calculation the correlation coefficient between the following scores of history and mathematics.

Calculation the coefficient of correlation between the following scores of history and mathematics

Students	A	B	C	D	E
History (X)	65	56	69	60	75
Mathematics (Y)	60	76	74	80	85

Computation of coefficient of correlation

Student	History	Deviation		Mathematics From A.M.=65	Deviation From A.M.=65	y^2	xy
	X	x	x^2	Y	y		
A	65	0	0	60	-15	225	0
B	56	-9	81	76	+1	1	-9
C	69	+4	16	74	-1	1	-4
D	60	-5	25	80	+5	25	-25
E	75	+10	100	85	+10	100	+100
	325		Óx^2=222	375		Óy^2=352	Óxy=62
	=65			$\overline{Y} = \frac{375}{5}$ =75			

Coefficient of Correlation (r) = $\frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}} = \frac{62}{\sqrt{222 \times 352}}$

$$\frac{62}{\sqrt{78144}} = \frac{62}{\sqrt{280}} = +0.22$$

3.6.2 Regression: Concept and Meaning

In common language 'regression' means to return or to go back. In statistics, the term 'regression' is used to denote backward tendency which means going back to average or normal. The term 'regression' was first used by Sir Francis Galton.

Regression shows a relationship between the average values of two variables. So regression is average value of one variable for a given value of the other variable. It is useful for calculation of cause and effect relationship. The best average value of one variable associated with the given value of the other variable may be estimated or predicted by mean of an equation known as "Regression Equation" and also by the help of a line called as "Regression Line" which shows for a given value of other variable.

In order to estimate the best average values of the two variables, two regression equations are required and they are used separately. One equation is used for estimating the value of the first variable (X), this is called "Regression Coefficient of X on Y" or "Regression Equation of X on Y" and the second equation is used

for estimating the value of the second variable (Y) for a given value of the first variable called "Regression Coefficient of Y on X" and "Regression Equation of X on Y".

The formula for calculation of regression coefficient are:-

1) Regression Coefficient of X on Y is $b_{xy} = r \frac{S_x}{S_y}$

2) Regression Coefficient of Y on X is $b_{xy} = r$

S_x = Standard Deviation of X series

S_y = Standard Deviation of Y series

r = Correlation coefficient between X and Y

1) Regression Equation of X and Y is

$X - \bar{X} = r \quad (Y - \bar{Y})$

2) Regression Equation of Y and X is

$Y - \bar{Y} = r \quad (X - \bar{X})$

$\frac{S_y}{S_x}$

X = Value of X

Y = Value of Y

$\bar{X}$ = Arithmetic Mean of X series

$\bar{Y}$ = Arithmetic Mean of Y series

S_x = Standard Deviation of X series

S_y = Standard Deviation of Y series

r = Correlation coefficient between X and Y

Example: obtain lines of regression for the following data:

Computation of Regression Equation

$\bar{X}$	$(\bar{X} - 5)$ x	x^2	Y	(Y-12) y	y^2	xy
1	–4	16	9	–3	9	12
2	–3	9	8	–4	16	12
3	–2	4	10	–2	4	4
4	–1	1	12	0	0	0
5	0	0	11	–1	1	0
6	+1	1	13	+1	1	1
7	+2	4	14	+2	4	4

8	+3	9	16	+4	16	12
9	+4	16	15	+3	9	12
$\acute{O}\bar{X}$= 45	Óx=0	Óx²=60	ÓY=108	Óy=0	Óy²=60	Óxy=57

Regression Coefficient (b_{xy}) = r = r =

$$= \frac{9\times 57 - 0\times 0}{9\times 60 - 0^2} = \frac{9\times 57}{9\times 60} = \frac{19}{20} = 0.95$$

Regression Coefficient (b_{yx}) = r = =

= = 0.95

i) The regression equation of X on Y is

$X - \bar{X} = {}_{r}$ $(Y - \bar{Y})$ is

$\bar{X} - 5 = 0.95\ (Y - 12) = 0.95Y - 11.4$

$\bar{X} = 0.95Y - 11.4 + 5$

$\bar{X} = 0.95Y - 6.4$

ii) The regression equation of Y on X is

$Y - \bar{Y} = r$ $(\bar{X} - \bar{X})$ is

$Y - 12 = 0.95\ (\bar{X} - 5) = 0.95\bar{X} - 4.75$

$Y = 0.95\bar{X} - 4.75 + 12$

$Y = 0.95X + 7.25$

Differences between Regression and Correlation

Sl.	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, on the other hand, 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. In regression we try to estimate the average value of one variable h m the given
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.

In this session you read about correlation and regression, 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) Differentiate between correlation and regression.

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3.7 HYPOTHESIS TESTING AND INFERENCIAL STATISTICS

3.7.1 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 that this is the case 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.

3.7.2 Tests of Significance

Different sets of data require different tests of significance. Throughout this module, 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.)

In order to help you choose the right test, a flowchart and matrices will be presented for different sets of data. We will discuss how significance tests work. Please keep in mind that independent groups are treated as independent populations.

i) 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. Examples of null hypotheses are

- There is no difference in the incidence of measles between vaccinated and non-vaccinated children.
- Males do not drink more alcohol than females.
- There is no association between families' income and malnutrition in their children.

If 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 ($\mathbf{H_1}$) 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.

ii) The Concept of Type I and Type II Error

There are four ways in which conclusion of the test might relate to in our study (i) true positive (ii) true negative and (iii) false positive and (iv) false negative. These may be expressed in terms of error in statistical test of significance in following terms:

Type I error (á): We reject the null hypothesis when it is true, or false positive error, or type I error '**á'** (called alpha). It is the error in detecting true effect.

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 (â): We accept the null hypothesis when it is false or false negative error; or simply, type II error '**â'** (called beta) can be stated as failure to detect true effect. 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.

The definition can be summarized as given below.

Actual Situation			
		True Ho	**False Ho**
Investigator's Decision	**Accept Null hypothesis**	Correct Acceptance	Error (Type II)
	Reject Null hypothesis	Error (Type I)	Correct Rejection

Note: Alpha **(á)** and beta **(â)** are the Greek letters and are used to denote probabilities for **type I error** and **type II error** respectively.

We would like to carry our test, i.e., choose our critical region 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 (**á**) fixed at a specified value (i.e., at 1% or 5%).

3.8 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. Although there are many statistical tests used in drawing inferences, here we will confine our discussion to four main types of tests:

i) ÷² test

ii) T-test

iii) Z- test

iv) F-test

3.8.1 Chi-Square Test (χ^2)

Chi-square test is termed as a non parametric test. Karl Pearson first introduced the concept of chi-square and its application in testing statistical hypothesis. The value of chi-square is determined by (i) taking the difference between each observed frequency (fo) and the corresponding expected theoretical frequency (fe) (ii) squaring each difference (iii) dividing each squared difference by the corresponding expected theoretical frequency and then (iv) adding all the quotient. The value of chi-square is represented by the symbol χ^2

Thus χ^2 =

Uses of chi-square Test

The chi-square test is very powerful tool in the hands of statisticians for testing hypothesis of a variety of statistical problems. The most important purposes served by the application of test of chi-square are follows:

1) test of goodness fit – the chi-square test is used for the comparison of observed frequencies with the expected theoretical frequencies in a sample.

2) test of Independence- the chi-square test is widely used to test the independence of attributes.

3) Test of homogeneity- the chi-square test is also used to test the homogeneity of attributes is respect to of a particular characteristic.

Formula used for computation of

$$\chi^2 = \sum \left[\frac{(f_0 - f_e)}{f_e} \right]$$

χ^2 = Chi-Square

F_o = Observed frequency

F_2 = Expected frequency

Ó = Sum total

Example: Compute the chi-square of data given in table below:

Computation of Chi-square test

		f_0	f_e	$f_0 - f_e$	$(f_0 - f_e)^2$	$\frac{(f_0 - f_e)^2}{f_e}$
1.	Favorably	20	27	-7	49	1.81
2.	Unfavourably	40	27	13	169	6.25
3.	Undecided	21	27	- 6	36	1.33
		81	81			9.39

Follows steps will be used in assessing the level of significance:

Step-1 **Determining the Degree of freedom-** The Chi-Square test depends on degree of freedom. The degree of freedom deals with rows and columns of a table. The formula to calculate degree of freedom is

df = (c-1) (r-1)

df = degree of freedom

C = columns of a table

r = rows of the table

the above table (question) has 3 rows and 2 columns.

df = (C-1)(r-1)

= (3-1) (2-1)

= 2X1

= 2

Step-2 **Determining the Critical Value-** χ^2 has pre-determined value. It requires significance level (5% or 1%) for the computed degree of freedom.

The df is 2. The critical value at 5% level is 5.991 and at 1% level is 9.210 by referring to χ^2 table.

Step-3 **Comparing the critical value of Chi-Square with Computed Value-** the computed χ^2 value is 9.39. It is higher than 5% and 1% level table value. So it is significant. Consequently null hypothesis is rejected in favour of alternative hypothesis.

3.8.2 T -Test

A t-Test is a statistical hypothesis test. The T-Statistic was introduced by W.S. Gossett under the pen name "student". Therefore, the T-test is also known as the "student T-test". The T-test is a commonly used statistical analysis for testing hypothesis, since it is straight forward and easy to use. Additionally, it is flexible and adoptable to a broad range of circumstances. The T-test is applied, if you have a limited sample, usually sample size is less than 30.

The formula used for the calculation of T-test is:

$$t = \frac{\bar{d}}{S\left(\bar{X}_1 - \bar{X}_2\right)}$$

Where,

t = t-test

$\bar{d}$ = mean difference

S = standard deviation

$\bar{X}_1$ = Mean of first set of variables

$\bar{X}_2$ = Mean of second set of variables

Calculation of $\bar{d} = \frac{\Sigma d}{N}$

$$S = \sqrt{\frac{\Sigma d^2}{n-1} - \frac{\left(\Sigma d\right)^2}{n(n-1)}}$$

Example: An IQ test was administered to 5 person before and after they were trained. The result are given below.

Candidates	**I**	**II**	**III**	**IV**	**V**
IQ before Training	110	120	123	132	125
IQ after Training	120	118	125	136	121

Test whether there is any change in IQ after training programme

Candidates	**I Q before training x_1**	**I Q before training x_2**	**Difference $(x_2 - x_1)$ d**	**d^2**
I	110	120	10	100
II	120	118	-2	4
III	123	125	2	4
IV	132	136	4	16
V	125	121	-4	12
			Ód=10	Ód²=140

Estimated standard deviation of population =ó

=

=

=

=

=

= 2

$$t = \frac{\bar{d}}{s\left(\bar{X}_1 - \bar{X}_2\right)} = \frac{2}{2.45} = 0.816$$

3) Level of significance: á=0.01

4) Decision At 0.01 level of significance for 5–1=4 degrees of freedom, the critical value of t = 4.6 (using t-table) but the computed value of t = 0.816 is less than the critical value of t = 4.6 [t = 0.816 < t = 406]. Hence the computed value of t = 0.816 falls in the acceptance region. Thus the null hypothesis (r_1 = r) is accepted. So it may be concluded that there is no change in IQ after training programme.

$$\sqrt{\frac{30}{4}}$$

$$\frac{10\times 10}{5\times 4}$$

$$s\left(\bar{X}_1 - \bar{X}_2\right) = \sigma / \sqrt{n} = \sqrt{\frac{30}{5}} = 2.45$$

$$\sqrt{\frac{S_1^2}{n_1}} + \sqrt{\frac{S_2^2}{n_2}}$$

3.8.3 Z -Test

Z-Test is another type of test like T-test applied to compare sample and population means to know if there is a significant difference between them. Z- Test is usually applied in large sample size, having more than 30 sample.

The formula for calculation of Z-Test is

=

Where

x_1 = mean of the first variable

x_{-2} = Mean of the Second variable

S_1= Standard deviation first equation

S_2= Standard deviation second equation

n_1= Standard size of first

n_2= Standard size of Second

Example: The score in mathematics for boys and girls is given in table below, calculate whether there is significant difference in score between them.

Scores of Boys		Scores of Girls	
40	30	22	42
35	20	33	19
25	11	26	26
26	36	33	29
24	39	44	39
20	44	20	49
45	19	41	23
43	28	33	15
28	36	37	40
33	27	27	26
29	34	18	27
31	18	19	28
41	47	44	11
49	16	32	31
21	47	22	29
34	22	36	25

$\bar{X}_1 = 31.19$

$\bar{X}_2 = 29.56$

$S_1 = 10.13$

$S_2 = 9.56$

$S_1^2 = 102.802$

$= 85.67$

$Z =$

$$= \frac{1.62}{2.42} = 0.67$$

Interpretation: The tabled value of z is 1.96. Since Z < - 1.96 (0.67<1.96), we reject H_0. It means that these is no significant difference between scores of boys and girls.

3.8.4 F -Test

The F-test was first developed by R.A. Fisher. Hence it is known as fisher's test on more commonly as F test. The f-test is used either for testing the hypothesis

about the equality of two population variances of the equality of two or more population means. The ratio of two sample variances.

The formula for calculation of f is:

F =

Where,

= variance of first set of data

= variance of second set of data

Example

The time taken by workers in performing a job by method I and method II is given below.

Method I	20	16	23	27	23	22	
Method II	27	33	42	35	32	34	38

Do the data show that the variances of time distribution in a population from which these samples are drawn do not differ significantly

Solution

Computation of Variances

$S_1^2 = \left\{\frac{\Sigma d_1^2}{n_1}\right\} - \left\{\frac{\Sigma d_1}{n_1}\right\}^2$

Method-I		
X_1	$X_1-22=d_1$	d_1^2
20	–2	4
16	–6	36
26	4	16
27	5	25
23	1	1
22	0	0
	$\Sigma d_1 = +2$	$\Sigma d_1^2 = 82$

Method-II		
X_2	$X_2-34=d_2$	d_1^2
27	–7	49
33	–1	1
42	8	64
35	1	1
32	–2	4
34	0	0
38	4	16
	$\Sigma d_2 = 3$	$\Sigma d_1^2 = 135$

Method-I

= 13.55

Variance = 13.55

Method-II

Varience

=

= 19.28 – 0.18 = 19.10

Varience = S_2^2 = 19.10

Computation of F-test statistic

Test Statistic F = = .709

3) degrees of freedom v_1= n–1 = 6 –1 = 5

And V_2= n_2–1 = 7–1 = 6

4) Decision- at 5% level of significance the critical value of F=4.95 for v_2=6 and v1=5 degrees of freedom. But the computed value of F=.709 is less than the critical value of F=4.95. Hence the null hypothesis $ó_1^2 = ó_2^2$ is accepted. So it may be concluded that the variance of time distribution in a population from which the samples are drawn do not differ significantly.

In this session you read about different deferential statistics, now 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 progress with possible answers given at the end of the unit.

1) What is t-test and where it is applied?

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2) What is Chi-square?

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3.9 LET US SUM UP

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. 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. $\div^2$ 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	χ^2 value if $\alpha = 0.05$	χ^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

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
infintie	1.96	2.58.

3.10 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 totalling 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.

3.11 REFERENCES AND SELECTED READINGS

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3.12 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

1) What are the important 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 be categorized in two types viz., discrete and continuous data.

2) What do you understand by non-parametric test?

   A 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.

Check Your Progress 2

1) What are the different measures of central tendency?

   The three measures of central tendency are the mean, median, and mode.

2) What are the different measures of dispersion?

   The measures of dispersion are range, percentiles, mean deviation and standard deviation.

Check Your Progress 3

1) Differences between Correlation and Regresion

The main difference between correlation and regression is that the 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. While regression finds out the best fit line for a given set of variables.

Check Your Progress 4

1) What is t-test and where it is applied?

A t-Test is a statistical hypothesis test. The T-Statistic was introduced by W.S. Gossett under the pen name "student". Therefore, The T-test is also known as the "student T-test". The T-test is a commonly used statistical analysis for testing hypothesis, since it is straight forward and easy to use. Additionally, it is flexible and adoptable to a broad range of circumstances. The T-test is applied, if you have a limited sample, usually sample size is less than 30.

2) What is Chi-squre?

Chi-square test is termed as a non parametric test. Karl Pearson first introduced the concept of chi-square and its application in testing statistical hypothesis. The value of chi-square is determined by (i) taking the difference between each observed frequency (fo) and the corresponding expected theoretical frequency (fe) (ii) squaring each difference (iii) dividing each squared difference by the corresponding expected theoretical frequency and then (iv) adding all the quotient . The value of chi-square is represented by the symbol χ^2.

UNIT 4 DATA PROCESSING AND ANALYSIS

Structure

4.1 Introduction

4.2 Data Measurement and its Types

4.3 Tabulation and Interpretation of Data

4.4 Let Us Sum Up

4.5 Keywords

4.6 References and Selected Readings

4.7 Check Your Progress – Possible Answers

4.1 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, and 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.

4.2 DATA MEASUREMENT AND ITS TYPES

4.2.1 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.

4.2.2 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, for example, a questionnaire, an interview schedule etc.

Secondary Data

Secondary data are data that have been collected for another purpose and where we will use a statistical method with the primary data. This means that 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, 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 are divided into a number of named categories. These categories, however, cannot be ordered one above another (as they are not greater or lesser than each other).

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.

In this section, you studied about the data measurement and its types. Now answer the following questions.

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?

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2) What do you understand by primary data?

.....

.....

.....

.....

4.3 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.

4.3.1 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 and education is given below.

Marital Status

Married	:	01
Separated	:	02
Widow	:	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 column 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 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.

4.3.2 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, and then, it must be mentioned in the footnote. An example of a table is given below:

Title

		Caption
STUB	**BODY**	**BOX HEAD**

Source:

Footnote:

4.3.3 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 4.1: Mark obtained by class fifth students in mathematics

Marks	Tally of marks	Frequency (No. of students)
20	𝍸	5
21	𝍸 𝍸 II	12
25	𝍸 𝍸 III	13
30	𝍸 𝍸	10
Total		**40**

Table 4.2: Grouped frequency distribution

Marks obtained	Tally of marks	Frequency
1-10	𝍸 𝍸 I	11
11-20	𝍸 𝍸 𝍸 IIII	20
21-30	𝍸 𝍸 𝍸 IIII I	21
31-40	𝍸 𝍸 III	13
41-50	𝍸 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 4.3: 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 4.3 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 4.4: 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 4.4 that there are more males serving in rural areas than females. These males in rural areas are apparently teachers.

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 4.5: 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, in a glance, that male nurses dominate the rural health services. It also indicates that males dominate in the medical profession, (18% M > 7% F doctors) but, that, overall, there are more female than male nurses, 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 3, 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 from Example 2 can be presented in a bar chart, using either absolute frequencies or relative frequencies/percentages and an example is given in Figure 4.1 below.

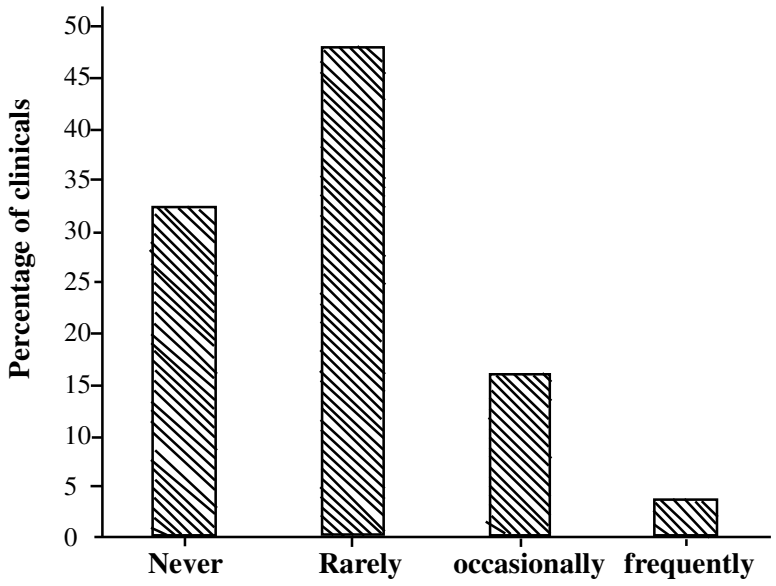

Figure 4.1: Relative frequency of shortage of anti-malaria drugs in rural health institutions (n=148)

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%.

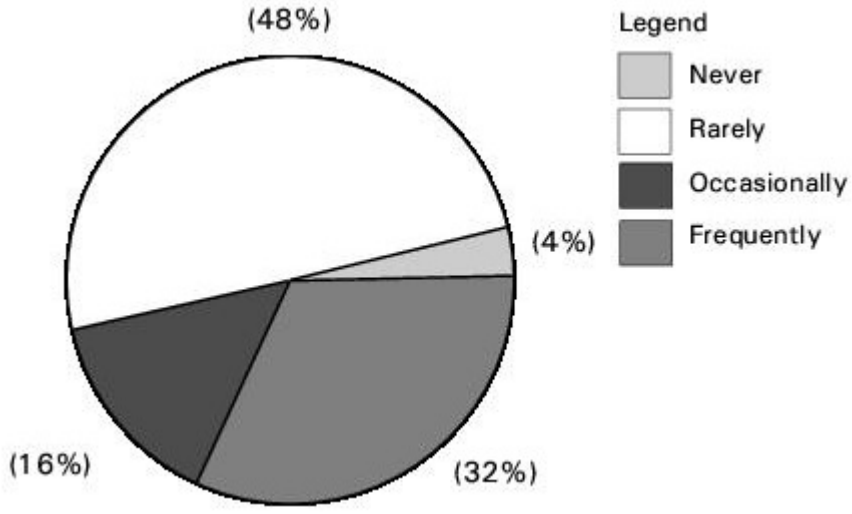

Figure 4.2: Relative frequency of shortage of anti-malaria drugs in rural health institutions (n=148)

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 4.3.

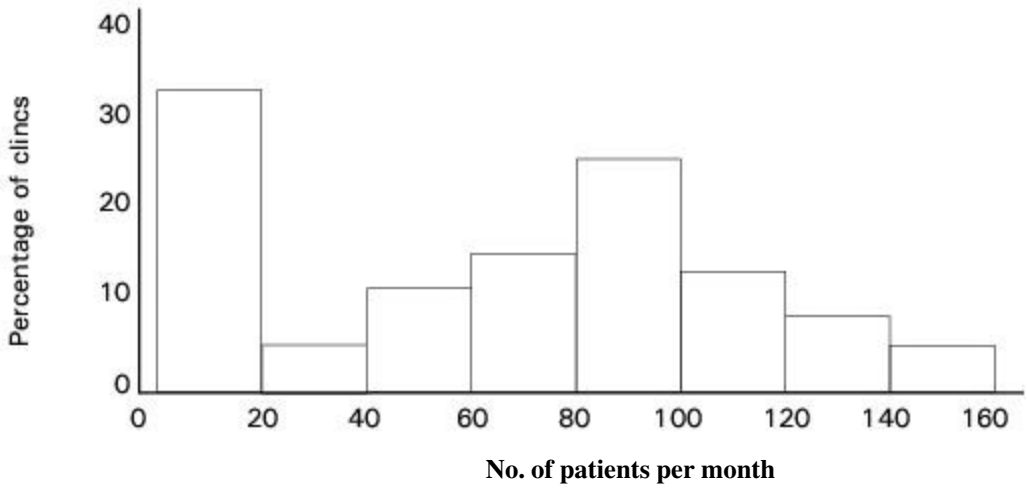

Figure 4.3: Percentage of clinics treating different numbers of malaria patients in one month (n=80).

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 4.4 .

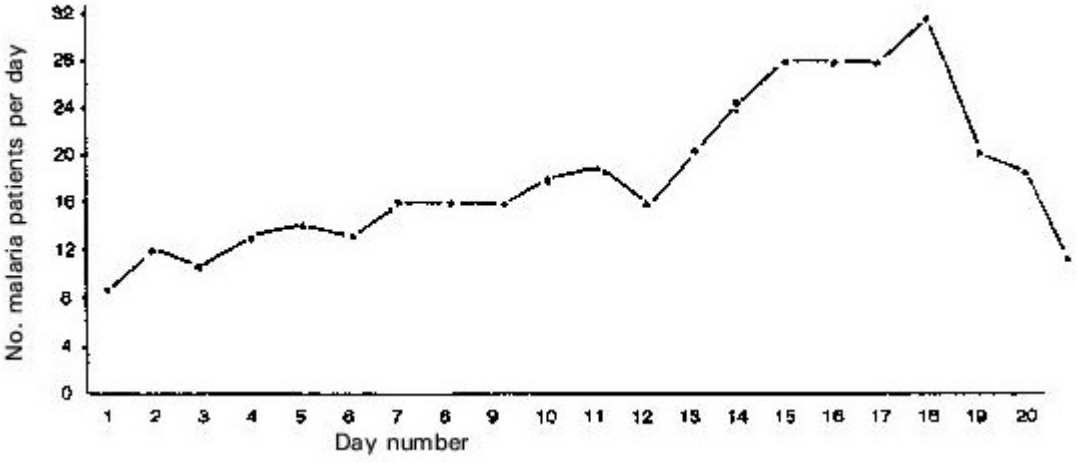

Figure 4.4: Daily number of malaria patients at the health centres in District X

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.

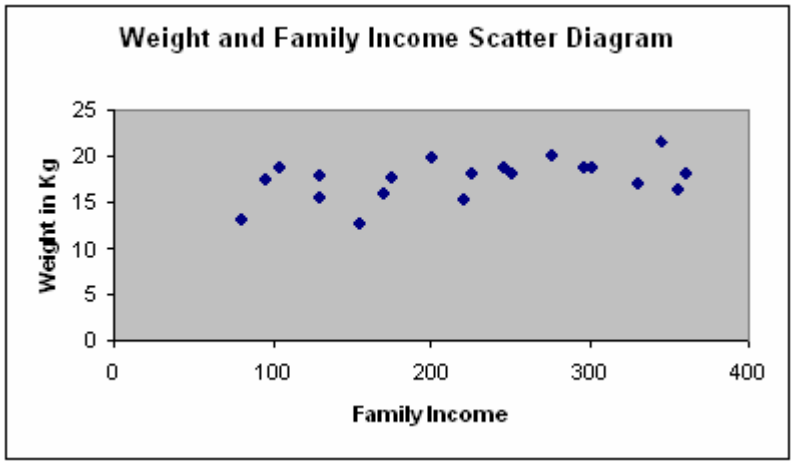

Figure 4.5: Weight of five-year-olds according to annual family income

Note: It is important that all figures presented in your research report have numbers, clear titles, and are clearly labelled (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 following questions.

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?

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2) What is a pie chart and where is it used?

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4.4 LET US SUM UP

Understanding data quality and its measurement are of utmost importance for any researcher. Poor quality data cannot be analysed 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.

4.5 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.

4.6 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.

4.7 CHECK YOUR PROGRESS - POSSIBLE ANSWERS

Check Your Progress 1

1) What is panel data.

   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) What do you understand by primary data?

   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) What is meant by coding of data?

   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) What is a pie chart and where is it used?

   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 5 REPORT WRITING

Structure

5.1 Introduction

5.2 Types of Report

5.3 Writing the Research Report

5.4 The Preliminary Pages of Research Report

5.5 Main Components or Chaptering of Research Report

5.6 Style and Layout of the Report

5.7 Common Weaknesses in Report Writing and Finalizing the Text

5.8 Let Us Sum Up

5.9 References and Selected Readings

5.10 Check Your Progress – Possible Answers

5.1 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:

- follow 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.

5.2 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 like 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.

5.3 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

5.4 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 Indian Council of Agricultural Research for providing funds and facilities for the project. I offer my sincere thanks to the Director, Indian Agricultural Research Institute for his encouragement and support for pursuing this study. I am also grateful to the head, Division of Agricultural Economics, IARI for providing all needed support, encouragement, and technical guidance. All the Research Associates, Senior Research Fellows and technical assistants working under the project deserve special appreciation for their hard work and sincere efforts in completing this project.

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 with page numbers. The initial letters of the key words in the title are capitalized and no terminal punctuation is used. An example is given below.

List of Tables

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	
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.	.	
.	.	

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 have collected while carrying out the study. It may be a questionnaire, a letter of appreciation, a government notification, etc. The list of appendices appears in the same format as the list of tables.

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)—the main
- objectives (**What** has been studied)
- the place of study (**Where**)
- the type of study and methods used (**How**)
- the major findings and conclusions
- the major (or all) recommendations.

The summary will be the first (and for busy programme manager/decision makers most likely the only) part of your study that will be read. Therefore, it demands thorough reflection and is time consuming. Several drafts may have to be made, each discussed by the research team as a whole.

As you may have collaborated with various groups during the drafting and implementation of your research proposal, you may consider writing **different summaries** for each of these groups. For example, you may prepare different summaries for policymakers and programme managers, for implementing staff of lower levels, for community members, or for the public at large (newspaper, TV). In a later stage, you may write articles in scientific journals.

In this section, we discussed about the types of report and the contents to be included in the preliminary pages of research report. Now answer the following questions.

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?

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2) What is the importance of writing an acknowledgement in a research report and where should it be placed?

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5.5 MAIN COMPONENTS OR CHAPTERING OF RESEARCH REPORT

The Main Text includes the following chapters

- Introduction
- Review of Literature
- Methodology
- Research Findings
- Discussion
- Conclusion and Recommendations
- Summary

5.5.1 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.

5.5.2 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.

5.5.3 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

Data Collection/Sample

A micro level study based on primary cross section data was designed to attain the objectives of this project. The survey was conducted in three states; Bihar, Uttar Pradesh and Punjab. A systematic interview schedule was used to collect information on various aspects of labour migration and its impact on rural economy of Indo-Gangetic Plains of India. The data was collected for 200 families with migration and 200 families without migrating members.

Analytical tools

Various statistical tools were used in the analysis of data. Those are mean, standard deviation, correlation, t-test, and regression.

5.5.4 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 5.1 is given in the box below.

Table 5.1: Social Characteristics of Migrants **(Percentage)**

Particulars	**Bihar**	**UP**	**Overall**
Number	**245**	**308**	**553**
i) Age Profile			
Up to 30 Years	69.80	56.49	62.39
31 to 45 Years	26.53	35.39	31.46
Above 46 Years	3.68	8.11	6.15
ii) Literacy Status			
Illiterate	33.88	19.16	25.50
Primary	50.20	29.87	38.00
Matriculation and above	15.92	50.97	36.48
iii) Social Status			
Upper Caste	22.86	9.42	15.37
SC/ST/BC	77.15	90.58	84.63

Analysis of Table 5.1

The socio-economic characteristics of the migrants are depicted in Table 3. The table clearly shows that in UP there had been 308 migrants from 200 households while Bihar had only 245 migrants from 200 households. On an average, 62 percent of the migrants were below 30 years of age with a higher percentage of younger migrants from Bihar than from UP. Most of the migrants from both UP and Bihar were literate, and only 25 per cent of the total migrants from both UP and Bihar were illiterate. Most of the migrants belonged to a schedule caste or backward class, the percentage being higher in UP (91%) compared with Bihar (77%).

Tables and **Figures** in the text should be numbered and have clear titles. It is advisable to first use the number of the section to which the table belongs. In the final draft you may decide to number tables and figures in sequence. It is appreciated in case some pictures from the field are also appropriately presented to give visual presentation of the field information.

Include only those tables and figures that present main findings and need more elaborate discussion in the text. Others may be put in annexes, or, if they don't reveal interesting points, be omitted.

It is advisable to involve statistician/data analyst from the very beginning and in each process of the research so that he may provide meaningful tables and himself judge irrelevant findings.

Note: It is unnecessary to describe in detail a table that you include in the report. Only present the main conclusions.

The first draft of your findings is never final. Therefore, you might concentrate primarily on content rather than on style. Nevertheless, it is advisable to structure the text from the beginning in paragraphs and to attempt to phrase each sentence clearly and precisely.

5.5.5 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 3. The number of migrants gives an idea about frequency of migrants in a household. In UP, the percentage of households having more than one migrant was relatively higher when compared with that of Bihar. Most of the migrants in both the states were up to 30 years of age. This clearly indicates that young men in their productive age were more involved in migration. Similar results were reported by Sidhu et.al. (1997) and Kumar et.al. (1998) in their studies, that most of the migrants of both the states were literate and belong to the backward sections of the society. The underlying fact is that the backward classes belonging to the lower social hierarchy were more capable of doing menial jobs and tasks, which required lot of energy.

5.5.6 Chapter 6: Conclusions and Recommendations

The conclusions and recommendations should follow logically from the discussion of the findings. Conclusions can be short, as they have already been elaborately discussed in Chapter 5. As the discussion will follow the sequence in which the findings have been presented (which in turn depends on your objectives) the conclusions should logically follow the same order. Sometimes, it is advisable to present conclusion and recommendations in specific sections related to issues of importance/under investigation/objectives of the study for better clarity to different stake holders. The conclusions should be given in bullets so that it can easily catch the attention of the reader.

Remember that action-oriented groups are most interested in this section.

The conclusions should be followed by suggestions or recommendations. While making recommendations, use not only the findings of your study, but also supportive information from other sources. The recommendations should be generated from the findings and conclusions. It should not be generalized; rather it should be specific to particular stake holders in pure, actionable term which is feasible in relation to social context, policy and constitution of country, political acceptability, budget, time, etc. One should **not give general recommendations** such as, "Government should provide free treatment to everyone for all health problems".

If your recommendations are short (roughly one page), you might include them all in your summary and omit them as a separate section in Chapter 6 in order to avoid repetition.

5.5.7 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). In the list of references, the publications are then arranged in alphabetical order by the principal author's last name. You can choose either system as long as you use it consistently throughout the report unless some guidelines specifically ask for it (in case of research publications).

The references should be given in the following order.

1) Name of the author, last name first.
2) Title, underlined to indicate italics.
3) Place, publisher and date of publication.
4) Number of volumes.

Example

Kothari, C.R., *Quantitative Techniques*, New Delhi, Vikas Publishing House Pvt. Ltd., 1978.

For magazines and newspapers the order may be as follows.

1) Name of the author, last name first.
2) Title of the article, in quotation marks.
3) Name of the periodical, underlined to indicate italics.
4) The volume and number.
5) The date of the issue.
6) The pagination.

Example

Robert V. Roosa, "Coping with Short-term International Money Flows", *The Banker*, London, September, 1971, p.995.

5.5.8 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.

5.6 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.

5.6.1 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'
- 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.

5.6.2 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.

5.6.3 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.

5.7 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 pro's and con's of possible solutions. Yet, too often the discussion is merely a dry summary of findings.

ii) **Neglect of Qualitative Data** is also quite common. Quotes of informants as illustration of your findings and conclusions make your report lively. They also have scientific value in allowing the reader to draw his/her own conclusions from the data you present. (Assuming you are not biased in your presentation!). Presentation of important photographs also makes report attractive and explains facts better.

iii) Sometimes qualitative data (e.g., open opinion questions) are just coded and counted like quantitative data, **without interpretation,** whereas they may provide interesting illustrations of reasons for the 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?

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2) What information do annexes and appendices contain?

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5.8 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.

5.9 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.

5.10 CHECK YOUR PROGRESS – POSSIBLE ANSWERS

Check Your Progress 1

1) What should be included on the cover page of a research report?

   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) What is the importance of writing an acknowledgement in a research report and where should it be placed?

   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) What is the order of chaptering in a research report?

   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) What information do annexes and appendices contain?

   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.

MEDS-044 MONITORING AND EVALUATION OF PROJECTS AND PROGRAMMES

BLOCK 1 : PROJECT FORMULATION AND MANAGEMENT

Unit 1 : Project Formulation

Unit 2 : Project Appraisal

Unit 3 : Project Management

BLOCK 2 : MONITORING AND EVALUATION

Unit 1 : Programme Planning

Unit 2 : Monitoring

Unit 3 : Evaluation

BLOCK 3 : MEASUREMENT AND SAMPLING

Unit 1 : Measurement

Unit 2 : Scales and Tests

Unit 3 : Reliability and Validity

Unit 4 : Sampling

BLOCK 4 : DATA COLLECTION AND ANALYSIS

Unit 1 : Quantitative Data Collection Methods and Devices

Unit 2 : Qualitative Data Collection Methods and Devices

Unit 3 : Statistical Tools

Unit 4 : Data Processing and Analysis

Unit 5 : Report Writing

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MEDS-044
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Data Collection and Analysis

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