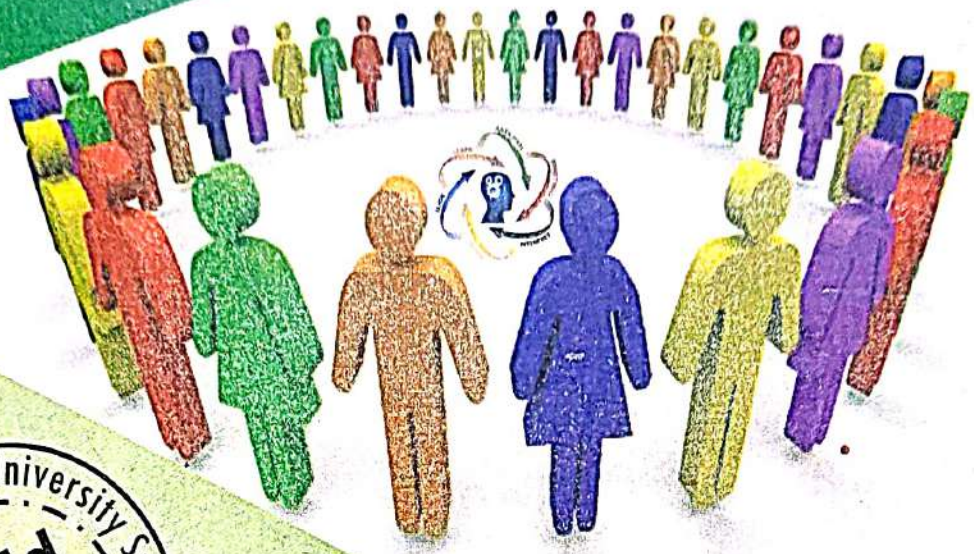
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As Per Chaudhary Ranbir Singh University Syllabus
B.Ed
2nd Year

Assessment for Learning

Dr. Gunjan Rana
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ASSESSMENT FOR LEARNING

B.Ed, Second Year

According to the new syllabus of
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COURSE-II: ASSESSMENT FOR LEARNING

Time: 3 Hours
Credits-4

Max. Marks: 100
(Theory: 80, Internal: 20)

UNIT 1

Assessment, Measurement, Evaluation and Revised taxonomy

- Concept of Assessment, Measurement, Evaluation and Examination.
- Importance and Principles of Assessment.
- Difference among Assessment, Measurement and Evaluation.
- Examination as a tool for Assessment.
- NCF's 2005 vision of Assessment for Learning
- Revised Bloom's Taxonomy(2000) for Instructional Objectives
- Teacher as a facilitator in Assessment for Learning.

UNIT- 2

Tools and Techniques

- Characteristics of a good Assessment tool.
- Assessment Approaches:
  - Formative (Assessment for Learning) and Summative (Assessment of Learning)
  - Quantitative and Qualitative
- Tools of Evaluation: Observation, Interview, Questionnaire, Rating scale, Checklist and Cumulative Record
- Self-assessment and Feedback
- Planning and Preparation of an Achievement test (Including blue print)
  - Objective Type Test
  - Subjective Type Test

UNIT-3

New Trends and Issues in Assessment:

- Semester System, Grading System, Credit system
- Online Examination System, Question Bank, Open Book System
- Flexibility in Examination, Exam on Demand
- Diagnostic and Remedial Teaching for Qualitative Assessment.
- Using ICT for Innovation in Examination: Administration and Execution.
- Issues in Assessment:
- Assessment at Different Stages
- Design and Conduct of Assessment
- Curricular Areas that can't be Tested for Marks

UNIT-4

Statistical Methods and Interpretation of Scores

- Meaning, Need and Importance of Statistics in Educational Assessment.
- Organization and Graphical Presentation of Data
- Scales of Measurement.
- Measures of Central Tendency: Mean Median and Mode.
- Measures of Variability: Range, Quartile Deviation and Standard Deviation.
- Normal Probability Curve: Concept and Characteristics.
- Co-efficient of Correlation: Spearman's Rank Difference Method.
- Percentile and Percentile Rank.

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UNIT 1

Assessment, Measurement, Evaluation and Revised Taxonomy

1.1. ASSESSMENT

1.1.1. Concept of Assessment

Today's students need to know is not only the basic reading and arithmetic skills, but also skills that will allow them to face a world that is continually changing. They must be able to think critically, to analyse, and to make inferences. Changes in the skills base and knowledge our students need require new learning goals; these new learning goals change the relationship between assessment and instruction. Teachers need to take an active role in making decisions about the purpose of assessment and the content that is being assessed.

Assessment is an integral part of instruction, as it determines whether or not the goals of education are being met. Assessment affects decisions about grades, placement, advancement, instructional needs, curriculum, and, in some cases, funding.

The term 'assessment', comes from Latin ***'ad sedere'***, which means to sit down beside. Assessment 'is primarily concerned with providing guidance and feedback to the learner'. We take a position that this is indeed the main function of assessment. But the original use of this word was quite different. **According to The New Shorter Oxford English Dictionary and Chambers Dictionary** the sense of 'sit down beside' derives from the word's use by the legal profession, meaning to sit down beside judges in a court. Some five or six hundred years ago, an assessor was a person who advised a judge or magistrate on technical points (compare the word 'assize') and these technical points seem largely to have related fines or taxes. Indeed, the word is till used in relation to income tax (a tax assessment) and various kinds of insurance (assessment of loss).

Teachers are trainers are inevitably involved in assessing learners. It is an important, if not the most important factor in formal education at all levels. Assessment, the way it is designed and implemented especially at higher education indicates how various, and many times conflicting in the Indian scenario, requirements of the main stakeholders in the educational process – the students, teachers, parents, managements, employers and society more generally.

1.1.2. Meaning and Definition of Assessment

The most general term is assessment. Assessment is a very general term that describes the many techniques that we use to measure and judge student behaviour and performance. Although in some professional circles the term

assessment sometimes means something more specific, in relation to the classroom, it is typically a very general, very generic term. When in doubt about how to label a technique, the safest label to use would be assessment.

Assessment is the gathering of information about students, the curriculum, and the school environment. This information can be gathered through information observations and verbal exchanges or through formal assignments, portfolios, or tests. The purpose of assessment, either through observable performance, product development, or traditional paper-and-pencil tests, is to provide data to measure the degree to which a desired outcome has been mastered. That is, assessment provides the information for evaluation. Students can show their learning by writing an essay, painting a picture, constructing a table, baking a pie, or taking a test. However, most assessments in schools are teacher-made tests, standardised tests, or quizzes. Assessment can be designed by classroom teachers or by local, state, or national agencies. Information about instruction and the classroom environment can also be an important part of the assessment process. In the evaluation process, the teacher compares the assessment information to some criteria and then makes judgements.

According to Erwin (1991), "Assessment is the systematic basis for making inferences about the learning and development of students. It is the process of defining, selecting, designing, collecting, analysing, interpreting and using information to increase students learning and development."

According to Huba and Freed, "Assessment is the process of gathering and discussing information from multiple and diverse sources in order to develop a deep understanding of what students know, understand can do with their knowledge as a result of their educational experiences – the process culminates when assessment result are used to improve subsequent learning."

Assessment focuses on learning, teaching and outcomes. It provides information for improving learning and teaching. Assessment is an interactive process between students and faculty that informs faculty how well their students are learning what they are teaching.

The information is used by faculty to make changes in the learning environment, and is shared with students to assist them in improving their learning and study habits. This information is learner centred, course based, frequently anonymous, and not graded.

1.1.3 Purpose of Assessment

There are following purposes of assessment as given below:

1) **Assessment Drives Instruction:** A pre-test or needs assessment informs instructors what students know and do not know at the outset, setting the direction of a course. If done well, the information garnered will highlight the gap between existing knowledge and a desired outcome.

2) **Assessment Drives Learning:** What and how students learn depends to a major extent on how they think they will be assessed. Assessment practices must send the right signals to students about what to study, how to study, and the relative time to spend on concepts and skills in a course.

3) **Assessment Informs Students of their Progress:** Effective assessment provides students with a sense of what they know and do not know about a subject. If done well, the feedback provided to students will indicate to them how to improve their performance. Assessments must clearly match the content, the nature of thinking, and the skills taught in a class.

4) **Assessment Informs Teaching Practice:** Reflection on student accomplishments offers instructors insights on the effectiveness of their teaching strategies. By systematically gathering, analysing, and interpreting evidence teacher can determine how well student learning matches teacher's outcomes/expectations for a lesson, unit or course.

5) **Assessment Makes System Improvement:** Assessment can do more than simply diagnose and identify students' learning needs; it can be used to assist improvements across the education system in a cycle of continuous improvement as students and teachers can use the information gained from assessment to determine their next teaching and learning steps.

1.1.4. Types of Assessment

There are different types of assessment. These are as follows:

1) **Formative Assessment:** Formative assessment is an integral part of teaching and learning. It does not contribute to the final mark given for the module; instead it contributes to learning through providing feedback. It should indicate what is good about a piece of work and why this is good; it should also indicate what is not so good and how the work could be improved. Effective formative feedback will affect what the student and the teacher does next.

2) **Summative Assessment:** Summative assessment demonstrates the extent of a learner's success in meeting the assessment criteria used to gauge the intended learning outcomes of a module or programme, and which contributes to the final mark given for the module. It is normally, though not always used at the end of a unit of teaching. Summative assessment is used to quantify achievement, to reward achievement, to provide data for selection (to the next stage in education or to employment). For all these reasons the validity and reliability of summative assessment are of the greatest importance. Summative assessment can provide information that has formative/diagnostic value.

3) **'Authentic' or 'Work-Integrated' Assessment:** 'Authentic' or 'work-integrated' assessment is an assessment where the tasks and conditions are more closely aligned to what you would experience within employment. This form of assessment is designed to develop students' skills and competencies alongside academic development. The Collaborate project at Exeter developed a set of tools to support academic staff in the design of authentic assessments, including a dimensions model, iTest and associated Tech Trumps. There is also an online Assessment Designer available which will allow you to design an assessment using a PC or tablet device.

4) **Diagnostic Assessment:** Like formative assessment, diagnostic assessment is intended to improve the learner's experience and their level of achievement.

However, diagnostic assessment looks backward rather than forward. It assesses what the learner already knows and/or the nature of difficulties that the learner might have, which, if undiagnosed, might limit their engagement in new learning. It is often used before teaching or when a problem arises.

5) **Dynamic Assessment:** Dynamic assessment measures what the student achieves when given some teaching in an unfamiliar topic or field. An example might be assessment of how much English is learnt in a short block of teaching to students who have no prior knowledge of the language. It can be useful to assess potential for specific learning in the absence of relevant prior attainment, or to assess general learning potential for students who have a particularly disadvantaged background. It is often used in advance of the main body of teaching.

6) **Synoptic Assessment:** Synoptic assessment encourages students to combine elements of their learning from different parts of a programme and to show their accumulated knowledge and understanding of a topic or subject area. A synoptic assessment normally enables students to show their ability to integrate and apply their skills, knowledge and understanding with breadth and depth in the subject. It can help to test a student's capability of applying the knowledge and understanding gained in one part of a programme to increase their understanding in other parts of the programme, or across the programme as a whole. Synoptic assessment can be part of other forms of assessment.

7) **Criterion Referenced Assessment:** Each student's achievement is judged against specific criteria. In principle no account is taken of how other students have performed. In practice, normative thinking can affect judgements of whether or not a specific criterion has been met. Reliability and validity should be assured through processes such as moderation, trial marking, and the collation of exemplars.

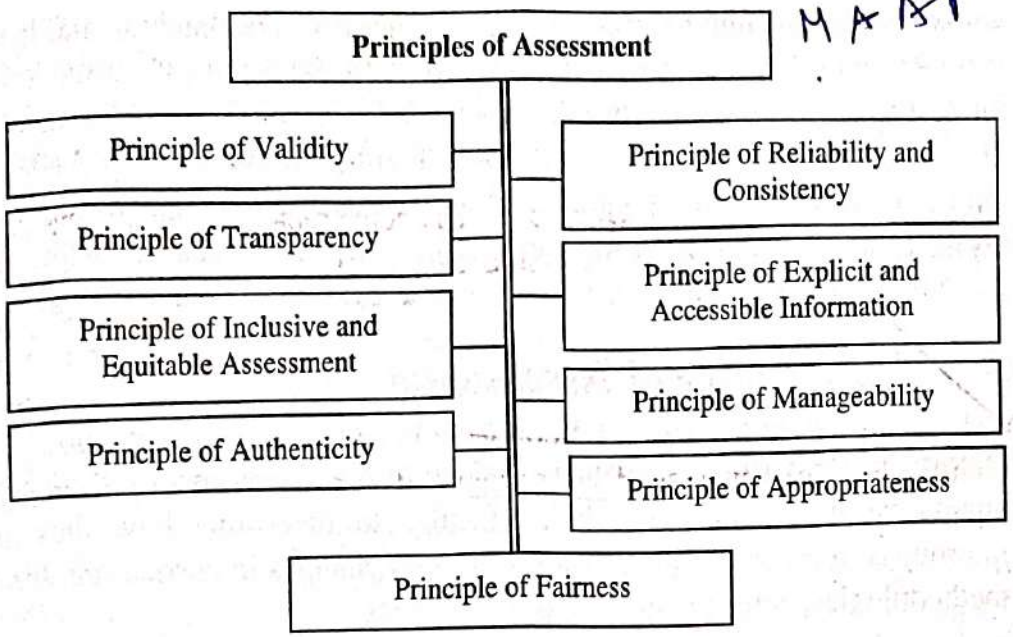
8) **Ipsative Assessment:** This is assessment against the student's own previous standards. It can measure how well a particular task has been undertaken against the student's average attainment, against their best work, or against their most recent piece of work. Ipsative assessment tends to correlate with effort, to promote effort-based attributions of success, and to enhance motivation to learn.

1.1.5. Principles of Assessment

Following are the some main principles of assessment:

1) **Principle of Validity:** Validity ensures that assessment tasks and associated criteria effectively measure student attainment of the intended learning outcomes at the appropriate level.

2) **Principle of Reliability and Consistency:** A reliable assessment consistently gives the same results under identical circumstances. There is a need for assessment to be reliable and this requires clear and consistent processes for the setting, marking, grading and moderation of assignments.



3) **Principle of Transparency:** Transparency refers to the how clear the assessment expectations are for students. Transparent assessment clearly sets out expectations for students with clear task descriptions, criteria and standards and the use of model exemplars.

4) **Principle of Explicit and Accessible Information:** Clear, accurate, consistent and timely information on assessment tasks and procedures should be made available to students, staff and other external assessors or examiners.

5) **Principle of Inclusive and Equitable Assessment:** As far as is possible without compromising academic standards, inclusive and equitable assessment should ensure that tasks and procedures do not disadvantage any group or individual.

6) **Principle of Manageability:** The scheduling of assignments and the amount of assessed work required should provide a reliable and valid profile of achievement without overloading staff or students.

7) **Principle of Authenticity:** Authentic assessment tasks are those that are relevant and reflect what occurs in the workplace beyond the school environment. Authentic assessments are relevant and reflect what the student will do in the real world.

8) **Principle of Appropriateness:** The type of assessment used must be suitable for 'what' it is that is being assessed, i.e., fit for purpose. It would not be appropriate, e.g., to assess a dental student's ability to fill a tooth cavity, via a multiple choice or written examination. Such traditional written examinations and assessments may effectively measure a student's knowledge about a skill, and even their knowledge and understanding of how that skill can be applied. Thus, the assessment method chosen must be appropriate for the desired learning outcomes being assessed. Appropriate assessment is suitable for the type (fit-for-purpose) and the level of learning being assessed.

9) **Principle of Fairness:** A fair and just assessment tasks provide all students with an equal opportunity to demonstrate the extent of their learning. Achieving fairness throughout assessment of students involves considerations

about workload; timing and complexity of the task. The teaching and learning activities must provide students with sufficient exposure and practice in the work before the assessment. An assessment of laboratory skills, without providing the appropriate teaching and learning activities to practice these skills, even if a written guide had been made available, would not be considered a very fair assessment task. Fair assessment provides equal opportunity for all students to demonstrate the extent of their learning.

1.1.6. Importance of Assessment

There are following importance of assessment in education as given below:

1) **Helpful in Providing Qualitative Information:** Assessment results provide qualitative information that helps faculty to determine how they might improve courses and/or programmes through changes in curriculum, teaching methodologies, course materials, or other areas.

2) **Helpful in Providing Comparative Data:** Assessment may provide comparative data that can give teachers an valuable information on how well their students are meeting the learning outcomes for their course or programme, or may show how students perform compared to those at similar institutions.

3) **Helpful in Future Instructional Development:** Because assessment can offer a larger view of student needs and accomplishments. So faculty can identify directions for future instructional development.

4) **Helpful in Providing Greater Satisfaction to the Teacher:** As assessment can provide evidence, that faculty can make a difference in student learning. Therefore, faculty can enjoy greater satisfaction in their work as educators.

5) **Helpful in Understanding the Casual Relationships:** Assessment helps teachers to understand the causal relationships between their actions (teaching) and outcomes (learning) and it explicitly establishes what is of importance (i.e., programme goals and objectives).

6) **Helpful in Meeting Responsibilities:** Through assessment, educators meet responsibilities to students and to the public.

1.2. MEASUREMENT

1.2.1. Concept of Measurement

There are many terms that describe the processes which teachers use to judge student's performance. The three terms most commonly used are measurement, assessment and evaluation.

Measurement, assessment and evaluation are not equivalent. These are three different concepts. **Measurement** refers to the process by which the attributes or dimensions of some physical object are determined. Measuring such things as attitudes or preferences also applies. However, when people measure, they generally use some standard instrument to determine how big, tall, heavy, voluminous, hot, cold, fast, or straight something actually is.

The process of measurement is (as it involves) carrying out actual measurement in order to assign a quantitative meaning to a quality, i.e., the length of the chalkboard. Determining this must be physically done. **Measurement is therefore a process of assigning numerals to objects, quantities or events in order to give quantitative meaning to such qualities.** In the classroom, to determine a child's performance, a teacher needs to obtain quantitative measures on the individual scores of students. If student scores 80 in Mathematics, there is no other interpretation teacher should give it. Student cannot say that he/she has passed or failed. Measurement stops at ascribing the quantity but not making value judgements on the students' performance.

1.2.2. Meaning and Definition of Measurement

Measurement is defined as the process of assigning a score that represents the degree to which some trait, characteristics, or behaviour is associated with a person. It encompasses variety of techniques, tests, ratings and observations that are designed to assign a score, which represents the degree of a predefined trait a student possesses. Thus, measurements provide the information that guide decision-making. While valid measurements contribute to valid decisions, erroneous measures can lead to inappropriate decisions. Therefore, it is crucial for teachers to ensure that their measurement instruments are sound.

According to M.S. Stevens, "Measurement is the process of assigning numbers to objects according to certain agreed rules."

According to Tyler (1963), "Measurement is the assignment of numerals according to rules."

According to Campbell, "Measurement is the assigning of numerals to objects or events according to rules."

According to G.C. Helmstadter, "Measurement has been defined as the process of obtaining a numerical description of the extent to which a person or things possesses some characteristic."

According to J.C. Nunnaly (1975), "Measurement consists of rules for assigning numbers to object to represent quantities of attributes."

Objectivity is an essential element of a trustworthy measurement. If a measurement instrument is not objective, the measurement's result depends more on the subjective opinion of the person who is conducting the measurement, rather than on the ability of the person who is being measured. A measurement instrument is objective only if it is confined to assigning a number or a rating to a student characteristic based on predefined objective evidence of the characteristic.

1.2.3. Characteristics of Measurement

There are following characteristics of educational measurement as given below:

1) **No Absolute Zero Point:** In educational measurement there is the concept of no absolute zero point. It is relative to some arbitrary standard. **For example,** a student has secured 'zero' in a test of mathematics. It does not mean that he

has 'zero' knowledge in mathematics. Because he may secured 30 in another test, which is easier than the first one. As the zero point is not fixed so teacher cannot say that a student with a score of '60' has doubled the knowledge of a student with a score of '30'.

2) **No Definite Units:** In educational measurement, the units are not definite, so, it is difficult to obtain the same value for every person. Since, the tests vary in their content and difficulty level, therefore, one student may perform differently on different tests and different students may perform differently on one test.

3) **Sense of Infinity:** It means teacher cannot measure the whole of an attribute of a student. Generally, the scores obtained from a measurement are observed scores which contain measurement errors, since the true score is infinite and unknown.

4) **Process of Assigning Symbols:** Measurement is a process of assigning symbols to observations in some meaningful and consistent manner. In measurement, generally one compares the data (value) with certain standard unit or criteria which have a universal acceptability.

5) **No Direct Measurement:** In case of educational measurement a teacher cannot measure attributes directly. It is observed through behaviour, e.g., a student's reading ability can only be measured when he/she is asked to read a written material.

6) **Means to an End but not an End Itself:** The objective of educational measurement is not just to measure a particular attribute. Rather it is done to evaluate to what extent different objectives have been achieved.

7) **Measurement is not Absolute:** Educational measurement is not absolute, it could change from time to time.

1.2.4. Need & Importance of Measurement in Teaching

Teaching and learning includes a lot of instructional decisions to enhance and increase student's learning, and quality of instruction is strongly connected to the structure of information on which these instructional decisions are made. Hence, the most important point is the determination of the way in which good, valid and reliable information about student's learning can be provided.

Measurement and evaluation in education sector is very important on wide spectrum across the board. Measurement is assessing a learners piece of work and testing its assessing tools. It is a process of assessing certain qualities or collecting data about something, e.g., scores in a test. In measurement we merely find out what is the situation without passing judgement and it involves quantitative and qualitative description of marks, e.g., 70%. Measurement allows a more precise description of pupils' performance. Unlike in evaluative terms of performance of different pupils may be stated as fairly good. Following points highlight the importance of measurement in teaching:

1) **For Admission:** Many institution give admission to student only after measuring their educational achievement.

2) **For Classification and Comparison:** Students are classified for different courses or programmes according to their achievement and ability. Educators classify them brilliant, average, or backward on the basis of educational measurement.

3) **For Prediction:** Teacher predicts the performance of students by measurement.

4) **For Diagnosis:** Teacher conducts tests to measure the weakness of students in specific areas. This helps the teacher to identify specific weakness in children and plan for remedial teaching.

5) **For Research:** No educational researches are possible without some sort of educational measurement.

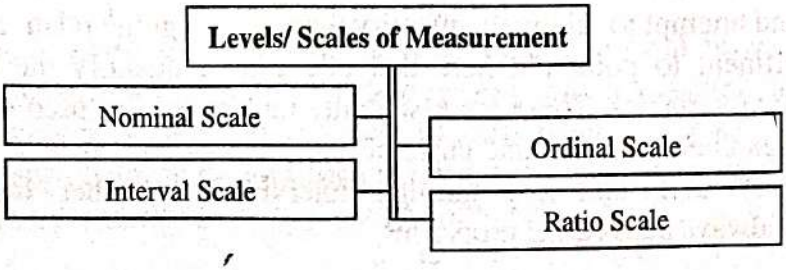
6) **For Guidance:** Measurement is helpful in giving guidance to students in any of the educational and business fields. By studying the traits, abilities, etc., of a student, it is helpful in deciding which subject student should take.

1.2.5. Levels/ Scales of Measurement

Level of measurement or scale of measure is a classification that describes the nature of information within the numbers assigned to variables. A famous psychologist, **Stanley Smith Stevens,** developed a very popular classification of these levels or scales of measurement, i.e., nominal, ordinal, interval, and ratio. Stevens proposed his theory in a science article titled "On the theory of scales of measurement" in 1946. In that article, Stevens claimed that all measurement in science was conducted using four different types of scales that he called nominal, ordinal, interval and ratio.

The level of measurement refers to the relationship among the values that are assigned to the attributes for a variable. Measurement is followed by scaling procedure in a research activity. Researchers always face the problem of how to measure or quantify abstract concepts and how to relate one student's response to that with another response. Hence, the problem is of two-fold. First is, how to quantify a response in absolute terms and the second is how to relate it with other responses. This problem is resolved by scaling process or assigning the numbers or values to responses and positioning them on a common scale.

Scaling can then be defined as, "creating a continuum with two extreme limits and few immediate values between them". Hence, scaling is the process or procedure of quantifying and measuring abstract concepts like attitudes, opinions, emotions, etc. Scaling also quantitatively determines the position of students in a range of values. In a scale, the values are progressively placed according to their value or magnitude in such a manner that moving forward in a scale will depict an item to be always higher than the immediate lower one. There are basically four types of measurement scales:



1.2.5.1. Nominal Scale

This is the most fundamental form of measurement scale. These scales are not used to measure the value of an object, but to categorise or classify the object. The values represented in these scales need not to be necessarily quantitative values. This makes it qualitative in nature. The nominal scales are used extensively by market researchers.

Nominal scales are essentially arbitrary because a researcher can assign any label to any category, without distorting the results. While the statistical measurements like mean and median cannot be calculated in the outcome of these scales, the findings of a nominal scale can be further subjected to statistical tools like mode, average, binomial and chi-square tests.

Examples of nominal scales can be:

1) What is your gender? (tick 'M'-Male and 'F'-Female)?
   i) M
   ii) F

2) What is your hair colour? (tick 'A'-Brown, 'B'-Black, 'C'-Blonde, 'D'-Gray, 'E'-Other)
   i) A
   ii) B
   iii) C
   iv) D
   v) E

Numbers can also be assigned to the categories, but those would be treated as merely 'labels' in order to categorise the items or people in a group. Typically, nominal scales are used to ascertain characteristics like gender, ethnicity, backgrounds, tastes, preferences, etc., and not their intensity.

1.2.5.2. Ordinal Scale

While nominal scale focuses on categorising or classifying students or their responses, the ordinal scale seeks to rank them on the basis of their characteristics. In other words, it deals with relative positioning of an item on the basis of the characteristics of other items on the scale.

The participants of the research rank the objects as per their preferences and tastes. Therefore, the respondents are required to rank the objects from highest to lowest preferential order.

Thus, in ordinal scale, the responses have nominal properties but these scales go a step further and attempt to relatively quantify them by assigning relative values. It would be pertinent to point out here that one cannot quantify the difference between the two variables. These are essentially ranking scales, used extensively by market researchers to determine customer preferences and choices. It may be noted that any data collected through interviews or other methods of interrogation, always has ordinal properties.

For example, consumers may be asked to rank five popular brands of ice cream on a scale of 1 to 5, with 1 representing the most preferred and 5 representing the least.

1) Amul ___
2) Kwality Walls ___
3) Mother Dairy ___
4) Cream Bell ___
5) Vadilal ___

1.2.5.3. Interval Scale

Interval scale is the improvement or refinement over ordinal scale. Here, absolute values are assigned to the variables. Therefore, the difference between two variables is also equal. The inputs collected from interval can be easily computed with the help of Mean, Standard Deviation, etc.

For example, the difference between 100 degrees and 110 degrees is the same as between 60 degrees and 70 degrees, i.e., 10 degrees.

Another example of interval scale can be:

What is your age? (tick the correct range)

1) Below 10 years ___
2) 10 to 20 years ___
3) 20 to 30 years ___
4) 30 to 40 years ___
5) 40 to 50 years ___
6) 50 to 60 years ___
7) Above 60 years ___

The difference between all the values is same in the above example.

1.2.5.4. Ratio Scale

Ratio scale is the most refined and sophisticated form of scales used primarily in physical sciences. In interval scales variables have a relative value, while in ratio scales the variables do not have a relative value but an absolute value. Hence, they incorporate the value for absence of any characteristics in an object. This absence can be denoted with the value 'zero'. It is the basic differentiator between an interval and a ratio scale.

The data obtained from a ratio scale makes the outcome a meaningful and scientific interpretation.

Ratio scales are endowed with the characteristics of interval scales and the ratios of the numbers or values on these scales provide better and important understanding regarding the analysis. In fact, when responses on descriptive variables are obtained through open-ended questions, they display ratio scale properties and features.

Consider the following few examples:

1) **Kelvin Scale:** 100K is twice as hot as 50K. The difference between values is meaningful and can be ordered.

2) **Weight:** 100kg is twice as heavy as 50kg. The values can be arranged in an order (ascending/descending).

1.2.6. Difference between Scales of Measurement

The difference between scales of measurement is given under following table:

Table 1.1: Difference between scales of Measurement

Basis of Differences	Nominal	Ordinal	Interval	Ratio
Meaning	Nominal is hardly measurement. It refers to quality more than quantity. A nominal level of measurement is simply a matter of distinguishing by name, e.g., 1 = male, 2 = female.	Ordinal refers to order in measurement. An ordinal scale indicates direction, in addition to providing nominal information. Low/ Medium/High; or Faster/Slower are examples of ordinal levels of measurement.	Interval scales provide information about order, and also possess equal intervals.	The ratio level variables have all of the characteristics of nominal, ordinal and interval variables, but also have an absolute zero point.
Type of Data	Data at the nominal level is qualitative.	Data at the ordinal level should not be used in calculations.	Data at the interval level can be used in calculations.	At the ratio level of measurement, not only can sums and differences can be calculated, but also ratios.
Properties	Nominal data have no order and thus only gives **names** or labels to various categories.	Ordinal data have **order**, but the interval between measurements is not meaningful.	Interval data have meaningful intervals between measurements, but there is no true starting point (zero).	Ratio data have the highest level of measurement. Ratios between measurements as well as intervals are meaningful because there is a starting point (zero).

Properties of Measurement	Labelling	Labelling and ranking	Labelling, ranking and equal intervals	Labelling, ranking, equal intervals and zero point
Nature of Measurement	Classifying	Ranking	Scoring	Scoring
Nature of Underlying Construct	Discrete	Discrete or continuous	Continuous	Continuous
Mathematical Functions	Mode, average, Binomial, and Chi-square tests.	Mode or median	Mean, standard deviation, etc.	Mode, Median, Mean, Standard Deviation, and Coefficient of Variation.
Statistical Tests	1) χ^2-test 2) Lambda test 3) Phi	1) U – test 2) Spearman's p 3) Gamma	1) Pearson's r 2) t - test	1) Pearson's r 2) t - test

1.2.7. Errors in Measurement

Measurement error in education generally refers to either the difference between what a test score indicates and a student's actual knowledge and abilities or errors that are introduced when collecting and calculating data based reports, figures, and statistics related to schools and students.

According to Gulikson, "It is the standard deviation of the distribution of differences between observed scores and true scores."

Measurement errors in testing may result from a wide variety of factors, such as a student's mental and emotional state during the test period or the conditions under which the test was administered. **For example,** students may have been unusually tired, hungry, or emotionally distressed, or distractions such as loud noises, disruptive peers, or technical problems could have adversely affected test performance.

Because some degree of measurement error is inevitable in testing and data reporting, education researchers, statisticians, data professionals, and test developers often publicly acknowledge that performance data, such as high school graduation rates or college enrolment rates, are not perfectly reliable (they may even report the "margin of error" for a given statistic or finding) or that test scores do not always accurately reflect what students know or can do, i.e., that there is no such thing as a perfectly reliable test of student knowledge and skill acquisition.

Types of Measurement Errors

Because measurement error can have predictable and not so predictable components, therefore, measurement error will be divided into following categories:

1) **Systematic Errors:** Systematic error (sometimes called bias) is a measurement error with an observed pattern. Of course observing a pattern in

the error requires some kind of knowledge about what the true value should be for comparison. A systematic error can be trickier to track down and is often unknown. In chemistry a teacher tells the student to read the volume of liquid in a graduated cylinder by looking at the meniscus. A student may make an error by reading the volume by looking at the liquid level near the edge of the glass. Thus this student will always be off by a certain amount for every reading he makes. This is a systematic error. Instruments often have both systematic and random errors.

2) **Random Errors:** Random errors are ones that are easier to deal with because they cause the measurements to fluctuate around the true value. Random error is essentially the part of the error that one cannot explain, which often means people must rely on statistical assumptions to interpret how this remaining component might affect the results. One might have noticed that the boundaries for these categories of error are largely dependent on what a student knows. With advancements in technology people are regularly decreasing measurement error and detecting patterns that help to minimise random error, even if people do not fully understand the processes behind the systematic error.

3) **Accidental Errors:** In experimental observations, an error which does not always recur when an observation is repeated under the same conditions. Accidental errors are unavoidable. They arise due to in consistent environmental conditions, limitations or deficiencies of instruments, assumptions and methods. Accidental error is usually not important as the error tends to be compensating. These errors occur in following form:
   i) Test centred error,
   ii) Student centred error, and
   iii) Scoring centred error.

4) **Statistical Errors:** A statistical error is the amount by which an observation differs from its expected value, the latter being based on the whole population from which the statistical unit was chosen randomly. **For example,** if the mean height in a population of 21-year-old men is 1.75 meters, and one randomly chosen man is 1.80 meters tall, then the 'error' is 0.05 meters; if the randomly chosen man is 1.70 meters tall, then the 'error' is –0.05 meters. The expected value, being the mean of the entire population, is typically unobservable, and hence the statistical error cannot be observed either. Statistical errors fall into two category:
   i) **Descriptive Statistical Errors**

   ii) **Inferential Statistical Errors:** It includes:
      a) **Type I Errors:** It occurs when we **reject** a null hypothesis that is actually **true**; the probability of this occurring is denoted by alpha (α).

      b) **Type II Errors:** These are when we **accept** a null hypothesis that is actually **false**; its probability is called beta (β).

In addition to the above stated classification, there is another classification for errors of measurement by **Mursell**. According to him, there are four kinds of errors of measurement in behavioural studies:

1) **Interpretative Errors:** Interpretative errors occur due to the wrong or erroneous interpretation of the (test/experiment) results or scores. Sometimes these errors occur because of a set of wrong assumptions on the part of the researcher, and sometimes these errors occur due to some inherent problems related to the numerical measurement of the psychological properties. There are two shortcomings in the measurement of behavioural quality:
   i) There is no absolute zero point, and
   ii) It is not certain that whether all the points on the scale are at equidistant.

   Because of these two reasons in measurement there is no value or meaning of data and results, until the results are interpreted by other persons.

2) **Variable Errors:** The second type of error in measurement is known as variable error. These errors are consequences of impurities arising due to different reasons and situational factors. **For example,** if the IQ of a person is measured during three different occasions by different persons, the results will vary. These errors are evident in psychological as well as physical measurements. Snapping of lead during administration or any kind of noise, pain experienced by the subject during administration, and even the incorrect instructions by the test conductor, can alter the results. All these are situational errors and these are called variable errors because the degree of error varies from person to person and if one person is tested twice on different occasions, the degree of error of measurement would be less. Such type of errors in test can be estimated through the amount of confidence one can lay on a test (the test reliability).

3) **Personal Errors:** These errors are due to subjective element of a person. **For example,** if four persons sitting in a car are asked to read the speedometer, the difference in readings will be quite evident. Similarly, two persons evaluating and interpreting the same response do so quite differently because each has a unique perspective. In the same way, two testers evaluating one subject express their results differently and if the same subject takes the same test twice on different occasions, it gives different results. Such errors are personal errors. Thus, personal errors should be checked out (kept in mind) during the measurement of behavioural qualities. Efforts are made to reduced personal errors during testing and measurement through objectivity.

4) **Constant Errors:** These are based on the fact that most of the behavioural qualities are measured indirectly. It is not possible in psychological measurement, like in mental ability to dissect the person's brain and tell that this much is his mental ability or intelligence. Instead, here, the measurement is related to internal abilities and qualities. It is evident that the score of any student on a mental ability test depends on his/her ability to read as well. The difference in these two qualities gives rise to constant error. Such errors are called constant errors because the amount of such errors remain constant irrespective of the tester. Such errors are related to the test validity.

1.2.8. Ways to Remove Measurement Errors

The primary goal when measuring exposures in an epidemiological study should be minimising measurement error. Several approaches to the reduction of measurement error and its effects are as follows:

1) **Use Pilot Test:** If someone doing measurement and evaluation then he/she should be used pilot test instruments for getting feedback from respondents regarding how easy or hard the measure was and information about how the testing environment affected their performance.

2) **Proper Training:** If you are gathering measures using people to collect the data (as interviewers or observers) you should make sure that you should train them thoroughly so that they are not inadvertently introducing error.

3) **Re-Checking Data Thoroughly:** When you collect the data for your study you should double-check the data thoroughly. All data entry for computer analysis should be "double-punched" and verified. This means that you enter the data twice, the second time having your data entry machine check that you are typing the exact same data you did the first time.

4) **Use Statistical Procedures:** You can use statistical procedures to adjust for measurement error. These range from rather simple formulas you can apply directly to your data to very complex modelling procedures for modelling the error and its effects.
   The following procedures are:
   i) First, **adjustment procedures**, these are methods of 'correcting' study results for the effect of measurement error by using information from a validity or reliability study.
   ii) Next is the use of multiple measures of exposure in an epidemiologic study to create an average score or index for each subject.
   iii) Finally, minimisation of error by way of quality control procedures.

   These procedures include careful design of the data collection forms, complete documentation of study procedures, pre-testing of the data collection instrument(s), appropriate training and supervision of data collectors, and documentation of raw, corrected and computed data variables via codebooks.

5) **Standardisation and Generalisation:** One way to remove measurement errors is through standardisation and limiting our generalisation. Hence, behavioural data obtained under controlled conditions such as observations in clinical settings or measurement of bio-indicators of behaviours can be expected to contain less measurement errors.

6) **Use Multiple Measures:** Finally, one of the best things you can do to deal with measurement errors especially systematic errors is to use multiple measures of the same construct. Especially if the different measures don't share the same systematic errors, you will be able to **triangulate** across the multiple measures and get a more accurate sense of what's going on.

1.2.9. Statistical Procedures to Assess Measurement Error

The following methods assess "absolute reliability":

1) **Standard Error of Measurement (SEM):** This estimates how repeated measurements taken on the same instrument are estimated around the true score.
2) **Coefficient Of Variation (CV):** A measure of the variability of a distribution of repeated scores or measurements. Smaller values indicate a smaller variation and therefore values closer to the true score.
3) **Limits of Agreement (LOA):** Gives an estimate of the interval where a proportion of the differences lie between measurements.

1.3. EVALUATION

1.3.1. Concept of Evaluation

Evaluation is a concept that has emerged as a prominent process of assessing, testing and measuring. Its main objective is qualitative improvement. Evaluation has a wider meaning as it goes beyond measurement. When we make a judgement from useful information, including measurement, then it is called evaluation.

Evaluation in its broader concept includes examination of academic and examination of non-academic aspects of education. **According to Wrightstone,** "Evaluation is a relatively new technical term, introduced to design a more comprehensive concept of measurement than is implied in conventional tests and examinations evaluation involves the identification and formulation of a comprehensive range of the major objectives of a curriculum; this definition is in terms of pupil behaviour, and the selection or construction of valid, reliable and practical instruments for appraising the specified phases of pupil behaviour." In examination and measurement the emphasis is upon the academic subjects only whereas evaluation includes all the changes that takes place in the development of a balanced personality and measures the qualities of head, hand, health and heart of an individual.

1.3.2. Meaning and Definition of Evaluation

Evaluation focuses on grades and may reflect classroom components other than course content and mastery level. These could include discussion, cooperation, attendance, and verbal ability. Evaluation is a science of providing information for decision-making. Evaluation includes measurement, assessment and testing. It is a process that involves information gathering, information processing, judgement forming and decision-making.

In other words, evaluation implies a critical assessment of educative process and its outcome in the light of the objectives. Evaluation is a process that tells the strengths and weaknesses of the programme, so that efforts are made to bring improvement in the system. Evaluation has a different role in education. Student evaluation gauges students' growth, development and progress in the educational course or programme against stated learning objectives.

According to NCERT, evaluation is a process of determining:

1) The extent to which educational objectives are being attained,
2) Effectiveness of teaching learning experiences provided in the classroom, and
3) How well the goal of education has been accomplished.

According to Bradfield and Moredock, "Evaluation is an assignment of symbols to a phenomenon in order to characterise the worth or value of a phenomenon usually with reference to the some social, cultural or scientific standard."

According to Kothari Commission, "Evaluation is a continuous process. It forms an integral part of the total educational system and thus, is intimately related to education objectives."

According to Hanna, "Evaluation is the process of gathering and interpreting evidence of change in the behaviour of all students as they progress through school."

According to J.W. Wrightstone, "Evaluation is a new technical term introduced to design a more comprehensive concept of measurement."

1.3.3. Characteristics of Evaluation

Following are the characteristics of evaluation:

1) **Teaching-Learning Outcomes:** It involves assessment of all the teaching-learning outcomes in terms of overall behavioural changes. It goes beyond the knowledge objectives to cover skill, application, interest, attitude and appreciation objectives. Therefore, the area of testing the stipulated objectives has been greatly increased by adopting this new term.

2) **Judgement and Decisions:** It involves forming judgements and taking decisions about the child's progress, difficulties encountered by him and taking corrective measures to improve his learning.

3) **Evaluation is Continuous:** It is not confined to one particular class or stage of education. It is to be conducted continuously as the student passes from one stage to another, from one class to another, and from one school to the other. It started at the time the child seeks admission in a particular grade in the form of placement evaluation. It continues as the child proceeds, from one unit to another unit of instruction in the form of formative and diagnostic evaluations and ends in summative evaluation at the end of instruction in a particular grade.

4) **Evaluation is Comprehensive:** It is not simply concerned with the academic status of the student but with all aspects of his growth, i.e., which includes both cognitive and non-cognitive aspects.

5) **Means of Collecting Information:** Evaluation includes all the means of collecting information about the student's learning. The evaluator should make use of tests, observation, interview, rating scale, checklist and value judgement to gather complete and reliable information about the students.

6) **Assesses Performance:** It assesses the performance of the students in scholastic and non-scholastic areas. It enlists various tools to assess the students' behavioural changes.

7) **Qualitative and Quantitative:** It is both qualitative and quantitative in nature. It gives value judgement. It helps curriculum planners to improve the curriculum pattern. It identifies learners' strength and weaknesses, problems, needs and demands.

1.3.4. Need and Importance of Evaluation

In the modern school, increasing emphasis on the personal and social development of the child, as well as his academic achievement, has called for the corresponding development of a variety of techniques for appraising all phases of child growth and development, of pupil achievement, of behaviour and of the teaching-learning processes. Due to the large number of factors that enter into teaching and learning including such instructional variables as objectives, methods and techniques, and subject-matter on the one hand; and such human variables as pupils, teachers, and supervisors on the other, it has been difficult to appraise the validity of the pupil's achievement.

There is, therefore, a comparatively large subjective factor in the evaluation of teaching and learning that needs to be taken into account together with its objective features. It cannot be denied that the evaluation of teaching and learning is an exceedingly complex activity. However, the efficiency of the teacher and the growth and achievement of the pupil can be evaluated through the use of such devices as check lists, rating scales, and tests of different aspects of teaching ability, interview, and questionnaires. Through the use of such devices much valuable data may be gathered relative to many of the important aspects of teaching and learning.

The importance of evaluation in teaching can be as given below:

1) **Evaluation is Important to the Classroom Teachers, Supervisors, and Administrators in Directing as well as Guiding, Teaching and Learning:** Evaluation, to be of importance to teachers and supervisors, should be diagnostic, i.e., it should reveal the specific points of strength and weakness in teaching and learning.

2) **Evaluation Aids in Devising more Effective Instructional Materials and Procedures of Instruction:** Current educational literature is filled with enthusiastic advocacy of various cooperative researches, and if one worked along this line, will determine the degree of success and effectiveness of evaluation.

3) **Evaluation Helps Teachers to Discover the Needs of the Pupils:** The purpose of any programme of evaluation is to discover the needs of the pupils being evaluated and then to design learning experiences that will satisfy these needs. Traditionally, the results of evaluation have been used to compare one individual with another. It is an accepted fact that growth is a continuous process and that each individual grows at a rate that is unique for him.

4) **Evaluation Stimulates Students to Study:** A questioning teacher offers incentives for students to learn more. He sets effective and definite goals for learning, giving oral or written examination is a good incentive for the students to study harder or to do better work. It makes the learner familiar with his/her own results. Likewise, one needs to understand his/her own high and low potential for learning, but even more, one needs help in understanding the personal problems of human relations.

5) **Evaluation Helps Parents to Understand Pupil-Growth, Interests, and Potentialities:** The major responsibility of the school and teacher is to help the parents understand their children. Understanding a youth means understanding the progress in the various areas of the curriculum, youth's desires and motives and behaviour they lead to, youth's potentialities for learning, as well as their achievement.

6) **Evaluation can be used to Enforce External Standards upon the Individual Class or School:** This method should be such as to encourage a flexible curriculum which is ever responsive to the changing needs of modern life and to the variations in local conditions. Local schools should be free to select and develop instruments for evaluation which are appropriate for their curriculum.

7) **Evaluation, Likewise, Helps to Provide Objective Evidences for Effective Cooperation between Parents and Teachers:** The increasing complexity of the present society has emphasised the importance of the cooperation of the school, the home, and the community in making significant educational progress.

8) **Evaluation is Helpful to the Teacher:** It enables teacher to see how he/she can make his/her contribution to the accomplishment of the total goals or aims of the school system. It helps the teacher to coordinate his/her efforts with the efforts of others who contribute to the general educational goals.

1.3.5. Purpose of Evaluation

The purpose of educational evaluation is to make a judgment about the quality or worth of something as an educational programme, or proficiency or students attainments. The important purposes of educational evaluations are as follows:

1) **To Make a Periodic Check on the Effectiveness of the Educational Institution:** The important purpose of evaluation is to make a periodic check on the effectiveness of the educational institution, and thus to indicate the points at which improvements in the programme are necessary. A periodic evaluation of the school or college, if comprehensively undertaken, should reveal points of strength which ought to be continued and points where practices need modification. This is helpful to all schools, not just to schools which are experimenting.

2) **To Validate the Hypotheses of Educational Institution:** The other important purpose of evaluation which is frequently not recognised is to validate the hypotheses upon which the educational institution operates. A school, whether called "traditional" or "progressive", organises its curriculum

on the basis of a plan which seems to the staff to be satisfactory, but in reality not enough is yet known about curriculum construction to be sure that a given plan will work satisfactorily in a particular community. **For example,** many high schools and colleges have constructed the curriculum on the hypothesis that students would develop writing habits and skills appropriate to all their needs if this responsibility were left entirely to the English classes. Careful appraisal has shown that this hypothesis is rarely, if ever, valid.

3) **To Provide Information:** Third important purpose of evaluation is to provide information basic to effective guidance of individual students. Only as we appraise the student's achievement and as we get a comprehensive description of his growth and development are we in a position to give him sound guidance. This implies evaluation sufficiently comprehensive to appraise all significant aspects of the student's accomplishments.

4) **To Provide a Certain Psychological Security:** Fourth purpose of evaluation is to provide a certain psychological security to the school staff, to the students, and to the parents. The responsibilities of an educational institution are broad and involve aspects which seem quite intangible to the casual observer. Frequently the staff becomes a bit worried and is in doubt as to whether it is really accomplishing its major objectives. This uncertainty may be a good thing if it leads to a careful appraisal and constructive measures for improvement of the program; but without systematic evaluation the tendency is for the staff to become less secure and sometimes to retreat the activities which give tangible results although they may be less important.

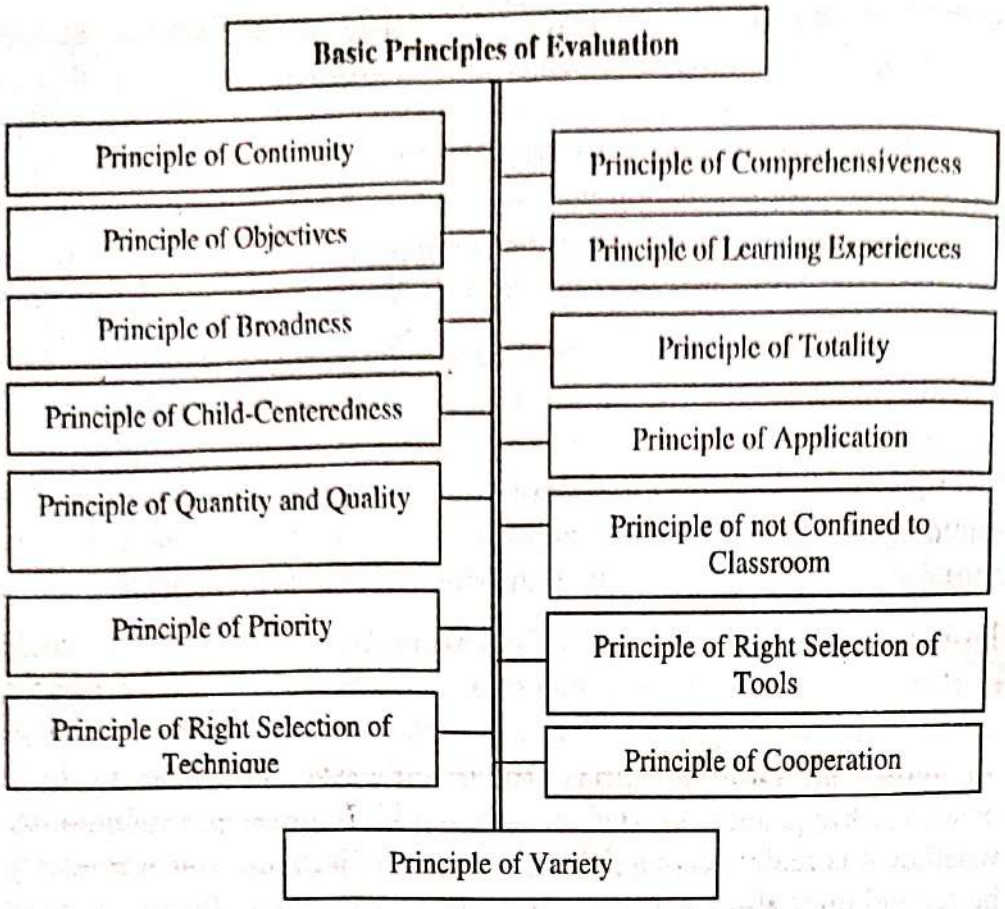
5) **To Provide a Sound Basis for Public Relations:** The last and fifth purpose of evaluation which should be emphasised is to provide a sound basis for public relations. No factor is as important in establishing constructive and cooperative relations with the community as an understanding on the part of the community of the effectiveness of its educational institutions. A careful and comprehensive evaluation should provide evidence that can be widely publicised and used to inform the community about the value of the school or college programme.

1.3.6. Basic Principles of Evaluation

Evaluation is based on the following principles:

1) **Principle of Continuity:** Evaluation is a process which runs constantly in a flow, till student education is not completed. Evaluation makes student consistent, punctual and work systematically. The evaluation process runs in parallel with teaching and learning. Basically a continuous process is necessary to learn a language and learned matter must be evaluated on a daily basis. This will help in having good command on English.

2) **Principle of Comprehensiveness:** Comprehensive evaluation is a process where assessment of the student's personality is done in a complete way. All traits of a student's personality are taken care of. The students are prepared to face all challenges and to achieve goals in the future. Comprehensive evaluation not only focuses on student's academics, but also on personality and teaching-learning of student that helps to maintain good command over English.



3) **Principle of Objectives:** Educational objectives are connected with evaluation. It helps in knowing about the growth of the different traits of personality being achieved. Evaluation helps in framing and redesigning of objectives. Every chapter of English must be taught by keeping an objective in a mind. If teaching-learning programmes are clearly pinpointed, then success is ensured.

4) **Principle of Learning Experiences:** Evaluation is directly connected with the learning principle of student. Here full importance is given to child's learning experience. This basically creates an extra favourable academic climate and maintains the curriculum of the school. Real learning practices must be given to students. To make teaching more effective and more learnable the teaching material must be correlated with the student's life and its atmosphere.

5) **Principle of Broadness:** Evaluation is very wide in nature; it is not a narrow process. Good learning includes the principle of broadness. The learning of language has been just like learning other different skills like reading, writing, listening, and speaking. A learner will be a master of these skills only when he/she learns them in different situations.

6) **Principle of Totality:** Evaluation is based on the entire process of teaching. Basically, it involves all levels of learning and all other types of learning exercises. Evaluation contains all important and unimportant things which are related to the education. A teacher must be concerned about the different aspects of student's behaviour such as social, moral, cultural, intellectual, emotional, physical, etc. Assume a child is doing sums of Mathematics or learning English or Civics, he is, at the same time learning attitudes,

developing interests and making emotional and social adjustments. So here the totality means that how much a student learns at the same time. In general, language learning includes all four aspects not only two or three.

7) **Principle of Child-Centeredness:** The process of evaluation goes around a child who is the main focus. In the case of examination, subject-matter formed by a student helps him to earn good credit as it focusses only on subject-matter, but in the case of evaluation, the behaviour and performance of the child is "the central point of assessment". Thus, child-centred approach is followed in the teaching and learning of language and learner will easily understand the language if the matter is child centred.

8) **Principle of Application:** Learning of a child will be given no weightage by evaluation till he is unable to apply those learning creatively in any situation of life. To get success in a life, evaluation concludes that a student must apply his knowledge at its best and create a better understanding in different situation. If a person is able to apply the learning in different situations, it means person learnt the language carefully.

9) **Principle of Quantity and Quality:** Quality and quantity both play important roles in teaching-learning process so a person must consider them carefully. The principle of quantity consists of examination as it is conducted in mass and judges only the educational side of the person. Alternatively, evaluation evaluates some unique characteristics of student by considering both quality and quantity perspective. Due to some economic reason, one cannot ignore quantity at the expense of quality of evaluation, and it must be done simultaneously.

10) **Principle of not Confined to Classroom:** Evaluation should not be confined to the classrooms; it should be given importance on the various activities more related to an individual outside of the classrooms. An individual's behaviour, cooperation and dedication to the society must be evaluated to judge his personality.

11) **Principle of Priority:** The process of evaluation is very extensive and time consuming, so it must be undertaken according to the priority level. A teacher must make a proper plan to evaluate those aspects first which include more weightage and then evaluate the other aspects accordingly. This will surely give more accurate results.

12) **Principle of Right Selection of Tools:** Having right selection of tools is very important in the whole process of evaluation. Moreover, the proper selection of tools is based on the evaluation objectives.

13) **Principle of Right Selection of Technique:** As like the importance of right selection of tools, proper selection of technique is also more important in the evaluation process. It should be done properly by focussing on the evaluation objectives.

14) **Principle of Cooperation:** Since evaluation is related to the teacher, parents, learners, etc. Cooperation is important in the evaluation process from both the

individuals, i.e., one who does evaluation and one who is being evaluated by others. As it is very likely that without cooperation, person will not obtain good results.

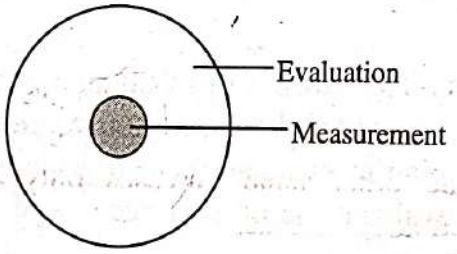
15) **Principle of Variety:** This comprises involvement of variation in different methods, timing hours, seating arrangements, etc. Since, the process of evaluation has been widespread and on-going, so variety in efforts must be taken into account with greater possibility. Various types of examination like oral, written or practical include different question patterns as they may be objective, subjective, short answer type, etc. Moreover, proper assessment of both quality as well as quantity along with the overall personality of the child must be kept so as to increase the reliability of evaluation process.

1.3.7. Relationship between Measurement & Evaluation

Measurement and evaluation are concepts that hold great significance in all human activities. Measurement and evaluation are very important tools in teaching profession which makes it prudent to have a better understanding of the two methods.

Measurement is the process of knowing about physical qualities of objects and individuals such as length, weight, height, volume, density, and so on. Measurement is the part of evaluation and depends on it, but without measurement evaluation is incomplete. Evaluation is more effective than measurement.

Evaluation is a continuous and comprehensive process covering every aspect of the educative programme. It is an integral part of education in which pupil and teacher are partners. Thus, evaluation signifies a wider process of judging students' progress. Measurement, On the other hand, implies only a precise quantitative assessment of instructional outcomes.



Under the following points, the relationship between measurement and evaluation is described:

1) Evaluation is integrated with the entire task of education and not only with examinations, tests and measurements. Evaluation encompasses tests and measurement but also gives beyond them. It depends upon measurement but is not synonymous with it.
2) Measurement is a quantitative determination of how much an individual's performance has been while evaluation is a qualitative judgement of how good or how satisfactory an individual's performance.
3) Measurement describes a situation while evaluation judges its worth or value.

4) Measurement is only a tool to be used in evaluation by itself, it is meaningless but without it evaluation is likely to be of little significance.
5) Sound evaluation is based upon the results of accurate and relevant measurement. It is also to be remembered that not all uses of test or measurement in education can be considered evaluation for evaluation is always in the light of some particular goal, purpose or value.
6) A good evaluation process is based upon the results of accurate and relevant information of measurement process.
7) Measurement helps the evaluator to make a qualitative explanation of externalised knowledge and behaviour.
8) Measurement indicates a situation and evaluation judges its worth or value.
9) Measurement is only a tool in evaluation process. By itself, it is meaningless.
10) Not all uses of tests in educational measurement process can be included in evaluation, for evaluation it includes complete assessment in the presence of some particular value, purpose or objective.
11) Evaluation is not only quantitative but also qualitative and includes value judgement.
12) Evaluation is related with the whole curriculum process. It does not only involve the element of measurement and examinations.
13) Evaluation is a comprehensive and continuous process which covers every aspect of an individual's achievement in the educative programme. It is an integral part of education in which students and teachers are partners, it signifies a wider students and teachers as partners and it signifies a wider process of judging students' progress in various aspects. Measurement on the other hand implies only a precise quantitative assessment of instructional outcome.
14) Evaluation is not only quantitative but also qualitative and includes value judgement. Mathematically it may be said that 'Evaluation Measurement (Quantitative Description of Students' Achievements) + Qualitative Description of Student Abilities + Value Judgement about Student's Achieves and Abilities.'
15) A continuous and comprehensive process is involved in evaluation including every aspect of curriculum process. It is an inclusive part of teaching-learning process in which student and teacher are involved cooperatively. Measurement, on the other hand, stresses only a specific quantitative assessment of instructional outcomes.

1.3.8. Difference between Measurement, Assessment and Evaluation

The difference between measurement, assessment and evaluation is given in the following given **table 1.2.**

Table 1.2: Difference between Measurement, Assessment and Evaluation

Details	Measurement	Assessment	Evaluation
Concept	The process of ascertaining the extent or quantity of something.	It is the process to judge the performance of student to evaluate.	It refers to the act or process of determining the value of something.

Aim	Numerical valuation is the main aim.	To decide learning outcomes is the aim.	To justify and evaluate.
Nature	It is totally numeric in nature.	It is descriptive. It describes in quantitative and qualitative form.	It concludes and interpret the data.
Inter-Relation	Measurement and evaluation are inter-dependent.	Assessment and evaluation are supportive to each other.	It is based on measurement and assessment.
Process	Measurement is a limited process.	In this process the data collection is at high extent for the evaluation and assessed objectively.	It is inclusive process.
Description	It describes the facts.	It gives the valuation for the facts.	It decides the standard of the values given to the facts.
Progress	It answers to how much progress.	It collects the information to describe the facts.	It gives information of progress.
Related to	Objectivity	Tangible things	Intangible things
Tool	Physical measurement tools. **For example,** meter, litre, and kilogram.	Tests are essential	Cumulative records are necessary
Use	Measurement of numerical information.	Activities and description of the facts.	Quantitative and qualitative integrally gives opinion.

1.3.9. Problems of Evaluation and Assessment

Research proves that evaluation and assessment are two important learning tools for educational system. But there are some hindrances in the system of evaluation which also hinder the inclusive education on a wider basis. This proves to be an obstacle in the assessment and education also. Some of the hindrances are as follows:

1) **Curriculum:** An unsuitable curriculum proves to be an obstacle in any kind of education system. The curriculum for inclusive education is designed, keeping in mind some special needs of the children. The assessment purpose fails if the curriculum of the system fails. The curriculum should be flexible enough to be modified according to the needs and situations. Curriculum should be inspiring enough to motivate the learning of special children.

2) **Socio-Economic Factors:** The socio-economic factors prove to be a major hindrance on the way of inclusive education. In most of the areas, parents do not consider the education of these special children to be important due to reasons like unaffordability or unemployment. When they lack the basic education, they undoubtedly are segregated from normal children. This proves a challenge for the system as this does not improve the mental or physical health and education lacks.

3) **Lack of Trained Teachers:** Education and training, both are important aspects of inclusive education. Teachers feel handicapped without proper training and knowledge to deliver to these kids. Without this they are unable to realise the difficulties and methods to solve them. Hence, while evaluating such students, it becomes important to realise their need, requirements, their level of learning and understanding. The national centre for education proves that 60% teachers of public schools are unaware of the social and emotional problems and needs faced by the children.

4) **Family Environment:** Family plays a vital role in a child's education. Sometimes it acts as a hindrance too when they do not allow or remain unaware of such needs and programmes like inclusive education. They remain in a nutshell blaming their fate and keeping the child away from the normal surroundings.

5) **Attitudes:** Often a negative behaviour and attitudes are observed towards such children. This creates discrimination between normal children and affects their education as well. These negative attitudes and thinking of few people creates a feeling of complex in these children, which hinder them to express themselves in every way and skills. These suppressed feelings and skills ultimately affect the evaluation in the educational zone.

6) **Lack of Communication and Language:** Language is one of the important factors for such kids without which no assessment is possible. It is important that communication is done in a language which is mutually understood by both the teacher and student, without such understanding no education is practically possible.

7) **Change in Policies:** Government often tries to experiment and change the different policies on education which affects the learning and evaluation. The policy makers should be aware of the needs, and importance of inclusive education. They should know about the principles and the ways of effective implementation for it to be successful.

8) **Funding:** The lack of funds remains a major hindrance in inclusive system of education.

1.4. EXAMINATION

1.4.1. Meaning of Examination

Generally, an **examination** is known as an **exam** which is a test to see how good somebody is at something.

The University defines an examination, as "a test scheduled within an official examination period which serves as the final evaluation of student performance in a course."

An examination is a test which is conducted by the schools, boards, colleges, universities and the like to assess the understanding of the person. Throughout the

year of teaching and imparting education, certain thoughts are provided to the students through their mentors/teachers and they want to assess what the student has learned so far, so that he is in a condition to apply those thoughts in principle and make him more competent in the corporate world. If the student fails to pass the examination/test, he is required to re-appear again and is expected to perform better.

Examinations are a very common assessment and evaluation tool in schools, colleges and universities. In these places different types of exams are conducted like multiple choice, true/false, matching, short answer, and essay, oral and computational, i.e., online.

1.4.2. Salient Features of a Good Examination System

A good exam system should possess the following features:

1) **Valid:** A good exam should be valid and providing useful information about the concepts. They were designed to test.
2) **Reliable:** A good exam should be reliable. It allowing consistent measurement and discriminating between different levels of performance.
3) **Recognisable:** A good exam should be recognisable. Instruction has prepared students for the assessment.
4) **Realistic:** A good exam should be realistic. It should concerned with time and effort required to complete the assignment.
5) **Flexible:** It should be flexible to adoption of changing mode.
6) **Transparent:** Exam system procedures and regulations should be transparent. Exam system must have transparency, accuracy, secrecy and efficiency.
7) **Proper Infrastructure:** There should be proper infrastructure for HR, computing facilities and software to process data. Quality problems in exam system should be taken efficiently.
8) **Governed by Academic Staff:** A good exam system is governed by academic people.

1.4.3. Purpose of Examination

The UNESCO publication examination systems stated that exams have following purposes:

1) It is a selection function and entails controlling access to secondary schools, courses within schools and entry to higher education institutions.
2) It is a certifying function and entails finding out and reporting what a student has achieved, whether they have graduated, and what they know and are able to do.
3) The systems often make use of examination results for accountability purposes, and in particular, for evaluating the effectiveness of instruction, for motivating students and teachers to perform well, and for reviewing the effectiveness of school.

1.4.4. Difference between Evaluation and Examination

The difference between evaluation and examination is given under following table 1.3:

Table 1.3: Difference between Evaluation and Examination

Basis of Differences	Evaluation	Examination
Meaning	Evaluation is to evaluate test and provide marks or grades to the students.	An examination is an assessment intended to measure a test-taker's knowledge, skill, aptitude, or classification in many other topics (e.g., beliefs).
Purpose	To evaluate the achievements of the students.	To measure quantitative and qualitative aspects of students.
Types	It is in the form of formative, summative, diagnostic, etc.	It is in the form of written, oral, practical, etc.
Techniques	Interview, observation, rating scale, etc.	An examination may be administered orally, on paper, on a computer, or in a confined area that requires a test taker to physically perform a set of skills.
Component	Generally, any evaluation process requires information about the situation in question.	The basic component of an examination is an item, which is sometimes colloquially referred to as a "question".

1.4.5. Types of Examination

There are different types of exams, which are conducted by the schools, colleges and other educational institutes. Some of them are as follows:

1) **Written Exams:** Written exams are tests that are administered on paper or on a computer (as an e-exam). A test taker who takes a written test could respond to specific items by writing or typing within a given space of the test or on a separate form or document.

   i) **Multiple Choice Tests:** Multiple choice tests or multiple choice questionnaires may be done on paper or online. Multiple choice questions are composed of one question with multiple possible answers, including the correct answer and several incorrect answers. If the test will be done on paper, always take a couple of sharp pencils, a rubber/eraser and a black pen into the exam with you. Typically, students select the correct answer by circling the associated number or letter, or filling in the associated circle on the machine-readable response sheet.

   For example, what is the capital of India?

   a) Lucknow
   b) Delhi
   c) Kolkata
   d) Bengaluru

   Here, the answer is (b).

   Multiple choice exams are often designed to test how quickly you can answer questions, as well as what you know, although you will not have to explain your answers.

ii) **True or False Test:** In a true/false examination the student require to indicate whether a particular statement is true of false. **For example,** consider the following statements. Indicate whether they are true or false.
   a) Mr. Narendra Modi is the prime minister of India. (True / False)
   b) Mahendra Singh Dhoni is the player of Football. (True / False).

iii) **Matching Type:** A matching item is an item that provides a defined term and requires a test taker to match identifying characteristics to the correct term.

iv) **Completion Type or Fill in the Blank:** A fill in the blank item provides a test taker with identifying characteristics and requires the test taker to recall the correct term. There are two types of fill in the blank tests.

v) **Short Answer Type Examination:** In this type of exams students have to answer according to the questions and indicated marks which are asked. The length of a short answer is quite flexible. It could range from one word, to a phrase, to a sentence or to a paragraph. Whatever the required format of the short answer, you will almost certainly be tested on memory (i.e. your ability to recall specific information) rather than interpretation. The examiner will be expecting you to produce discrete pieces of information.

vi) **Essay Type Examination:** Essay type examination is basically a descriptive type exam in which students has to describe a given topic in detail. Essay exams are designed to test not just how well you understand the subject, but also your memory for facts. This means effective revision is essential, since you can't take notes or prompters in with you. The basic essay-writing rules apply (clear argument, good essay structure, accurate grammar, spelling and punctuation, etc.), but with time constraints. This means that writing essays under exam conditions is a particular skill; but one that is easy to acquire.

Students could also practise writing an essay and answer the question in a prescribed time limit. To determine how long practice time limit should be a student will need to know some background details of the exam.
   a) Length of the exam, (i.e., one, two, or three hours).
   b) Number of essay answers required,
   c) Value of essay answers as a proportion of the total exam mark, and
   d) Value of each essay as a proportion of the total marks for the essay section.

2) **Oral Examination:** It allows students to respond directly to the instructor's questions and/or to present prepared statements. These exams are especially popular in language courses that demand 'speaking' but they can be used to assess understanding in almost any course by following the guidelines for the composition of short answer questions. Some of the principle advantages to oral exams are that they provide nearly immediate feedback and so allow the student to learn as they are tested. There are some drawbacks of oral exams as the amount of time required and the problem of record-keeping and oral

exams typically take at least ten to fifteen minutes per student, even for a mid-term exam. As a result, they are rarely used for large classes.

The other two types are:

i) **Physical Fitness Test:** A physical fitness test is a test designed to measure physical strength, agility, and endurance. They are commonly employed in educational institutions as part of the physical education curriculum, in medicine as part of diagnostic testing, and as eligibility requirements in fields that focus on physical ability such as military or police. Common tests include timed running or the multi-stage fitness test which commonly known as the 'beep test', and numbers of push-ups, sit-ups/abdominal crunches and pull-ups that the individual can perform.

ii) **Performance Test:** A performance test is an assessment that requires an examinee to actually perform a task or activity, rather than simply answering questions referring to specific parts. The purpose is to ensure greater fidelity to what is being tested.

3) **Practical Examination:** Practical exams basically conducted in science disciplines which aim to examine students ability to perform specific tasks in which he apply his knowledge of the subject to solving specific practical problems or performing specific tasks. The best way to prepare is to practice what he will be required to do in the exam. Work through the various laboratory exercises that he did during the semester. He:

i) Think about what each laboratory exercise was trying to achieve;
ii) Link the aims of the experiments up with the appropriate topic for his subject;
iii) Try to reconstruct in his mind his physical movements when doing the experiment; and
iv) Re-familiarise himself with the various pieces of equipment that he used, especially their technical names.

Remember, in a practical exam, the examiners are trying to find out what a student knows by examining how he apply his understanding of the subject matter to the problems posed in the exam.

1.4.6. Examination as a Tool for Assessment

Examination is an important part of not only higher education but at primary and secondary level education also. The examination methods and questions have a large impact on how and when students study and what they learn. Examination should not only be used as a control that a student is qualified, but also as an educational tool to influence the learning process. If the assessment is mainly for factual knowledge, the students will primarily learn, memorise and recall facts and details.

Assessment tests may have a high reliability, i.e., are easy to grade, but the validity might be low. For measuring that the aims and objectives of education, assessments need to include tests of understanding, such as ability to interpret, exemplify, summarise, compare and explain, as well as ability to apply, analyse,

evaluate and synthesise; assessment of skills, such as ability to communicate, should also be included. When students know that all this will be examined, they will extend their learning and gain useful and enduring knowledge and skills.

For this, students' provided opportunity to learn from the examination, and realise what an answer should have covered. Furthermore, the students' answers are of value for the teacher to reveal what has been difficult for students to understand or to apply, and thus identify modifications needed in the teaching.

Thus, to accomplish this various examinations methods are used which works as an assessment tool. These examination methods are as discussed below:

1) **Written Exams, Including Short Answer and Essay Questions:** Short-answer questions are usually easy to judge and grade, but mainly test how students recall specific facts. In subjects involving quantitative manipulations, it is suggested to include numeric tasks for the students to elaborate on, as well as some questions on explaining the meaning of concepts and the results in words. It is also recommended to include essay questions in the written examination; those will give a better assessment of how students have understood a subject and their ability to apply their knowledge and do analysis, comparison, evaluation and synthesis. The grading of the essay questions could also include how students outline and express their answers in writing.

2) **Open-Book Exams:** In an open-book exam, students are allowed to use their textbooks and possibly also other materials during the examination session. This examination form can be helpful to test students' understanding and ability to apply knowledge, as well as to select relevant information.

3) **Multiple-Choice Tests:** In multiple-choice tests, the students select the answer from several alternative answers (usually 4-5) for each question. These types of tests mainly focus on detailed knowledge and are not very effective at measuring and stimulating learning for understanding, analysis, synthesis and application of knowledge. The tests are easy to judge and grade, but to construct good multiple-choice questions with realistic alternatives is difficult and time consuming. Multiple-choice tests might be found useful for examination in very large groups of students, or as a guiding quiz in continuous assessment.

4) **Computer-Based Assessment:** Computer tests can be based on multiple-choice questions, but might also involve more interactive events where students are presented a case or a problem to elaborate on at the screen. An advantage of computer tests is that students get an immediate feedback on their answers; the tests can also be used for continuous self-assessment.

5) **Take Home Exams:** In a take home exam, the tasks or questions can be distributed to students in the morning, and at the end of the following day they deliver a written short report to be judged and commented upon by the teacher(s). Takes home exam can be a good way to test students' understanding and ability to apply knowledge, and to select and synthesise relevant information.

6) **Oral Examination:** Oral examination is useful to test the students' knowledge and understanding of a topic, as well as their ability for application, analysis, integration and synthesis. The direct feedback in oral examination provides opportunities for students to learn from the examination, and for the teacher to realise what problems students are facing in grasping the topic. It is also a good training for students to express themselves orally, without extended time to think about the answer. Such situations will occur in their professional careers. Oral examinations can be done in groups and still grade each student individually. Performing an oral examination in a group of 3-4 students (during 1-1.5 hours) can have several advantages.

7) **Report Writing and Oral or Poster Presentations of Tasks Performed:** Parts or all of the assessment of students in a course might consist of reporting of projects, practicals (field and lab), literature studies or problems/cases dealt with during the course. Examining students on their ability to perform tasks and apply knowledge to unfamiliar situations, as well as to write and present the outcomes is important; it will also test their capacity for application, analysis, synthesis, etc. Projects are often performed as group work; they test students' ability to cooperate, but some testing also of each student individually might be needed.

1.5. NCF'S 2005

1.5.1. Introduction

The National Curriculum Framework (NCF 2005) is one of four National Curriculum Frameworks published in 1975, 1988, 2000 and 2005 by the National Council of Educational Research and Training (NCERT) in India.

The Framework provides the framework for making syllabi, textbooks and teaching practices within the school education programmes in India. The NCF 2005 document draws its policy basis from earlier government reports on education as Learning without Burden and National Policy of Education 1986-1992 and focuses on group discussion. After wide ranging deliberations, 21 National Focus Group Position Papers have been developed under the agencies of NCF-2005. The state of art position papers provided inputs for formulation of NCF-2005. The document and its offshoot textbooks have come under different forms of reviews in the press.

Its draft document came under the criticism from the Central Advisory Board of Education (CABE). In February 2008, the director Krishna Kumar in an interviewer who also discussed the challenges that are faced by the document. The approach and recommendations of NCF 2005 are for the entire educational system. A number of its recommendations, e.g., focus on rural schools. The syllabus and textbooks based on it are being used by all the CBSE schools, but NCF based material is also being used in many State schools.

NCF 2005 has been translated into 22 languages and has influenced the syllabi in 17 States. The NCERT gave a grant of ₹10 lakh to each State to promote NCF in the language of the State and to compare its current syllabus with the syllabus proposed, so that a plan for future reforms could be made. Several States have taken up this challenge. This exercise is being carried out with the involvement of State Councils for Educational Research and Training (SCERT) and District Institutes of Education and Training (DIET).

1.5.2. Features of National Curriculum Framework (2005)

The document is divided into 5 areas:

1) **Perspective of NCF:** The NCF was framed considering the articulated ideas in the past such as:
   i) To shift learning from rote method,
   ii) To ensure overall development of children,
   iii) To integrate examination into classroom learning and make it more flexible,
   iv) To nurture identify of caring concerns within the democratic policy of India, and
   v) Nurturing an overriding identity informed by caring concerns within the democratic polity of the country.

   NCF focused on learning without burden.to make learning a joyful experience and move away from textbooks to be a basis for examination and to remove stress from children. It recommended major changes in the design of syllabus such as:
   i) To develop a sense of self-reliance and dignity of the individual which would be for the basis of social relationship and would develops a sense of non-violence and oneness across the society.
   ii) To develop a child-centred approach and to promote universal enrolment and retention upto the age of 14.
   iii) To inculcate the feeling of oneness, democracy and unity in the students. The curriculum is enabled to strengthen our national identity and enable the new generation to reevaluate.
   iv) J.P. Naik has described equality, quality and quantity as the exclusive triangle for Indian education.
   v) With respect to social context NCF 2005 has ensured that irrespective of caste, creed, religion, and sex, all are provided with a standard curriculum.

2) **Learning and Knowledge:** Learning should be an enjoyable Act where children should feel that they are valued and their voices are heard. The curriculum structure and school should be designed to make school a satisfactory place for students to feel secure and valued. In order to bring about the overall development of the students, adequate nutrition, physical exercise and other psyco-social needs are addressed hence participation in yoga and sports is required. Learning should be made enjoyable and should relate to real life experiences and learning should involve concepts and deeper understandings.

The foundation should be laid strongly and firmly. Primary, upper primary and middle school should provide the space for children to explore and develop rational thinking that they would imbibe in them and have sufficient knowledge on concepts, language, knowledge, investigation and validation procedures.

3) **Curricular Area, School Stages and Assessment**

i) **Language:** Three language formula system is to be followed. Medium of communication should be the home language. The first language to be studied must be the mother tongue or the regional language. The Second language in Hindi speaking states, the second language will be some other modern Indian language or English, and in non-hindi speaking states, the second language will be Hindi or English. The Third language – In Hindi speaking States, the third language will be English or a modern Indian language not studied as the second language, and – In non-Hindi speaking States, the third language will be English or a modern Indian language not studied as the second language.

ii) **Mathematics:** The emphasis for learning mathematics is that all students can learn and need to lean mathematics. Pedagogy and learning environment have to be made favourable for students to develop interest by going far beyond basic skills and include variety of mathematics models by pedagogy which devotes a greater percentage of instructional time to problem solving and active learning.

iii) **Computers:** Introduction of computers in schools is to move from a predetermined set of outcomes and skill sets to one that enables students to develop 16 explanatory reasoning and other higher-order skills. Introduction of computer will:

a) Enable students to access sources of knowledge, interpret them, and create knowledge rather than be passive users,
b) Promote flexible models of curriculum transaction,
c) Promote individual learning styles, and
d) Encourage use of flexible curriculum content, at least in primary education, and flexible models of evaluation.

iv) **Science:** Pedagogy of learning sciences should be designed to address the aims of learning science is to learn the facts and principles of science and its applications, consistent with the stage of cognitive development.

v) **Social Sciences:** Social science a subject is included in schools to assist students to explore their interests and aptitudes in order to choose appropriate university courses and/or careers.

vi) **Art Education:** The objectives of including art education in schools is to bring about the complete development of the students' personality and mental health, to appreciate cultural heritage and to develop respect for each other's work and connect to environment.

vii) **Health and Physical Education:** To provide theoretical and practical inputs to provide an integrated and holistic understanding of health, disease, accidents and physical fitness among children. To provide skills

for dealing with psycho-social issues in the school, home and the community. To help children grow as responsible citizens by inculcating in them certain social and moral values through games, sports, N.C.C., Red Cross, Scouts and Guides, etc.

viii) **Study of Peace:** Skills that are developed as part of curriculum activity such as to listening with patience and endurance, purity of mind to develop concentration, aptitude for cooperation and teamwork, to reach out to get answers (curiosity and rational inquiry), acceptance of discipline, and a positive attitude to study/work are the trademarks of a good student which in turn are also the skills of a peace-oriented person. Thus the curriculum also inculcates peace and democracy into students.

ix) **Work and Education:** Work related education is made as an integral component of the school curriculum, in the form of – work experience, work education, SUPW, craft education, life-oriented education, pre-vocational education and generic education. Work-based education aims at involving children in a variety of production or service oriented activities, to develop skills, positive attitudes and values through work and also to develop work related competencies.

4) **School and Classroom Environment:** Physical environment has to be maintained favourable to students in terms of infrastructure, adequate light and ventilation, student teacher ratio, hygiene and safe environment. Schools should also treat students with equality, justice respect, dignity and right of the students. Give equal opportunities for all students to participate in all activities without any bias. Policy of inclusion has to be part of the school where differently abled and children from marginalised section get equal opportunities. The schools should also be well-equipped with libraries, laboratories and educational technology laboratories.

5) **Systemic Reforms:** The NCF has aimed at bringing about reforms in the education system to bring about a curriculum that is learner centric, has a flexible process, provide learner autonomy, teacher plays a role of a facilitator, supports and encourages learning, involves active participation of learners, develops multidisciplinary curriculum, focuses on education, brings about multiple and divergent exposure, multifarious, continuous appraisal in educational system.

1.5.3. Recommendations of National Curriculum Framework 2005

In order that education may be relevant to the present and future needs, NCF 2005 recommends that:

1) Subject boundaries are softened leading to integrated knowledge and understanding.
2) Textbooks and other material should incorporate local knowledge and traditional skills.
3) School should provide a stimulating environment that responds to the child's home and community environment.

1.5.4. NCF's 2005 Vision of Assessment for Learning

The NCF 2005 states that the purpose of education can be achieved only if the teacher is prepared even before the course of teaching begins. While teacher autonomy is important, it is also necessary that teachers keep the objectives of the curriculum in mind and align those with meaningful and constructive assessment. The curriculum objective can only act as a guide.

Teachers need to exercise professional judgement based on the age, interest and cognitive ability of the learners and handle any particular piece of work accordingly. They need to remember that the main aim is to improve learning. Teachers should be flexible and sensitive towards children with limited proficiency. Bilingual children should be given an opportunity to express themselves in the language they know and gradually they can be encouraged to switch over to the target language. In reporting achievement to students or parents, the focus should be on the achievement level so that it can be used as a key indicator for the next level.

Assessment is not only important for learners, but it is equally valuable for the teachers as it can help them identify individual and special needs, requirements and interests of the learner. Teachers can then plan teaching and learning situations in a more suitable way. They can observe the changes and progress that have taken place in the child over a period of time, assess the child and accordingly make improvisations in the curriculum. The most vital thing being that the fear of assessment in children is reduced and they perform better. "Assessment must recognise and reflect the intellectually and socially complex nature of reading and writing and the important roles of school, home and society in literacy development."

According to NCF 2005, **the purpose of evaluation is not:**

1) To motivate children to study under threat (Children should be motivated to study by coming to enjoy the process of learning, not by the threat of examinations).
2) To identify or label children as 'slow learners', or 'bright students', or 'problem children'. (Placing such labels and categories on children and ranking them has a demonising effect on children, since it humiliates them, makes them internalise these labels and leads them to believe they cannot escape these categories, creates feelings of inferiority and low self-esteem and encourages unhealthy competition.).
3) To identify children who need remedial help (this need not wait for formal assessment; it can be detected by the teacher in the course of teaching and attended to as a part of teacher's planning, through individualised attention while teaching).

According to NCF 2005, the purpose of evaluation is:

1) To gauge the progress that both learner and teacher have made towards achieving the learning aims that have been set,

2) To give feedback on how the teaching process and learning materials need to be improved in order to facilitate children's understanding of concepts, and
3) To help the teacher to think about each individual child and review what he/she has learnt during the term, and in which areas he/she needs more support, revision, and improvement.

Following points should be kept in mind:

1) **Assessment should be Comprehensive:** At present, exams test a very limited range of abilities, and do not provide a complete picture of a students' progress towards fulfilling the broader aims of education of preparing citizens for a meaningful and productive life. Instead of measuring only the extent to which the child has memorised subject-related facts, assessment should also measure the child's development in different areas – her attitudes to learning, her interest, her ability to learn independently, cooperation with peers, social and emotional development, etc.

2) **Assessment should be Continuous during the Course of Teaching:** In order to identify areas where children are facing problems in learning and understanding, one does not need to wait until conducting formal tests to find this out. Teachers should be able to identify such problems in the course of teaching itself, by asking questions that make children think or by giving them small assignments.

   She can then attend to them in the process of teaching by ensuring that her planning is flexible and responsive to the learners and their ongoing learning. Maintaining a daily Teachers' Diary based on observation of children's progress helps in continuous and comprehensive evaluation, providing both the teacher and the learner with a systematic record of his/her learning progress.

   Testing should be used to gauge not only what children have learnt, but also their ability to use this knowledge for problem solving and application in the real world. It should test not only the product but also the process of thinking, to gauge if the learner has learnt where to find new information, how to use it, how to analyse and evaluate new information.

   The types of questions that are set for assessment need to go beyond what is given in the book, and children should be allowed to present answers in their own words. Correction should be carried out in the presence of students so that it gives them feedback on the answers they got right and wrong, and why. Asking children about why they answered what they did assists teachers in going beyond the written answer to engage with children's thinking, to understand why they make the mistakes they did and how their thinking process can be helped.

1.6. BLOOM'S TAXONOMY (2000) FOR INSTRUCTIONAL OBJECTIVES

1.6.1. Meaning of Instructional Objectives

Instructional objectives, also known as behavioural objectives or learning objectives are basically statements which clearly describe an anticipated learning outcome.

According to Dick and Carey (1990), "a performance objective is a detailed description of what students will be able to do when they complete a unit of instruction. It is also referred to as a behavioural objective or an instructional objective."

Robert Mager (1984), in his book **'Preparing Instructional Objectives',** describes an objective as "a collection of words and/or pictures and diagrams intended to let others know what you intend for your students to achieve".

An objective does not describe what the instructor will be doing, but instead the skills, knowledge, and attitudes that the instructor will be attempting to produce in learners.

1.6.2. Purpose of Instructional Objectives

The main purpose of instructional objectives is:

1) To provide direction for the instructional process by clearly stating the intended learning outcomes,
2) To convey instructional intent to pupils, parents and educational organisations, and
3) To provide a basis for evaluating pupil learning by describing the performance to be measured.

1.6.3. Kinds of Instructional Objectives

Instructional objectives are often classified according to the kind or level of learning that is required in order to reach them. There are numerous taxonomies of instructional objectives; the most common taxonomy was developed by **Benjamin Bloom** and his colleagues. The first level of the taxonomy divides objectives into three categories, namely, cognitive, affective, and psychomotor. Simply put, cognitive objectives focus on the mind; affective objectives focus on emotions or affect; and psychomotor objectives focus on the body. Following are the kinds of instructional objectives:

1) **Cognitive Objectives:** Cognitive objectives call for outcomes of mental activity such as memorising, reading, problem solving, analysing, synthesising, and drawing conclusions. **Bloom** and others further categorise cognitive objectives into various levels from the simplest cognitive tasks to the most complex cognitive task. These categories can be helpful when trying to order objectives so they are sequentially appropriate. This helps to insure that prerequisite outcomes are accomplished first.

2) **Affective Objectives:** Affective objectives focus on emotions. Whenever a person seeks to learn to react in an appropriate way emotionally, there is some thinking going on. What distinguishes affective objectives from cognitive objectives is the fact that the goal of affective objectives is some kind of affective behaviour or the product of an affect (e.g., an attitude). The goal of cognitive objectives, on the other hand, is some kind of cognitive response or the product of a cognitive response (e.g., a problem solved).

3) **Psychomotor Objectives:** Psychomotor objectives focus on the body and the goal of these objectives is the control or manipulation of the muscular skeletal system or some part of it (e.g., dancing, writing, tumbling, passing a ball, and drawing). All skills requiring fine or gross-motor coordination fall into the psychomotor category. To learn a motor skill requires some cognition. However, the ultimate goal is not the cognitive aspects of the skill such as memorising the steps to take. The ultimate goal is the control of muscles or muscle groups.

1.6.4. Role of Instructional Objectives in Teaching

Instructional objectives in teaching has number of roles:

1) Objectives can be helpful in instructional planning, during the teaching/learning process, and when assessing student progress. Instructional objectives are often either ignored (by both teachers and students) or are, at best, occasionally referred to. However, it can be argued that instructional objectives should guide the teaching and learning process from beginning to end.
2) Most lesson plan forms include a place for the objectives of the lesson to be recorded. However, to write an objective down and then to plan the lesson around the topic of the lesson rather than around the learning outcomes to be reached is missing the point. There is good evidence in the human learning literature that different kinds of outcomes are learned differently.
3) Instructional objectives are extremely valuable teaching tools that guide both teachers and students through the teaching and learning process.
4) They provide a solid foundation for designing relevant activities and assessment. Activities, assessment and grading should be based on the objectives.
5) They help in identifying critical and non-critical instructional elements.
6) They help in removing subjectivity from the instruction.
7) They help in designing a series of interrelated instructional topics.
8) Students better understand the expectations and the link between expectations, teaching and grading.

1.6.5. Bloom's Taxonomy

A great psychologist, **B. F. Skinner,** in 1954 in his article **"The Science of Learning and the Art of Teaching"** suggested that effective instructional materials, called programmed instructional materials, should include small steps, frequent questions, and immediate feedback; and should allow self-pacing. **Robert F. Mager** popularised the use of learning objectives with his 1962 article **"Preparing Objectives for Programmed Instruction"**. The article describes how to write objectives including desired behaviour, learning condition and assessment.

In 1955, **Benjamin Bloom** published an influential taxonomy of what he termed the three domains of learning, i.e., **Cognitive** (what we know or think), **Psychomotor** (what we do physically) and **Affective** (what we feel, or what attitudes we have). These taxonomies still influence the design of instruction. The taxonomy was created in 1956 by an educational committee chaired by **Benjamin Bloom**, an American educational psychologist. In 1956, **Benjamin Bloom** headed a group of educational psychologists who developed a classification of levels of intellectual behaviour important in learning. **Bloom** found that over 95 % of the test questions that students encounter require them to think only at the lowest possible level, the recall of information. **Bloom** identified six levels within the cognitive domain, from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental levels, to the highest order which is classified as evaluation. Phases of this model are as follows:

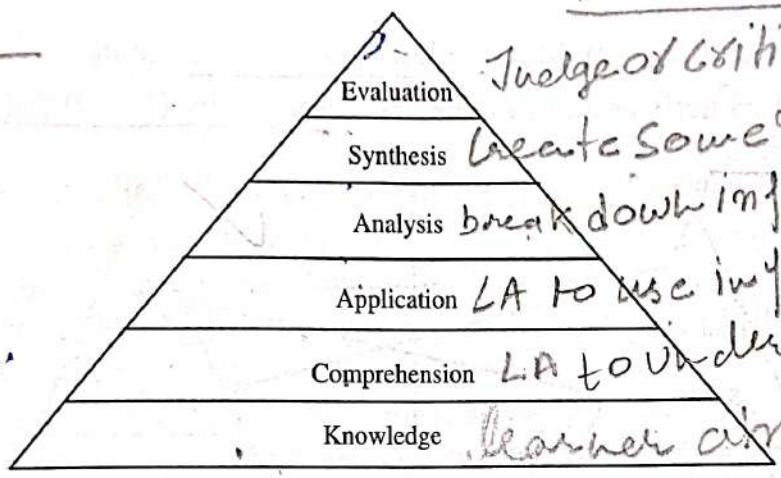


Figure 1.1: Bloom's Taxonomy

1) **Knowledge:** Knowledge is the learner's ability to recall information. **For examples,** arrange, define, duplicate, label, list, memorise, name, order, recognise, relate, recall, repeat, and reproduce state.

2) **Comprehension:** Comprehension is the learner's ability to understand information. **For examples,** classify, describe, discuss, explain, express, identify, indicate, locate, recognise report, restate, review, select, and translate.

3) **Application:** Application is the learner's ability to use information in a new way. **For examples,** apply, choose, demonstrate, dramatise, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, and write.

4) **Analysis:** Analysis is the learner's ability to breakdown information into its essential parts. **For examples,** analyse, appraise, calculate, categorize, compare, contrast, criticise, differentiate, discriminate, distinguish, examine, experiment, question, and test.

5) **Synthesis:** Synthesis is the learner's ability to create something new from different elements of information. **For examples,** arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organise, plan, prepare, propose, set-up, and write.

6) **Evaluation:** Evaluation is the learner's ability to judge or criticise information. **For examples,** appraise, argue, assess, attach, choose compare, defend estimate, judge, predict, rate, core, select, support, value, and evaluate.

1.6.6. Revised Bloom's Taxonomy (2000) for Instructional Objectives

Bloom's Taxonomy was revised in 2000. In 2000, Bloom's Taxonomy was revised by **Lorin Anderson**, a former student of Bloom's, and **David Krathwohl,** one of Bloom's original research partners on cognition. Their hope for the updates was to add relevance for 21st century students and teachers. The elements of **Anderson and Krathwohl's** Taxonomy are as follows:

1) **Remembering:** Learner's ability to recall information.
2) **Understanding:** Learner's ability to understand information.
3) **Applying:** Learner's ability to use information in a new way.
4) **Analysing:** Learner's ability to break down information into its essential parts.
5) **Evaluating:** Learner's ability to judge or criticise information.
6) **Creating:** Learner's ability to create something new from different elements of information.

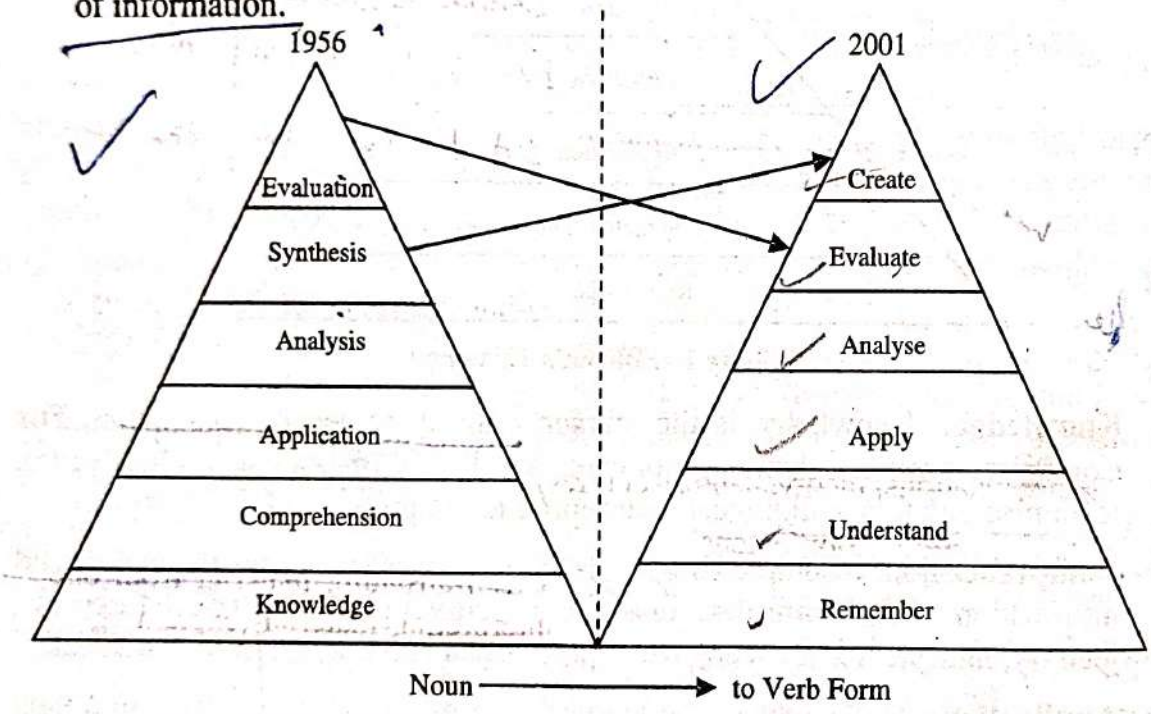


Figure 1.2: Revised Bloom's Taxonomy

Anderson and Krathwohl Updates

The updates are reflective of a more active thought process and include three main changes:

1) **Category Names were Revised from Nouns to Verbs: Anderson and Krathwohl** felt that subject matter (noun) and cognitive processes (verb) should have be separate dimensions, so they replaced Bloom's nouns with verbs to reflect the nature of thinking for each category.
2) **The Last Two Stages of Bloom's Taxonomy were Switched so that Evaluation (Evaluating) comes before Synthesis (Creating): Anderson and Krathwohl** believed that a learner's ability to evaluate came before his or her ability to synthesise/create and therefore changed the order of these last two categories in Bloom's Taxonomy.

3) **The Knowledge (Remembering) Category was Updated to Reflect Four Knowledge Dimensions instead of Three:** Under the original Bloom's Taxonomy, the knowledge/remembering category only included three knowledge dimensions, i.e., factual (basic elements of knowledge), conceptual (the interrelationships between basic elements of knowledge), and procedural (the "how-to" part of knowledge). With **Anderson and Krathwohl's** updates, they added a fourth knowledge dimension, metacognitive (knowledge of cognition and awareness of one's own cognition).

1.6.6.1. Cognitive Domain (Knowledge based)

In the original version of the taxonomy, the cognitive domain is broken into the following six levels of objectives. In the 2001 revised edition of **Bloom's taxonomy**, the levels are slightly different, i.e., knowledge or remember, understand, apply, analyse, evaluate, create (rather than synthesise).

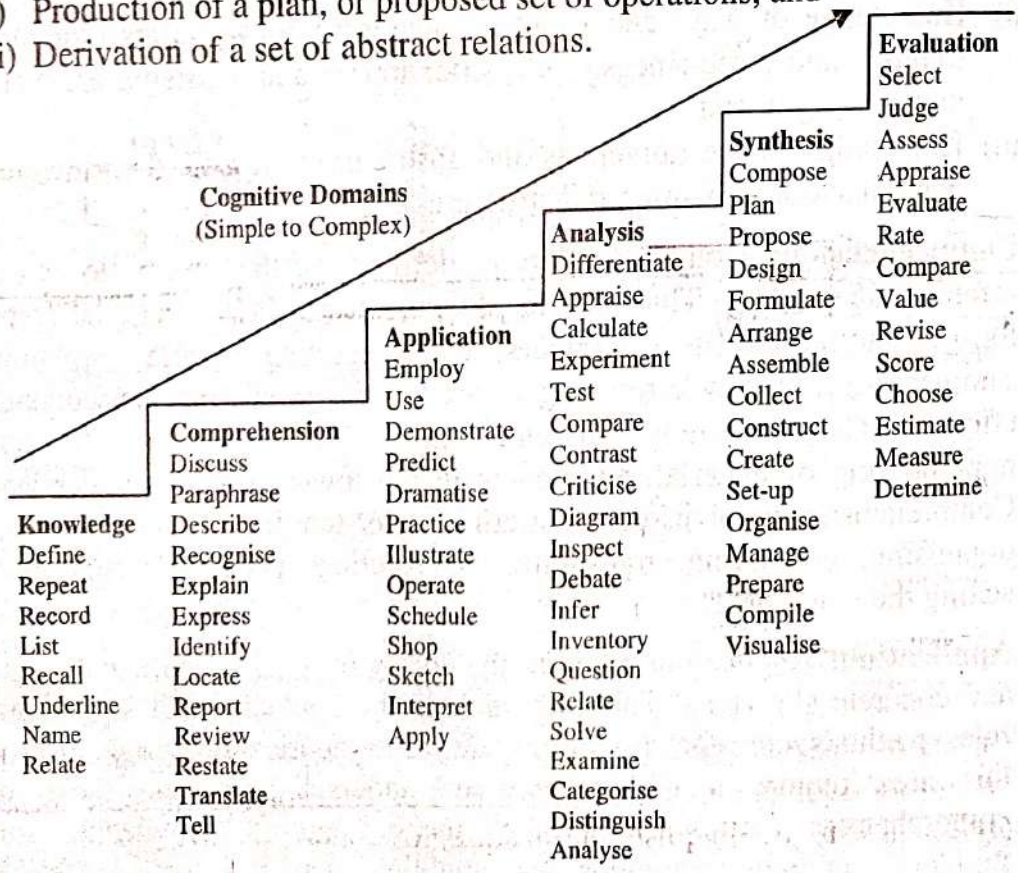
1) **Knowledge or Remembering: Knowledge** is defined as remembering of previously learned material. This may involve the recall of a wide range of material, from specific facts to complete theories, but all that is required is the bringing to mind of the appropriate information. Knowledge represents the lowest level of learning outcomes in the cognitive domain. **Remembering** involves recognising or remembering facts, terms, basic concepts, or answers without necessarily understanding what they mean. Its characteristics may include:
   i) Knowledge of specifics (terminology, and specific facts),
   ii) Knowledge of ways and means of dealing with specifics (conventions, trends and sequences, classifications and categories, criteria, methodology), and
   iii) Knowledge of the universals and abstractions in a field (principles and generalisations, theories and structures).

2) **Comprehension:** Comprehension is defined as the ability to grasp the meaning of material. This may be shown by translating material from one form to another (words to numbers), by interpreting material (explaining or summarising), and by estimating future trends (predicting consequences or effects). These learning outcomes go one step beyond the simple remembering of material, and represent the lowest level of understanding. Comprehension involves demonstrating understanding of facts and ideas by organising, comparing, translating, interpreting, giving descriptions, and stating the main ideas.

3) **Application:** Application refers to the ability to use learned material in new and concrete situations. This may include the application of such things as rules, methods, concepts, principles, laws, and theories. Learning outcomes in this area require a higher level of understanding than those under comprehension. Applying involves using acquired knowledge, solving problems in new situations by applying acquired knowledge, facts, techniques and rules. Learners should be able to use prior knowledge to solve problems, identify connections and relationships and how they apply in new situations.

4) **Analysing:** Analysis refers to the ability to breakdown material into its component parts so that its organisational structure may be understood. This may include the identification of the parts, analysis of the relationships between parts, and recognition of the organisational principles involved. Learning outcomes here represent a higher intellectual level than comprehension and application because they require an understanding of both the content and the structural form of the material. Analysing involves examining and breaking information into component parts, determining how the parts relate to one another, identifying motives or causes, and making inferences and find evidence to support generalisations. Its characteristics include:
   i) Analysis of elements,
   ii) Analysis of relationships, and
   iii) Analysis of organisation.

5) **Synthesising:** Synthesis refers to the ability to put parts together to form a new whole. This may involve the production of a unique communication (theme or speech), a plan of operations (research proposal), or a set of abstract relations (scheme for classifying information). Learning outcomes in this area stresses on creative behaviours, with major emphasis on the formulation of new patterns or structures. Synthesising involves building a structure or pattern from diverse elements; it also refers to the act of putting parts together to form a whole. Its characteristics include:
   i) Production of a unique communication,
   ii) Production of a plan, or proposed set of operations, and
   iii) Derivation of a set of abstract relations.



6) **Evaluating:** Evaluation is concerned with the ability to judge the value of material (statement, novel, poem, research report) for a given purpose. The judgements are to be based on definite criteria. These may be internal criteria (organisation) or external criteria (relevance to the purpose) and the student

may determine the criteria or be given them. Learning outcomes in this area are highest in the cognitive hierarchy because they contain elements of all the other categories, plus conscious value judgements based on clearly defined criteria. Evaluating involves presenting and defending opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. Its characteristics include:

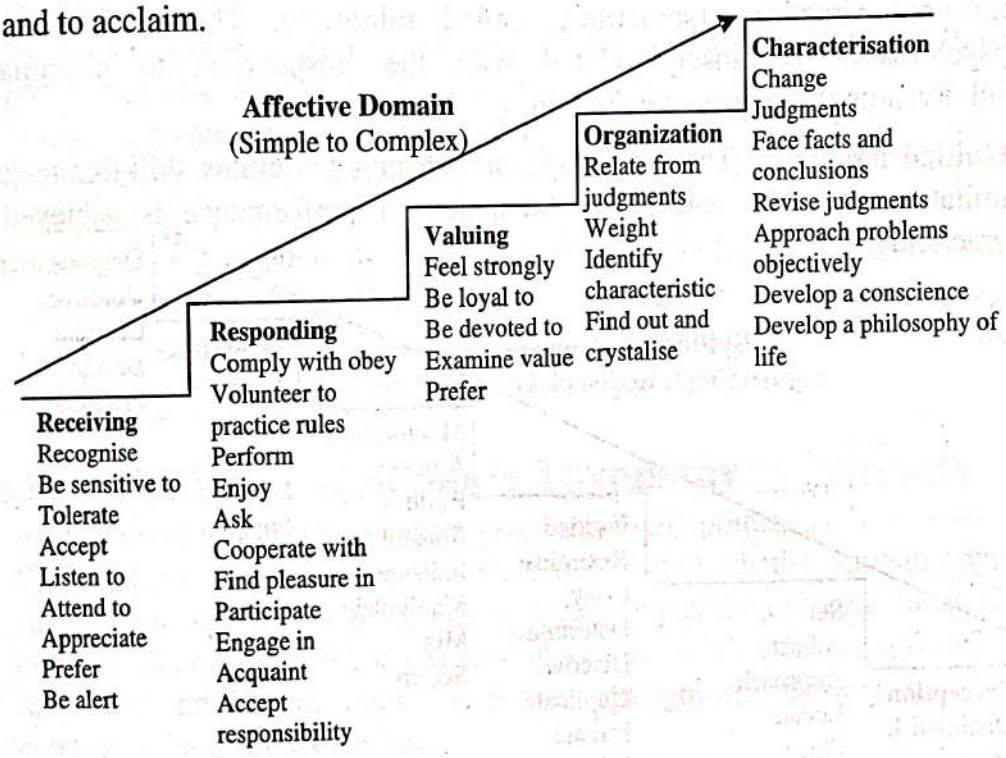
i) Judgments in terms of internal evidence, and
ii) Judgments in terms of external criteria.

1.6.6.2. Affective Domain (Emotive Based)

Skills in the affective domain describe the way people react emotionally and their ability to feel other living things' pain or joy. Affective objectives typically target the awareness and growth in attitudes, emotion, and feelings. There are five levels in the affective domain moving through the lowest-order processes to the highest:

1) **Receiving:** Receiving describes the stage of being aware of or sensitive to the existence of certain ideas, material, or phenomena and being willing to tolerate them. **For example,** to differentiate, to accept, to listen (for), and to respond to.

2) **Responding:** Responding describes the second stage of the taxonomy and refers to a commitment in some small measure to the ideas, materials, or phenomena involved by actively responding to them. **For example,** to comply with, to follow, to commend, to volunteer, to spend leisure time in, and to acclaim.



3) **Valuing:** Valuing means being willing to be perceived by others as valuing certain ideas, materials, or phenomena. **For example,** to increase measured proficiency in, to relinquish, to subsidise, to support, and to debate.

4) **Organising:** Organisation is the fourth stage of Krathwohl's taxonomy and involves relating the new value to those one already holds and bringing it into a harmonious and internally consistent philosophy. **For example,** to discuss, to theorise, to formulate, to balance, and to examine.

5) **Characterising:** Characterisation by value or value set means acting consistently in accordance with the values the individual has internalised. **For example,** to revise, to require, to be rated high in the value, to avoid, to resist, to manage, and to resolve.

1.6.6.3. Psychomotor Domain (Action-Based)

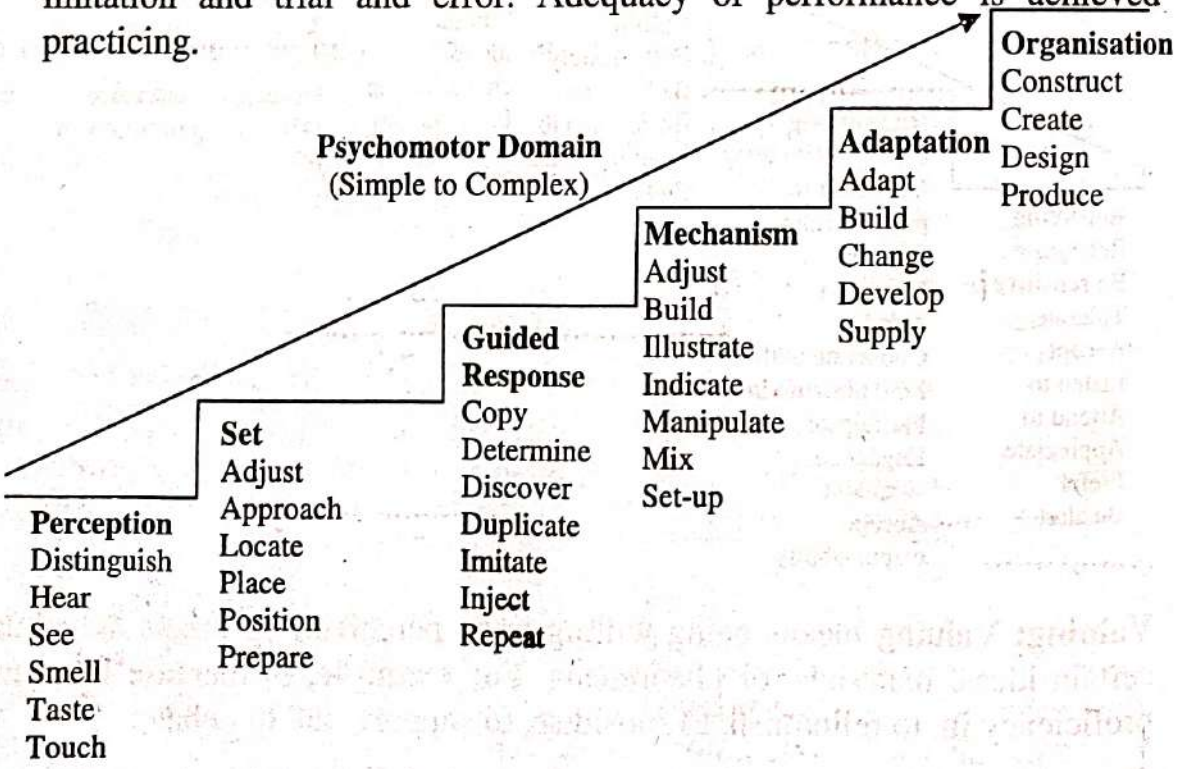
The psychomotor domain is skill based and refers to the learning of skills. Physical skills are the ability to move, act, or manually manipulate the body to perform a physical movement. Skills in the psychomotor domain describe the ability to physically manipulate a tool or instrument like a hand or a hammer. Psychomotor objectives usually focus on change and/or development in behavior and/or skills. Bloom and his colleagues never created subcategories for skills in the psychomotor domain, but since then other educators have created their own psychomotor taxonomies.

Simpson (1972) has proposed the following levels of psychomotor domain:

1) **Perception:** Perception is the ability to use sensory cues to guide motor activity. This ranges from sensory stimulation, through cue selection, to translation.

2) **Set:** A set is readiness to act. It includes mental, physical, and emotional sets. These three sets are dispositions that predetermine a person's response to different situations (sometimes called mindsets). This subdivision of psychomotor is closely related with the 'responding to phenomena' subdivision of the affective domain.

3) **Guided Response:** The early stages in learning a complex skill that includes imitation and trial and error. Adequacy of performance is achieved by practicing.



4) **Mechanism:** It is the intermediate stage in learning a complex skill. Learned responses have habitual and the movements can be performed with some confidence and proficiency.

5) **Complex Overt Response:** The skillful performance of motor Acts that involve complex movement patterns. Proficiency is indicated by a quick, accurate, and highly coordinated performance, and requiring a minimum of energy. This category includes performing without hesitation, and automatic performance. **For example,** players will often utter sounds of satisfaction or expletives as soon as they hit a tennis ball or throw a football, because they can tell by the feel of the Act what the result will produce.

6) **Adaptation:** Skills are well-developed and the individual can modify movement patterns to fit special requirements.

7) **Organisation:** Creating new movement patterns to fit a particular situation or specific problem; Learning outcomes emphasise creativity based upon highly developed skills.

1.6.7. Educational Implications of Bloom's Taxonomy

Educational implications of Bloom's taxonomy include the following:

1) Bloom's taxonomy provides a universally effective strategy for creating all types of content to impart learning.
2) The taxonomy helps teachers make decisions about the classification of content.
3) Bloom's taxonomy also helps teachers map content to tasks that students need to perform.
4) Bloom's taxonomy guides teachers to develop higher levels of thinking process for critical thinking or creative thinking.
5) Using the taxonomy a teacher develops questions or projects that require the development of thinking and reflection from the knowledge level to the evaluation level.
6) A teacher or a syllabus designer designs a curriculum as well as classroom assignment using Bloom's taxonomy to advance the learning process from recalling learning materials to higher level of thinking.
7) A teacher creates class activities based on Bloom's Taxonomy.

1.6.8. Criticism of Bloom's Taxonomy

Bloom's taxonomy is criticised under given following points:

1) Critics of the original taxonomy have questioned whether human cognition can be divided into two distinct categories – sequential or hierarchical. Others embrace the utility of the classification system, while still recognising that it does not and cannot represent human thought or learning in all their complexity and sophistication.
2) Most criticism is focused less on the system itself and more on the ways in which educators interpret and use the taxonomy. **For example,** teachers may view the system as linear prescription, believing that students must first begin with remembering, move onto understanding, and proceed through the levels to creating. Other educators may place too much emphasis on the importance of higher order thinking at the expense of lower order skills despite the fact that acquiring a strong foundation of knowledge, information, and facts is essential in the application of higher level thinking skills.

3) Some educators have even proposed an alternative formulation, suggesting that the taxonomy should be reversed because higher-level thinking skills require that students both remember and understand underlying concepts first. Others suggest that the taxonomy should be interpreted as a non-hierarchical continuum in which no one form of cognition is more or less important.

While still widely used, Bloom's taxonomy is gradually being supplemented and may perhaps even supplanted one day by new insights into the workings of human thought and learning made possible by advances in brain imaging and cognitive science. Still, it is likely, given its logical simplicity and utility that Bloom's taxonomy will continue to be widely used by educators.

1.7. TEACHER AS A FACILITATOR IN ASSESSMENT FOR LEARNING

Assessment for learning is designed to give teachers information to modify and differentiate teaching and learning activities. It acknowledges that individual students learn in idiosyncratic ways, but it also recognises that there are predictable patterns and pathways that many students follow. It requires careful design on the part of teachers so that they use the resulting information to determine not only what students know, but also how, when, and whether students apply what they know. Teachers can also use this information to streamline and target instruction and resources, and to provide feedback to students to help them advance their learning. Assessment for learning occurs throughout the learning process. It is interactive, with teachers:

1) **Enhance Students' Motivation and Commitment:** "Teachers also use assessment for learning to enhance students' motivation and commitment to learning. When teachers commit to learning as the focus of assessment, they change the classroom culture to one of student success."

2) **Promote Increased Learner Progress:** Assessment for Learning and quality feedback can and do promote increased learner progress. However, assessment of learning rather than assessment for learning has preoccupied the minds of the profession for many years in an effort to meet awarding body requirements. Assessment of learning can detract from effective classroom practice and prevent feeding back assessment decisions to learners on their performance with the view to improving their work.

3) **Creating Differentiated Teaching Strategies and Learning Opportunities:** The teachers create differentiated teaching strategies and learning opportunities for helping individual students so that they can move forward in their learning.

4) **Questioning:** Through questioning, teachers gather evidence about their students' current level of knowledge and skills, as well as their attitudes, interests and learning preferences. Strategically planned questions guide students' thinking on a topic, and focus their efforts to achieve learning goals. The evidence of learning gathered from questioning can provide teachers

with information they need to differentiate instruction. Further, questioning makes students' thinking visible so teachers can detect confusions and misconceptions.

5) **Feedback:** Feedback describes student performance. Its purpose is to reduce the gap between the student's current level of understanding and/or performance and a desired goal. Depending on the nature and delivery of the feedback, it can have powerful effects on student engagement and learning. Teachers make professional judgements on learners' performance in every teaching and learning session undertaken, whether consciously or subconsciously. Using these professional judgements and translating them into feedback on the quality of individuals' work is the focus of assessment for learning. Successful assessment for learning strategies result in improved learner progress on a continual basis. The principal characteristic of assessment for learning is effective feedback provided by teachers to learners on their progress. The value of the feedback is dependent on two factors, i.e., the quality of the feedback and how learners receive and ultimately use it. Teachers, therefore, need training and support to enable them to make valuable assessment decisions, to provide quality feedback to learners, and to teach learners to receive feedback positively and use the information contained within it effectively to improve their work.

1.8. EXERCISE

1.8.1. Very Short Answer Type Questions

1) What do you mean by measurement?
2) Define evaluation.
3) What is assessment?
4) What is affective domain?
5) What is psychomotor domain?

1.8.2. Short Answer Type Questions

1) Describe the various principles of assessment.
2) What is the purpose of evaluation?
3) Describe the vision of NCF 2005 in assessment for learning.
4) What is the cognitive domain?
5) Write a short note on teacher as a facilitator for learning.

1.8.3. Long Answer Type Questions

1) Discuss in detail the basic concept of measurement and evaluation.
2) Discuss in detail concept purpose and principles of assessment.
3) What is relationship between measurement and evaluation? Differentiate between measurement, assessment and evaluation.
4) Focus on examination as an assessment tool.
5) What is Bloom's taxonomy? Describe revised Bloom's taxonomy.

UNIT 2
Tools and Techniques of Assessment

2.1. ASSESSMENT TOOLS

2.1.1. Introduction

Assessment tools – also called evidence-gathering tools – contain both the instrument and the instructions for gathering and interpreting evidence in an assessment process. Assessment tools are an important part of judging the capabilities, progress and development of students. Assessment tools help teachers to judge how much a student knows at the beginning of a school year, semester, or subject. Assessment tools also help to track progress and inform the teacher when the subject matter has been adequately learned by the students. Teachers' assessment tools come in various forms, including homework, tests, interviews, oral reports, papers, and instructor observation. Teachers' assessment tools can be formative, summative, objective, and subjective. These tools are for immediate use with students present in the classroom. They are suitable for use in many different contexts and are aimed at improving assessment practices.

Assessment tools should provide clear guidance and support for students so that there is no ambiguity about what is required of them or the basis on which lecturers will make decisions. They can also, if well designed, be used for recording and reporting purposes. An assessment tool is made up of the following components, namely, context and conditions for the assessment; tasks to be administered to the student; an outline of the evidence to be gathered from the student; evidence criteria used to judge the quality of performance; and administration, recording and reporting requirements.

Tools can be standardised and non-standardised. **Standardised tools** have the attributes of objectivity, reliability, validity and quality of discriminating between a high and low performer. Psychological tests and inventories like intelligence and aptitude tests, interest and study habit inventories, attitude scales, etc., have those properties. **Non-standardised** tools are teacher made examinations or tests (oral, written and practical), rating scale, observations, interview, questionnaire, opinionnaires, checklists, records, etc.

2.1.2. Characteristics of a Good Assessment Tool

Some of the characteristics of good assessment tools are as follows:

1) **Reliability:** The reliability of an assessment procedure is a measure of the consistency with which the question, test or examination produces the same results under different but comparable conditions. To help produce reliability, the questions which comprise an assessment should (ideally) test only one

thing at a time and give the candidates no choice. The assessment should also adequately reflect the desired outcomes of the teaching unit. An assessment is considered reliable if a student's score on the same test given twice is similar. It is important to remember that reliability is not measured, it is estimated.

2) **Validity:** It is the statement of how far and accurately the test measures what it is designed to measure. A valid assessment procedure is one which actually tests what it sets out to test, i.e., one which accurately measures the behaviour described by the learning outcomes under scrutiny. Educators must identify the expected learning outcomes and goals of the course in order to appropriately assess student work. It is vital for a test to be valid in order for the results to be accurately applied and interpreted.

3) **Practicability:** It (usability) pertains to the action of the assessment method and its relevance to the overall learning goals in the course. It also addresses whether or not the workload for the instructor is reasonable. For most purposes, assessment procedures should be realistically practical in terms of their cost, time taken, and ease of application. It is noteworthy that such compromises can reduce the validity of the assessment. It should be feasible and usable, and the quality of being usable in context to the objective must be achieved.

4) **Objectivity:** It is one of the major factors contributing to the development of the standardised and objective type tests. Objectivity is a prerequisite to the reliability of a test, subjective judgements are considered unreliable. The objectivity of a test is ensured to the extent its items can readily be scored as right or wrong. The objective test item are so worded that only one answer satisfies the requirements of the statements.

5) **Standardisation:** Another quality of a good assessment tool is standardisation. People take many standardised tests in school that are for state or national assessments, but standardisation is a good quality to have in classroom assessments as well. Standardisation refers to the extent to which the assessment and procedures of administering the assessment are similar, and the assessment is scored similarly for each student. Standardised assessments have several qualities that make them unique and standard:

i) All students taking the particular assessment are given the same instructions and time limit.
ii) The assessments contain the same or very similar questions.
iii) The assessments are scored, or evaluated, with the same criteria.

6) **Fairness:** To be fair to all students, an assessment should give all students an equal chance to show what they know and can do. It is also highly desirable that students should know exactly how they are to be assessed. Indeed, it is now generally accepted that students have a right to information such as the nature of the materials on which they are to be tested (i.e., content and outcomes), the form and structure of the test or examination, the length of the examination, and the value (in terms of marks) of each component of the course.

7) **Usefulness to Students:** Students should also find assessment useful, in that it contributes to the effectiveness of their learning. It should do this in two different ways, namely, by getting them to carry out tasks that facilitate learning (revising material covered in lectures, writing essays, etc.) and in providing them with feedback on how they are progressing, thus helping them to identify their strengths and weaknesses.

8) **Discrimination Power:** When a test is able to discriminate among different levels of an attribute or ability, it is said to have discrimination power. To assess a change in performance over time or in relation to a particular intervention, a test needs to measure performance levels on a continuum, with minimal floor or ceiling effects. A floor effect occurs when a test is too difficult for many of the clients performing it (e.g., using the 1-mile (1.6 kilometres) walk or run for frail older adults). A ceiling effect occurs when a test is too easy for most clients.

For example, the Berg Balance Scale tends to exhibit ceiling effects when administered to high-functioning older adults. Many community-residing older adults achieve the maximum score of 56 points on that test, despite reporting balance problems. A sub-component of discrimination power is the responsiveness of a measure, which is its ability to detect meaningful change over time. The smaller the change in performance detected by the measure, the higher the responsiveness and the more confident the instructor can be about detecting changes at the end of the exercise programme. Tests that use continuous scoring systems (e.g., the timed eight-foot (2.4 metre) up-and-go, which is reported in seconds) are inherently more sensitive to changes in performance than tests that use only categorical scores (e.g., Good, Average, and Poor) or a numerical rating scale (e.g., 1, 2, 3).

9) **Performance Standards:** After clients are tested, it is important to have a way of interpreting their score to them. Performance standards provide a useful way of evaluating test results. There are two types of performance standards – norm referenced and criterion referenced.

The scores of a test with norm-referenced standards can be evaluated in comparison to others of the same age and sex. Criterion-referenced standards provide a means of evaluating performance in relation to a particular reference point or goal of interest, such as having the fitness level needed to climb stairs or to remain functionally independent. Although both types of standards provide important comparison information, criterion standards are especially helpful in identifying people at risk for mobility problems. **For example,** if an older adult is unable to complete eight chair stands in 30 seconds without using his or her hands, studies have shown that he or she may be at risk for loss of functional mobility.

2.2. ASSESSMENT APPROACHES

The terms formative and summative are frequently used in discussions of educational assessments. Actually, the concepts of formative and summative assessment when first developed had little to do with classroom assessment or even with learning.

The distinction between formative and summative assessment was first popularised by **Michael Scriven** in 1967 as part of an American Educational Research Association monograph series on evaluation. Scriven's original point was that a distinction should be made between programmes that are being formulated *versus* programmes that have evolved to their final state. Consequently, evaluation takes on different characteristics and is interpreted differently in formative *versus* summative situations. This distinction was soon applied to the assessment of students. Specifically, formative assessment was defined as occurring while knowledge is being learned. Summative assessment was defined as occurring at the end of a learning episode, e.g., at the end of a course.

Summative assessments are commonly contrasted with formative assessments, which collect detailed information that educators can use to improve instruction and student learning while it is happening. In other words, formative assessments are often said to be for learning, while summative assessments are of learning.

2.2.1. Formative Assessment

Since the introduction of the concept, formative assessment has evolved in its meaning and it has spawned substantial interest and research. Formative assessment refers to the collaborative processes engaged in by educators and students for the purpose of understanding the students' learning and conceptual organisation, identification of strengths, diagnosis of weaknesses, areas for improvement, and as a source of information that teachers can use in instructional planning and students can use in deepening their understandings and improving their achievement. The possible formats of formative assessments are correspondingly broad. Formative assessment information can be gleaned from information-gathering activities such as traditional classroom tests, but also from observations, oral questioning, class discussions, projects portfolios homework, performance assessments, group work with peer feedback, student self-assessment, and other sources.

According to Black and William, "Assessment refers to all those activities undertaken by teachers, and by the students in assessing feedback to modify themselves. Such assessment becomes 'formative assessment', when the evidence is actually used to adapt the teaching to meet their goals".

According to Garrison and Ehringhaus, "Formative assessment is part of the instructional process which informs both teachers and students of student understanding at a point when timely adjustments can be made."

Formative assessment refers to assessment that is specifically intended to generate feedback to improve and accelerate student learning. The principles of formative assessment may be applied at the school and policy levels, to identify areas for improvement and to promote effective and constructive cultures of evaluation throughout education systems. More consistent use of formative assessment throughout education systems may help stakeholders to address the barriers to its wider practice in classrooms.

For example, A teacher asks students in his 6th grade social studies class to form pairs to generate three strategic questions that will help them better meet their learning target of describing how erosion has produced physical patterns on the Earth's surface that have affected human activities.

2.2.1.1. Features of Formative Assessment

There are many features of formative assessment as given below:

1) **Student Focused:** Formative assessment is purposefully directed toward the student. It does not emphasise how teachers deliver information but, rather, how students receive that information, how well they understand it, and how they can apply it. With formative assessment, teachers gather information about their students' progress and learning needs and use this information to make instructional adjustments. They also show students how to accurately and honestly use self-assessments to improve their own learning. Instructional flexibility and student-focused feedback work together to build confident and motivated learners.

2) **Instructionally Informative:** During instruction, teachers assess student understanding and progress toward standards mastery in order to evaluate the effectiveness of their instructional design. Both teachers and students, individually and together, review and reflect on assessment outcomes. As teachers gather information from formative assessment, they adjust their instruction to further student learning.

3) **Outcomes Based:** Formative assessment focuses on achieving goals rather than determining if a goal was or was not met, and one of the ways it does so is by helping to clarify learning goals and standards for both teachers and students. Teaching and learning are based on these standards. Students know the criteria for meeting the standards and are frequently shown exemplars. Teachers give frequent and substantive feedback to students about their progress, pointing out both strengths and areas that need improvement. Teachers plan steps to move students closer to learning goals. Work is assessed primarily on quality in relation to standards rather than student attitude or effort.

4) **Affects Teacher Quality:** Teacher quality exerts greater influence on student's achievement than any other factor in education – no other factor even comes close. Formative assessment affects teacher quality because it operates at the core of effective teaching. Engaged in the formative assessment process, teachers learn about effective teaching by studying the effectiveness of their own instructional decisions. This practice promotes professional learning that is relevant, authentic, and transformational.

5) **Others Features:** Some other features of formative assessment are as follows:
   i) Requires students to take responsibility for their own learning.
   ii) Communicates clear, specific learning goals.
   iii) Focuses on goals that represent valuable educational outcomes with applicability beyond the learning context.
   iv) Identifies the student's current knowledge/skills and the necessary steps for reaching the desired goals.
   v) Requires development of plans for attaining the desired goals.
   vi) Encourages students to self-monitor progress toward the learning goals.
   vii) Provides examples of learning goals including, when relevant, the specific grading criteria or rubrics that will be used to evaluate the student's work.
   viii) Provides frequent assessment, including peer and student self-assessment and assessment embedded within learning activities.
   ix) Includes feedback that is non-evaluative, specific, and timely, related to the learning goals, and provides opportunities for the student to revise and improve work products and deepen understandings.
   x) Promotes metacognition and reflection by students on their work.

2.2.1.2. Objectives of Formative Assessment

Formative assessment has the following objectives:

1) **To Provide Timely Feedback to Students:** To provide timely feedback to students, which they can integrate into their learning process. Several studies indicate that feedback is most effective when it is timely, is tied to criteria regarding expectations, and includes specific suggestions for how to improve future performance and meet learning goals.

2) **To Help Students to Feel Safe to take Risks and make Mistakes:** To help students to feel safe to take risks and make mistakes in the classroom. Students are thus more likely to reveal what they do and do not understand and are able to learn more effectively.

3) **To Diagnose Student Learning Needs and Differentiate Teaching Accordingly:** In order to develop an appropriate teaching intervention, teachers need to assess students' learning needs and explore a range of potential causes of learning difficulties.

4) **To Actively Engage Student in their own Learning Processes:** To actively engage student in their own learning processes so as to develop higher-order thinking skills and skills for "learning to learn", and to allow students and teachers to engage in conscious reflection on the learning process.

2.2.1.3. Formative Assessment Procedures for Formal Teaching-Learning Context

Formative assessment can be formal or informal. Formal assessment is one in which planned act designed to provide evidence about student's learning. Informal assessment is that where evidence of learning is generated in the course of a teacher's day-to-day activities.

Formal formative assessment focuses on obtaining information from the whole class. It usually starts with students doing/carrying out an activity designed or selected by the teacher so that information may be more precisely collected (gathering). The activity enables teachers to step back at key points during instruction, check student understanding (interpreting), and reflect on the next steps they must take to move forward their students' learning (acting).

Commonly, formal formative assessment practices come in the form of curriculum embedded assessments that focus on some specific aspect of learning (e.g., students' knowledge about why objects sink or float), but it can also take the form of direct questioning, quizzes, brainstorming, generation of questions, and the like. Teachers plan in advance the implementation of this type of assessment and it can take place at the beginning, during, or end of a unit.

Different formative assessment techniques suitable for formal teaching-learning context are as follows:

1) **Standardised Tests:** These are assessments in which the questions, instructions, scoring, and the way the test are administered are done in exactly the same way across individuals. Standardised tests are primarily used as a means to compare a student's knowledge and skills in a particular area to those of other students. Examples of standardised tests includes comprehensive test of basic skills.

2) **Programme Tests:** These are the test which are also known as teacher made tests. These are used to measure how well a student is able to understand and remember specific content. Example of programme test includes class projects, class presentations, quizzes and tests.

3) **Essay Tests:** This is a test that requires the student to structure a rather long written response upto several paragraphs. In essay type of test few questions are given and the students are expected to answer in detail. An attempt is made to judge the students' abilities of expression, creativity, style of writing, language in use, coherence and cohesion, etc.

2.2.1.4. Formative Assessment Procedures for Non-Formal Teaching-Learning Context

Informal or non-formal formative assessment can take place in any student-teacher interaction. It has the potential to occur at any time and can involve whole class, small group or one-on-one interactions. It can arise out of any instructional/learning activity at hand (gathering), and it is 'embedded and strongly linked to learning and teaching activities'.

Different formative assessment techniques suitable for non-formal teaching-learning context are as follows:

1) **Written Reflections:** Sometimes referred to as "Minute Papers" or "Muddiest Points", these popular assessment techniques have students reflect immediately following a learning opportunity (e.g., at the end of a class or after completing an out-of-class activity) to answer one or two basic questions like:
   i) "What was the most important thing you learned today?"

ii) "What was the most confusing topic today?"
iii) "Which important question remains unanswered?"

2) **Polls/Surveys:** Data on student opinions, attitudes, behaviours or confidence in understanding can be gathered either during class (e.g., with a classroom response system) or outside of class. This can illustrate student engagement with the material as well as prior knowledge, misconceptions, and comprehension.

3) **Checks for Understanding:** Pausing every few minutes to see whether students are following alongwith the lesson not only identifies gaps in comprehension, but helps break up lectures (e.g., with Clicker questions) or online lessons (e.g., with embedded quiz questions) into more digestible bites.

4) **Wrappers:** "Wrapping" activities, using a set of reflective questions, can help students develop skills to monitor their own learning and adapt as necessary.

5) **Observations:** Observing students can provide valuable information about how students are progressing and what strategies they are using to learn. Recording information can take several different forms. A teacher can use sticky notes to jot down the observations. At the end of the day, these sticky notes can be easily filed into individual students file folders or binders. Using a grid that contains all the names of the students in the class is another useful collection device. As the teacher observes different students, he/she can jot down information in their box on the grid. The grid allows the teacher to see, at a glance, the names of the students who have not been observed.

2.2.1.5. Benefits of Formative Assessment

There are following benefits of formative assessment as given below:

1) **Flexibility:** Summative assessments are typically given at one time and one time only – at the end of the instruction. Formative assessments can be given whenever the teacher needs to get a gauge on student learning.

2) **Promoting High-Performance – Raising Levels of Student Achievement:** Formative assessment methods have been important to raising overall levels of student achievement. Quantitative and qualitative research on formative assessment has shown that it is perhaps one of the most important interventions for promoting high-performance ever studied.

3) **Building Students' Skills for Learning to Learn:** Formative assessment builds students' "learning to learn" skills by:
   i) Placing emphasis on the process of teaching and learning, and actively involving students in that process.
   ii) Building students' skills for peer and self-assessment.
   iii) Helping students understand their own learning, and develop appropriate strategies for "learning to learn".

4) **Improvements in the Quality of Teaching:** Teacher across several of the case study schools believe that their own teaching has improved as they have developed their ability to scaffold learning goals for students and to adapt instruction to meet students learning needs. They pay closer attention to teaching approaches that work well and put them into practice more often.

5) **Stronger Relationship with Students and Increased Contact with Parents:** In several of the case study schools, parents commented that they appreciated getting more specific feedback on what their children were learning, and teachers' suggestions as to how they can better support their learning. In one case study school, students commented that instead of just getting grades, they felt they were involved in a process with their teachers.

6) **Different and Better Work Products from Students:** Students across the case study schools are taking more responsibility for their learning, and taking more pride in work.

7) **Greater Student's Engagement:** Students in the case study schools are making more connections between what they are learning in class and what is happening in their lives outside of school.

2.2.1.6. Drawbacks of Formative Assessment

There are following drawbacks of formative assessment as given below:

1) **Variation in Results:** Formative assessment results can vary widely between pupils, and so there is the risk that data may be subjective or less accurate than that from summative assessment.

2) **Lesser Involvement of Students:** Formative assessment may have the less involvement of students as a summative assessment, and students may not take the assessments seriously, which may cause teachers to misread feedback from students.

3) **Purpose:** The biggest challenge ahead for implementing formative assessment in the classroom is identification of and adherence to a clear, focused purpose for the assessments. The power of formative assessments lies in their non-evaluative nature, their focus on providing timely, specific, corrective feedback, and on actively engaging the learner in valuable educational experience. The efficacy of formative assessments will be compromised if they devolve into mere quizzes or assignments.

4) **Resources:** Development of relevant and rich formative assessments requires a substantial investment in teacher time for development, administration, and feedback on the assessments. Depending on the activity, the implementation of a formative assessment may require additional costs for supplies, space or other tangible items. Thus, a second challenge facing formative assessment at the classroom level involves the commitment of resources to support professional development, time for planning, administration and feedback, and support for additional materials as needed to implement an effective assessment programme.

5) **Validity:** It refers to the degree to which evidence supports the interpretations or inferences that are intended to be drawn from assessment information. Many sources of invalidity threaten the confidence that can be placed in an intended inference. One threat to validity seems particularly powerful and under researched in the classroom assessment context. Bias (or

differential functioning of items or tasks) has been thoroughly researched in large-scale summative testing programmes, but the area has received little attention in any formative assessment contexts. **For example,** optical scanners used in large-scale assessments make the scoring of bubble sheets highly objective, but the influences of human preferences, prejudices, and personalities are unavoidable in more subjective classroom contexts.

6) **Time:** A key to successful implementation of formative assessment will be the development of high quality assessment events, the purposeful integration of formative assessment into classroom activities and the iterative use of formative assessment results to inform the next instructional steps for teachers and refinement of learning goals for students. Each of these requires a considerable investment in time to plan and conduct the activity time that is currently allocated to different purposes in many classrooms. Assuming a constant school day, a major challenge for implementing and sustaining formative assessment will be the reallocation of time and effort to support instructional planning, modified instructional practices and individualisation of instruction on the part of teachers and students.

2.2.2. Summative Assessment

Summative assessment is usually conducted at the end of a learning programme. It is the final measurement of what was learnt. Summative assessments should include formative assessment evaluations and a final overall assessment of whether learners have achieved the learning outcomes for the programme. Summative assessments often include projects and performance tasks conducted in a real-life context after attending a practical learning programme.

Summative assessments are used to evaluate student learning, skill acquisition, and academic achievement at the conclusion of a defined instructional period – typically at the end of a project, unit, course, semester, programme, or school year.

These assessments are given periodically to determine at a particular point in time what students know and do not know.

Summative assessment is measuring the outcome of an educational programme for the students who participated in that programme, i.e., what skills and knowledge, relevant to the programme, do they have at the conclusion of the programme. Summative assessment is typically used for credentialing (awarding of qualifications), selection (e.g., for jobs or university places), or as accountability measures for educational providers.

The goal of summative assessment is to evaluate student learning at the end of an instructional unit by comparing it against standards and/or benchmarks. Examples of summative assessments include:

1) A mid-term exam or end-of-course exam,
2) A final project, and
3) A presentation or report.

2.2.2.1. Features of Summative Assessment

There are following features of summative assessment as given below:

1) **Summative Assessments "Weigh" on both the Teacher and the Student:** The first and most important characteristic to keep in mind with summative assessments is that they are weighted. Although all assessments require grading in order to evaluate students, weighted assessments are evaluations that the teacher keeps on permanent record, and therefore uses to ultimately determine a student's final grade in a course.

2) **Placement of Summative Assessments:** Furthermore, the second characteristic of summative assessments is that they must only be scheduled at the end of whatever sub-section or unit that teacher schedule into their course, including course-end. There should be no time where a summative assessment occurs in the middle of a unit, sub section of course content, or any other obvious break between course materials.

3) **Comprehensive:** The third characteristic of summative assessment is the comprehensiveness. It is with this concept in mind that teachers realise why they need to design these assessments to be comprehensive in nature. Since teacher want to use these assessments to determine whether or not their students have mastered the material they have just taught, teachers will want to ensure that these evaluations cover all of the different lessons, teaching points, and information that have been taught in the course upto that point.

4) **Rigid in Nature:** Summative assessment is rigid in nature as it is an unchanging measure of what the student achieved.

5) **Teachers Directed:** In summative assessment teachers assign what the students must do and then evaluate how well they complete the assignment.

2.2.2.2. Objectives of Summative Assessment

The objectives of summative assessment are as follows:

1) **To Motivate Students:** To motivate students to increase effort and achievement. The marks, transcripts or diplomas connected to summative assessment are often conceived as rewards for having performed successfully on an assessment.

2) **To Provide Information:** To provide information about student performance to a range of different stakeholders, such as the students themselves, their parents, other within the school, or school-external players such as employers.

3) **To Select or Group Students:** To select or group students according to their achievement levels. In many countries, assessment results are used to stream students according to their ability levels within schools, or to select them into certain types of schools.

4) **To Certify Learning and Award Qualifications:** To certify learning and award qualifications that grant students access to higher education institutions or certain professions.

2.2.2.3. Summative Assessment Procedures for Formal Teaching-Learning Context

Summative assessments, such as exams, are used to evaluate learning as well as serve as comparisons for standards, like class averages. They are used to determine what the students know and what they do not know. They can help to determine the effectiveness of teaching. Summative assessments are given periodically to determine at a particular point in time what students know and do not know. Summative assessment procedures in a formal setting are as follows:

1) **Written Tests:** They are typically used as a summative assessment technique in all school curricula. This is appropriate in the physical education arena as well. Indeed, the formal, summative written test is still one of the best ways for teachers to assess student understanding of cognitive concepts and general knowledge. Unfortunately, traditional written physical education tests are problematic. True-false, multiple choice, matching, and short-answer formats are typically used, which often necessitates limiting the testing topics to game or activity rules, procedures, history, and etiquette.

2) **End of Unit Tests or Projects:** When assessments reflect the stated learning objectives, a well-designed end of unit test provides teachers with information about individual students (identifying any student who failed to meet objectives), as well as provides an overall indication of classroom instruction.

3) **Course Grades:** If end of course grades are based on specified criteria, course grades provide information on how well a student has met the overall expectations for a particular course.

4) **Standardised Assessments:** Tests that accurately reflect state performance and content standards provide an indication of how many students are achieving to established grade-level expectations.

5) **Performance Assessments:** Any activity undertaken by a student provides an opportunity for an assessment of the student's performance. Performance assessment often implies a more formal assessment of a student as he or she engages in a performance-based activity or task. Students are often provided with apparatus and are expected to design and conduct an investigation and communicate findings during a specified period of time. Because of the numerous opportunities to observe students at work and examine their products, performance assessments can be closely aligned with curriculum and pedagogy.

6) **Exams:** This includes mid-term exams, final exams, and tests at the end of course units. The best tests include several types of questions – short answer, multiple-choice, true-false, and short essay – to allow students to fully demonstrate what they know.

7) **Papers, Projects, and Presentations:** These give students the chance to go deeper with the material to put the knowledge they have acquired to use or create something new from it. This level of application is an extremely important and often overlooked part of the learning process. These types of projects also give students who do not test well a chance to shine.

2.2.2.4. Summative Assessment Procedures for Non-Formal Teaching-Learning Context

Summative assessment techniques evaluate student learning. These are high-stakes assessments (i.e., they have high point values) that occur at the end of an instructional unit or course and measure the extent to which students have achieved the desired learning outcomes. Summative assessment could also be formal or informal; the type of training should determine what the best of course of action is. However, it is believed that all training should have some form of summative assessment, without it how can a student be sure that learning has actually occurred? The various summative assessment procedures for non-formal teaching-learning is as follows:

1) **Portfolios:** When used as part of an evaluation of student learning, portfolios provide evidence to support attainment of stated learning objectives. **Duschland Gitomer** have conducted classroom-based research on portfolios as an assessment tool to document progress and achievement and to contribute to a supportive learning environment. They found that many aspects of the portfolio and the portfolio process provided assessment opportunities that contributed to improved work through feedback, conversations about content and quality, and other assessment-relevant discussions. The collection also can serve to demonstrate progress and inform and support summative evaluations. The researchers document the challenges as well as the successes of building a learning environment around portfolio assessment. Researchers suggest that the following elements be included in any portfolio system:
   i) Collection of student work that demonstrates what students have learned and understand,
   ii) An extended timeframe to allow progress and effort to be captured,
   iii) Structure or organising principles to help organise as well as interpret and analyse, and
   iv) Student involvement in not only the selection of the materials but also in the reflection and assessment.

2) **Observations:** It is useful as both an informal assessment during instruction as well as a summative tool. Instructors might watch students use a database or listen to a small group discussion about evaluation techniques. As an informal assessment, observations might include informal questions to check student understanding or stimulate conversations. They may also include self-reflection activities to help the instructor in providing additional materials or useful feedback. **Radcliff** and others suggest the following tips for making information observations:
   i) Be comfortable and familiar with what is being observed,
   ii) Identify what to observe,
   iii) Limit how much to observe, and
   iv) Record key observations in key situations.

3) **Peer Review:** It is a documented, critical judgement by students of peer work. **For example,** oral feedback or written notes.

4) **Reflective Journal:** It is an evaluation of student's own learning that includes critical, analytic reflection. **For example,** personalised account of a topic, experience or event critical analysis of experience/activity.

2.2.2.5. Benefits of Summative Assessment

There are following benefits of summative assessment as given below:

1) **Creation of Proper Learning Environment:** As learners will need to be aware of summative assessment from the starting, therefore summative assessment provides motivation and helps to create an appropriate learning environment.

2) **Confidence Booster:** Positive results give the trainees a boost in confidence and can act as a springboard into subsequent behaviour change back in the workplace.

3) **Helpful in Identifying Weaker Areas:** Trainers can identify those areas where results are consistently lower and can then consider alternative delivery methods helping to develop the training for future events.

4) **Evaluative rather than Diagnostic:** Summative assessment is generally evaluative, rather than diagnostic, i.e., they are more appropriately used to determine learning progress and achievements.

5) **Helpful in Determining Degree of Learning:** Summative assessment is used to determine whether and to what degree students have learned the lesson, they have been taught.

2.2.2.6. Drawbacks of Summative Assessment

Summative assessment has some drawbacks too, which are:

1) **Biasness:** Summative assessments with limited means of expression, particularly large-scale standardised tests that use multiple choices for automated grading, may unfairly disadvantage large classes of students, including non-native speakers with language or cultural barriers to understanding the questions asked, those with physical or learning disabilities, or those who do not do well under the pressure of the testing conditions.

2) **Unauthentic:** Summative assessment may measure the wrong things. The ways in which students are assessed do not provide accurate information about how they are doing. Questions are asked in ways that students do not understand or have difficulty in answering. Neither of these get at whether the student really knows the material that was taught.

3) **Reliability and Validity Errors:** To be free of distortion, an assessment must be constructed so that it accurately reflects the whole of the material it is intended to cover, including the way the material has been taught. There also needs to be consistency across tasks and how they are marked, both internally

within the assessment and externally across different versions. Reliability and validity errors call into question the point of the summative assessment, which is to accurately measure student performance.

4) **Curriculum Distortion:** External summative assessments of students used to judge teacher and school performance can negatively impact what occurs in the classroom.

5) **Unable to Rectify Problems:** Summative assessments do nothing to identify and remedy instructional problems before they become critical.

6) **Making Students Anxious and Disruptive:** Summative assessments having the big tests make students anxious and disruptive to school life.

2.2.3. Distinction between Assessment for Learning and Assessment of Learning

The term 'assessment' refers to all those activities undertaken by teachers, and by their students in assessing themselves, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged.

In assessment the two most usually used terms are Assessment for Learning and Assessment of Learning; both these terms are different to each other:

1) **Assessment for Learning:** It is the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there. Assessment for learning is best described as a process by which assessment information is used by teachers to adjust their teaching strategies, and by students to adjust their learning strategies. Assessment, teaching, and learning are inextricably linked, as each informs the others. Assessment is a powerful process that can either optimise or inhibit learning, depending on how it's applied.

   In classrooms where assessment for learning is practiced, students know at the outset of a unit of study what they are expected to learn. At the beginning of the unit, the teacher will work with the student to understand what she or he already knows about the topic as well as to identify any gaps or misconceptions. As the unit progresses, the teacher and student work together to assess the student's knowledge, what she or he needs to learn to improve and extend this knowledge, and how the student can best get to that point (formative assessment). Assessment for learning occurs at all stages of the learning process.

   Assessment for Learning comprises two phases — initial or diagnostic assessment and formative assessment. Assessment can be based on a variety of information sources (e.g., portfolios, works in progress, teacher observation, and conversation). It gives verbal or written feedback to the student. It is primarily descriptive and emphasises strengths, identifies challenges.

2) **Assessment of Learning**: It involves looking at assessment information at the end of the teaching and learning process to rank students' achievement levels against a standard. It is summative in nature and typically involves standardized tests. Assessment of learning scores is often used to rate teachers' or schools' ability to move student achievement based on the results of single, point-in-time tests. Activities associated with summative assessment (Assessment of Learning) result in an evaluation of student achievement. **For example,** allocation to a level or standard or allocation of a letter or numerical grade, this might later appear in a report.

Difference between Assessment for Learning and Assessment of Learning

Assessment for learning and Assessment of learning both can differ on the basis of following grounds:

Table 2.1: Difference between Assessment for Learning and Assessment of Learning

Basis of Differences	Assessment for Learning	Assessment of Learning
Aim	Assessment for learning is **'formative'**, aiming to support and advance students in their learning.	Assessment of learning is **'summative'**, i.e. its main purpose is to grade and certify students' achievement.
Involvement	Assessment for learning embeds assessment processes throughout the teaching and learning process to constantly adjust instructional strategy. While it can include test data, it also addresses other quantitative and even qualitative data, and even encompasses a great deal of anecdotal and descriptive data.	Assessment of learning involves looking at assessment information at the end of the teaching and learning process to rank students' achievement levels against a standard. It is summative in nature and typically involves standardised tests. Assessments of learning scores are often used to rate teachers' or schools' ability to move student achievement based on the results of single, point-in-time tests.
Function	Some assessments for Learning (formative), whose primary function is for support/feedback can have some low weighted grades, such as grades for engaging and participating in this activity.	Some Assessment of Learning (summative) whose primary function is for grade and certification may also have a feedback component to it, **for example,** a mid-semester essay.
Activities	Activities associated with Assessment for Learning do not result in an evaluation. Information about what a student knows, understands and is able to do is used by both the teacher and the learner to determine where learners are in their learning and how to achieve learning goals.	Activities associated with Assessment of Learning result in an evaluation of student achievement – for example, allocation to a level or standard or allocation of a letter or numerical grade, which might later appear in a report.
Decision	Assessment for learning is to determine the goals for future programme.	Assessment of learning is what the person has learnt until this moment.

2.2.4. Quantitative Assessment

Quantitative tool is the method by which data are collected and can be analysed, i.e. numbers, statistical analysis. Quantitative tools are those that express their results in numbers. They tend to answer questions like "How many?" or "How much?" or "How often?" When they are used to compare things – the results of community programmes, the effects of an economic development effort, or attitudes about a community issue – they do it by subjecting all of the things or people they are comparing to exactly the same tests or to the same questions whose answers can be translated into numbers. Quantitative measures are often demanded by policy makers; they are considered trustworthy because their results can be measured against one another, and because they leave less room for bias. **Examples** of quantitative tools are survey, existing data, rubric, etc.

Quantitative tools and techniques are used for assessing learning outcomes at ordinal, interval as well as ratio levels. Under this, quantitative changes in the behaviour of a child are measured and explained. All the modes related to traditional testing and examination are applied in this assessment. Mainly it is used to measure the knowledge and skill-development related achievements of a child.

For this purpose, following assessment tools are used:

1) **Tests:** It is an assessment intended to measure a test-taker's knowledge, skill, aptitude, physical fitness, or classification in many other topics. A test may be administered verbally, on paper, on a computer, or in a confined area that requires a test taker to physically perform a set of skills. Tests vary in style, rigour and requirements. A good test should have a positive effect on learning and teaching, which result in improved learning habits. Such a test will aim at locating the specific and precise areas of difficulties experienced by the class or the individual student so that assistance in the form of additional practice and corrective exercises can be given.

2) **Surveys:** It means a planned effort to collect the desired information from a representative sample of the relevant population generally known as respondents. It can also be defined as systematic gathering of data from respondents through questionnaires. Here the observations are directly gathered from the students. The administration of a questionnaire to an student or group of students is called interview.

   Surveys represent one of the most common types of quantitative, social science research. In survey research, the educator selects a sample of students from a classroom and administers a standardised questionnaire to them. The questionnaire, or survey, can be a written document that is completed by the student being surveyed, an online questionnaire, a face-to-face interview, or a telephone interview. Using surveys, it is possible to collect data from large or small classrooms. The commonly used methods of survey are as follows:

   i) Mail survey,
   ii) Telephone survey,
   iii) Personal interview survey,

iv) E-mail survey,
v) Social media survey, and
vi) Online survey.

3) **Questionnaire:** For evaluating social aspects of one's personality like sociability, self-exposition, etc., questionnaire is widely used in psychology. There is a series of selected questions, the answers to which give an insight into an individual's personality. These questions have two or three alternatives like 'yes', 'no' and '?'. The examinee marks (✓) on the correct word and (×) on the wrong word. From the questionnaire, different attributes of personality like self-confidence, sociability, introversion, extroversion, dominance, subservience, etc., become apparent.

4) **Checklists:** It contain a list of behaviours or specific steps, which can be marked as Present/Absent, Complete/Incomplete, Yes /No, etc. In some cases, a teacher will use a checklist to observe the students. In other cases, students use checklists to ensure that they have completed all of the steps and considered all of the possibilities. Checklists help to provide structure for students and they are great tools to use when teacher wants to note the completion of a task, but do not need to assign a rating scale. Checklists can be created in word processors, spreadsheets, or by using online tools.

   Checklists can be used for on-going assessment to monitor students' behaviour and progress towards reaching stated goals. Checklists only indicate if a student can accomplish the listed objectives. Nothing is included about the quality of performance.

2.2.4.1. Advantages of Quantitative Assessment Tool

The advantages of quantitative approach are as follows:

1) Standardised approaches permit the study to be replicated in different areas or over time with the production of comparable findings.
2) It is possible to control for the effects of extraneous variables that might result in misleading interpretations of causality (although this can be challenging in the natural settings of evaluations).
3) Many large datasets already exist that can be analysed.

2.2.4.2. Disadvantages of Quantitative Assessment Tool

It has some disadvantages too:

1) Data collection methods provide respondents with a limited number of response options.
2) Requires some expertise with statistical analysis.
3) Many kinds of information are difficult to obtain through structured data collection instruments, particularly on sensitive topics such as domestic violence or income.

2.2.5. Qualitative Assessment Tool

Qualitative tool is the method by which data are collected. This method does not lend itself to quantitative methods but rather to interpretive criteria.

Qualitative assessment may be defined as "a situated activity that locates the observer in the world consists of a set of interpretive material practices that make the world visible."

Qualitative tools do not yield numerical results in themselves like "How many?" or "How much?" or "How often?" It looks at questions that concern why and/or how. Qualitative tools produce data with more depth and description.

They may involve asking people for "essay" answers about often-complex issues, or observing interactions in complex situations. When you ask a lot of people for their reactions to or explanations of a community issue, you are likely to get a lot of different answers. When you observe a complex situation, you may see a number of different aspects of it, and a number of ways in which it could be interpreted. Researchers and policymakers sometimes see qualitative methods as less accurate and less legitimate than quantitative ones. That can be true, but, as we will see, if qualitative methods are used with care, they can also yield reliable information.

Examples of qualitative methods are focus group/interview, portfolio, rubric (if descriptive), visual methods, one-minute assessment, open-ended survey question, observation, document analysis, case study etc.

Qualitative tools and techniques are used for assessing learning outcomes at nominal level. At this level qualitative changes in the behaviour of child such as, interest, hobby, aptitude, habit and personality can be measured by the use of below given assessment tools:

1) **Observation Method:** Observation is an activity of a person which senses and assimilates the knowledge of the phenomenon or the recording of data using instrument. It can also be referred as datum collected during this activity. The observation method is the most commonly used method especially in studies relating to behavioural sciences. In a way we all observe things around us, but this sort of observation is not scientific observation. Observation becomes a scientific tool and the method of data collection for the educator, when it serves a formulated research purpose.

2) **Interview Method:** Interview refers to an exchange of ideas among a group of two or more than two people, where the interviewers ask the questions to interviewees in order to extract the requisite data from them. The process of interview consists of acquiring information by putting forward various verbal stimuli and getting the responses in verbal forms. The interview can be carried-out through various methods, as per the conveniences.

3) **Documentation:** The process, under which measurement, evaluation and all the exam-related activities are recorded thereby secured, is known as documentation. It helps in providing desired documents to respective

individuals (students, guardians and authorities) when it is required. Documentation is the basis for planning future course of action. It is an essential component of each planning system and work methodology. It can be used as an evidence for providing important information regarding any plan or a person. All the student-related information can be easily availed through such documents. In the evaluation process documentation is like that foundation stone on which the structure of a student's overall development is established. This is so because only documentation can be used for predicting his/her current and future achievements.

4) **Focus Group:** For the first time focus group method was used by a social worker named **Robert K. Mertor** at Bureau of Applied Social Research, U.S.A. in 1976. Focus group was mainly used in psychology and market areas. Focus groups are a method of group interviewing in which the interaction between the moderator and the group, as well as the interaction between group members, serves to elicit information and insights in response to carefully designed questions. The dynamic nature of the questions asked by the moderator and the group process produces a level of insight that is rarely derived from 'unidirectional' information collection devices such as observation, surveys and less interactional interview techniques.

   Methods of recording and analysing information gathered during focus groups, and strategies for collecting unbiased information have helped focus group research to gain credibility as an accurate and useful source of information collection.

5) **Photography:** This procedure was first used by **Nicephore Miepce**. Photography comes under the type of image formation and for this type of image formation CCD or CMOS chips are used but mainly in all photographs there is a camera used. The word photography is taken from greek words '*phos*' and '*graphe*' where *phos* means light and *graphe* means drawing. In photography, pictures taken from photograph can be inspected with a relaxed mind. In these pictures intense inspection of even very minute object is done and information is collected related to that object.

6) **Recording:** There must be the recording of information received from interviews because only on that basis analysis and conclusion can be achieved. More pure the recording, more pure the results will be. Recording done by tape recorder is the best method. If it is not possible then secured questionnaire or checklist are to be used or the answers can be written in symbols, sentences or words. Sometimes important words and sentences can be written depending upon understandings.

7) **E-Mail:** It (electronic mail or simply called mail) is a process of sending messages (includes text, images, etc.) electronically over the Internet. This method enables a group or an individual to communicate over Internet. In this method, a sender can send a mail to one or more recipients. A telephone line and high speed modem is used to transmit the messages. The received messages are stored in user's mail box and it can be modified, sorted, classified and forwarded to someone else.

2.2.5.1. Advantages of Qualitative Assessment Tool

The advantages of qualitative assessment tool approach are as follows:

1) Qualitative inquiry allows us to ask different types of questions that surveys alone might not be appropriate for.
2) Important to remember that this data is just as good as quantitative data, it is just another kind of information.
3) An accessible introduction to this type of research might allow for expanding the thinking to more deeply explore student needs.
4) Use of open-ended questions provides opportunity to explore and question answers and increases participants' ability to respond.
5) Creates rapport with participants and improves access to information.

2.2.5.2. Disadvantages of Qualitative Assessment Tool

Qualitative assessment tool has some disadvantages too:

1) Requires skills and experience to undertake.
2) Generalisation of findings to large population groups is not possible without quantitative approaches (should be done with caution).
3) Results could be questioned as being subjective (need cross-checking).

2.3. TOOLS OF EVALUATION

Evaluation is a very important part of any educational programme, and it helps in assessment of the concepts learnt by students in classrooms. Evaluation is a tool without which teachers cannot work as periodic evaluation or assessment of abilities by students help teachers to take stock of their teaching methodology. The various tools that are used in evaluation are described below:

2.3.1. Observation

Observation would seem to be an obvious method of carrying out research in psychology. However, there are different types of observational methods.

According to Oxford Concise Dictionary, observation means "accurate watching, noting the phenomenon by which they occur in the nature with regard to the cause and effect of mutual relations."

There are two different types of observation. The first involves viewing the subject of interest in a laboratory setting. The benefit of this is that the situation can be controlled by the experimental. The drawbacks of lab observation are that the setting can be unnatural and the subject is aware that they are being studied. Both of these factors can have an impact on results of the study.

Naturalistic observation allows researchers to observe participants in real-world settings. The strength of this method is that it allows researchers to view behaviour as it really happens in a natural setting. The drawback is that the researcher cannot control outside variables that might impact behaviour.

2.3.1.1. Types of Observations

Following are the main types of Observations:

1) **Casual and Scientific Observation:** An observation can be sometimes casual in nature or sometimes it may act scientifically. An observation with a casual approach involves observing the right thing at the right place and also at the right time by a matter of chance or by luck whereas a scientific observation involves the use of the tools of the measurement, but a very important point to be kept in mind here is that all the observations are not scientific in nature.

2) **Natural Observation:** It involves observing the behaviour in a normal setting and in this type of observation; no efforts are made to bring any type of change in the behaviour of the observed. Improvement in the collection of the information and improvement in the environment of making an observation can be done with the help of natural observations.

3) **Subjective and Objective Observation:** A" the observations consist of the two main components, the subject and the object. The subject refers to the observer whereas the object refers to the activity or any type of operation that is being observed. Subjective observation involves the observation of the one's own immediate experience whereas the observations involving observer as an entity apart from the thing being observed, are referred to as the objective observation. Objective observation is also called as the retrospection.

4) **Direct and Indirect Observation:** With the help of the direct method of observation, one comes to know how the observer is physically present, in which type of situation is he present and then this type of observation monitors what takes place. Indirect method of observation involves studies of mechanical recording or the recording by some of the other means like photographic or electronic. Direct observation is relatively more straight-forward as compared to the indirect observation.

5) **Participant and Non-Participant Observation:** Participation by the observers with the various types of operations of the group under study refers to the participant type of observation. In participant observation, the degree of the participation is largely affected by the nature of the study and it also depends on the type of the situation and also on its demands. But in the non-participant type of observation, no participation of the observer in the activities of the group takes place and also there occurs no relationship between the researcher and the group.

6) **Structured and Unstructured Observation:** Structured observation works according to a plan and involves specific information of the units that are to be observed and also about the information that is to be recorded. The operations that are to be observed and the various features that are to be noted or recorded are decided well in advance. Such observations involve the use of especial instruments for the purpose of data collection that are also structured in nature. But in the case of the unstructured observation, its basics are

diametrically against the structured observation. In such observation, observer has the freedom to note down what he or she feels is correct and relevant to the point of study and also this approach of observation is very suitable in the case of exploratory research.

7) **Controlled and Non-Controlled Observation:** Controlled observations are the observations made under the influence of some of the external forces and such observations rarely lead to improvement in the precision of the research results. But these observations can be very effective in the working if these are made to work in the coordination with mechanical synchronising devices, film recording, etc. Non-controlled observations are made in the natural environment and reverse to the controlled observation these observations involve no influence or guidance of any type of external force.

2.3.1.2. Benefits of Observation

It has various benefits:

1) It is a direct method for collecting data or information best for the study of human behaviour.
2) Data collected is very accurate in nature and also very reliable.
3) Improves precision of the research results.
4) Problem of depending on respondents is decreased.
5) Helps in understanding the verbal response more efficiently.
6) By using good and modern gadgets observations can be made continuously and also for a larger duration of time period.
7) Observation is less demanding in nature, which makes it less biased in working abilities.
8) By observation, one can identify a problem by making an in-depth analysis of the problems.

2.3.1.3. Limitations of Observation

It has some limitations too:

1) Problems of the past cannot be studied by means of observation.
2) Having no other option one has to depend on the documents available.
3) Observations like the controlled observations require some especial instruments or tools for effective working, which are very much costly.
4) One cannot study opinions by this means.
5) Attitudes cannot be studied with the help of observations.
6) Sampling cannot be brought into use.
7) Observation involves a lot of time as one has to wait for an event to happen to study that particular event.
8) The actual presence of the observer himself vis a vis the event to occur is almost unknown, which acts as a major disadvantage of observation.
9) Complete answer to any problem or any issue cannot be obtained by observation alone.

2.3.2. Interview

Interview methods typically involve face-to-face interaction between a researcher and a participant, with the researcher asking questions and the participant giving verbal answers. In child development studies, interview methods have been used with various types of participants, most notably children, parents, and teachers, to investigate many aspects of development, and to address a wide range of theoretical and applied issues. Generally, interview is defined by various authors in different ways.

According to Chaplin, "Interview is a face-to-face conversation for the purpose of obtaining factual information."

According to Goode and Hatt, "Interviewing is fundamentally a process of social interaction."

According to P.V. Young, "The interview may be regarded as a systematic method by which one person enters more or less imaginatively into the inner life of a comparative stranger."

According to Viteles, "Interview is a face-to-face conference between the interviewer and the interviewee."

According to Maccoby and Maccoby, "Interview refers to a face-to-face verbal interchange, which one person, the interviewer, attempts to elicit information or expression of opinion or belief from another person or persons."

According to Viteles, "Interview is a face-to-face conference between the interviewer and the interviewee."

Interview is a very significant method for assessment of learning outcomes. It can be a collaborative and organised communication between the educator and the student, which is usually done to acquire information related to a particular field of study. Not only the oral communication, but also the body language of the student, his facial expressions, gestures, pauses, and the settings play a crucial role in the interview method. The basic skill of interviewer in conducting an interview is also very important. The interview is generally carried-out with the help of a structured interview schedule or even through an unstructured manual.

2.3.2.1. Types of Interviews

There are many different types of interview approaches and techniques, Generally speaking, all interviews fall into one of three categories, namely, structured, semi-structured, and depth/unstructured interviews:

1) **Structured Interviews:** Structured interviews are most typically used in quantitative investigations, including survey research. In structured interviews, the interviewer presents the interviewee with a standardised set of questions, often in questionnaire form. These questions usually have pre-set answers from which the interviewee selects, rather than 'open-ended'

questions. Each individual interview features the same set of questions, asked in a fixed order. All questions included in the research design are asked in each interview session. Structured interview questions are the most common type used in surveying interviewing.

2) **Semi-Structured Interviews:** These interviews centre on a mixed framework of general themes and pre-established questions, which can be adapted in the context of individual sessions. The interviewers is thus free to leave certain questions out, mix the order of questions, or ask certain standard questions in different ways depending on context. Semi-structured interviews also rely on a combination of both open and closed questions.

3) **Unstructured Interviews:** These are also known as 'informal' or 'conversational' interviews – are wholly qualitative, and include only topic areas and themes rather than standard questions. Unstructured interviews take the form of natural conversation between two or more people, and allow the interviewer to pursue follow-up questions or new lines of discussion as they see fit. Closed questions are avoided, and the interviewee is often asked to identify the information they feel is most important for the discussion.

2.3.2.2. Reasons for Using Interviews

Interviews are a useful method to:

1) Investigate issues in an in-depth way,
2) Discover how individuals think and feel about a topic and why they hold certain opinions,
3) Investigate the use, effectiveness and usefulness of particular library collections and services,
4) Inform decision-making, strategic planning and resource allocation,
5) Sensitive topics which people may feel uncomfortable discussing in a focus group,
6) Add a human dimension to impersonal data, and
7) Deepen understanding and explain statistical data.

2.3.2.3. Advantages of Interviews

The main advantages of interviews are:

1) They are useful to obtain detailed information about personal feelings, perceptions and opinions,
2) They allow more detailed questions to be asked,
3) They usually achieve a high response rate,
4) Respondent's own words are recorded,
5) Ambiguities can be clarified and incomplete answers followed up,
6) Precise wording can be tailored to respondent and precise meaning of questions clarified (e.g., for students with English as a Second Language),
7) Interviewees are not influenced by others in the group,
8) Some interviewees may be less self-conscious in a one-to-one situation.

2.3.2.4. Disadvantages of Interviews

There are following disadvantages of interviews:

1) They can be very time-consuming – setting up interviewing, transcribing, analysing, feedback, reporting,
2) They can be costly, and
3) Different interviewers may understand and transcribe interviews in different ways.

2.3.3. Questionnaire

A questionnaire is essentially a structured technique for collecting primary data. It is generally a series of written questions for which the respondents has to provide the answers.

Questionnaire contains a series of questions designed to gather particular information. It is used in different fields like business, science, and social science. It is a research instrument having sequence of questions with a purpose to get information from respondents and extract desired statistical data.

According to Goode and Hatt, "Questionnaire is a device for securing answers to questions using a form which the respondents fill it."

According to Bogardus, "A questionnaire is a list of the questions sent to a number of persons to answer. It secures the standardised results that can be tabulated and also treated statistically."

According to Lundberg, "Fundamentally a questionnaire is a set of stimuli to which literate people are exposed in order to observe their verbal behaviour under those stimuli."

According to P.V. Young, "Questionnaire is a paper consists on questions with answers sent to the respondents through mail with a specified covering latter."

A questionnaire can serve as an inductive method with the aim to formulate new theory, where open-ended questions are used to 'explore a substantive area'. A questionnaire allows the researcher to adopt either an inductive or a deductive approach, or even a combination of these two.

Questionnaires can be classified as both, quantitative and qualitative method depending on the nature of questions. Specifically, answers obtained through closed-ended questions with multiple choice answer options are analysed using quantitative methods and they may involve pie-charts, bar-charts and percentages, whereas answers obtained to open-ended questionnaire questions are analysed using qualitative methods and they involve discussions and critical analyses without use of numbers and calculations.

2.3.3.1. Purpose of Questionnaires

The questionnaires possess three specific objectives, these are:

1) The information needed must be translated into a set of questions that can be answered by the respondents. Constructing the right type of questions that yields the desired information from the respondents is quite difficult. Thus, this objective is a challenge for the researcher.
2) It must be designed in such a manner that respondents are uplifted, encouraged and motivated to get involved in the interview and fill in the complete details. Since the incomplete questionnaire reduces the usefulness of the research. A researcher, while designing the questionnaire must strive to reduce respondent boredom, fatigue, non-response and incompleteness.
3) The questionnaire must strive to minimise the response error. The response error is an error arising out of wrong information given by the respondent or the answers being wrongly recorded or analysed.

Thus, the purpose of a questionnaire is to convert the information needed into a formalised set of questions and present these to one or more respondents to collect the desired responses and then finally interpret and analyse the data being collected.

2.3.3.2. Types of Questionnaire

Questionnaire comes in different types, such as:

1) **Structured Questionnaire:** It is one which has predetermined questions with answers. The respondents only tick the correct answers in short term "Yes" or "No". It is also called pre-coded, closed, restricted and categorical questionnaire. **For example,**
   i) Marital status?
      a) Married
      b) Unmarried
   ii) Gender status?
      a) Male
      b) Female
2) **Unstructured Questionnaire:** It is that in which pre-determined questions are given but have no answers. These answers are to be structured by the respondents. Open questions are given for the respondents to give answers. In such type of questionnaire, interview between researcher and respondents or face-to-face conversation takes place. Such type is also called open-ended, unrestricted, or noon-categorical questionnaire. **For example,**
   i) What do you mean by poverty?
   ii) What are the types of poverty?
   iii) What factors can influence poverty?
3) **Scaled Questionnaires:** The respondents are asked to scale the answers based on a given rating prescribed by the question. Depending on the type of format used in questionnaires, they are divided into the following:
   i) **Open-Ended Questions:** These are the type of questions that are used to allow the respondents to express their views in a free flowing manner. By using such questions, the respondents do not have to follow the criteria

for answering questions and he/she can truly express their beliefs and suggestions. An ideal questionnaire is a type of questionnaire that includes open ended questions and also has feedback and suggestions for future improvements. **For example,**

a) What are your views on changing social values?
b) What are your views about Kargil War?

ii) **Closed Ended Questions:** Multiple choice questions comes under this category. The user is restricted to answer their opinions through the options that is set by the surveyor. Hence, these are also called as close ended questions. One of the main advantages of using closed ended questions is the ease of doing preliminary analysis. These are usually used to find opinion about known questions and answers. They are usually used to track the status and the improvements of organisations and companies.

a) Do you like gossiping? yes/no
b) Do you feel happy when guests come? yes/no

Closed ended questions are of various types:

a) **Leading Questions:** These types of questions force a definite type of answer from the audience. In such a question, all kind of answers are equally likely. The answers can vary from bad, very bad to good and very good. These are usually used to collect information from the users in very limited words.

b) **Importance Questions:** The respondents are asked to take a rating for a certain type of issue on a scale of 1 to 5. This shows how much of an importance does the questionnaire topics really hold within the company or within the minds of the user.

c) **Likert Questions:** These questions show how much the customer agrees to a certain topic and how much it impacts the respondent.

d) **Dichotomous Questions:** These questions ask the respondents only a yes or no answer. Hence, it makes it difficult to analyse beyond the yes and no answer.

e) **Bipolar Questions:** Such questions have answers that are in the extreme case. The respondents are required to ask to rate the question between these two extremities.

f) **Rating Scale Questions:** In such questions, the respondents are asked to rate a particular issue between the ratings of good and bad. Such questions have even number of choices, so as to prevent selecting the middle option all the time.

g) **Buying Propensity Questions:** These questions are used to rate whether the respondent will again use the service or the product in the future.

2.3.3.3. Advantages of Questionnaire

The advantages of questionnaire are given below:

1) **Economical:** It is an economical way of accumulating information. It is economical both for the sender and for the respondent in time, effort and cost. The cost of conducting the study with the help of questionnaire method is very low. In questionnaire the researcher has to spend for paper printing and postage only. There is no need to visit each and every respondent personally. So it does not require high cost for conduct of the research.

2) **Wide Coverage:** It is probably the best method to collect information, compared to the other methods like interview or observation, when the sample population is spread over a large territory. It permits a nationwide or even international coverage. Questionnaire makes it possible to contact with many people who could not otherwise be reached. It can cover a large group at the same time. **For example,** if the researcher wishes to poll the membership of the American Sociological Society, transportation costs for interviewing would be excessive, both in terms of money and time. There may not be enough time to make the necessary interview. However, questionnaires could be distributed to all those members and information could be collected from them. This can be done by a single researcher without the large funds otherwise required to hire an interviewing staff to carry out the interview.

3) **Rapidity:** Replies may be received very quickly in questionnaire method. In this case there is no need to visit the respondent personally or continue the study over a long period. Therefore in comparison with other methods, the mailed questionnaire is the quickest method.

4) **Suitable in Special Type of Response:** The information about certain personal, secret matters can be best obtained through questionnaire method. **For example,** information about sexual relationship, marital relationship, secret desires etc. can be easily obtained by 'keeping the names of the respondents anonymous.

5) **Repetitive Information:** Compared to other methods like schedule, interview or observation, questionnaire method is regarded as more useful and cheap, where the repetitive information has to be collected at regular interval.

6) **Easier Method:** Questionnaire is comparatively an easier method to plan, construct and administer. It does not require much technical skill or knowledge.

7) **It Puts Less Pressure on the Respondents:** It puts less pressure on the respondents for immediate response. He can answer it at his own leisure, whereas interview or observation demands specific fixation of time and situation,

8) **Uniformity:** It helps in focusing the respondent's attention on all the significant items. As it is administered, in a written form, its standardised instructions for recording responses ensure some uniformity. Questionnaire does not permit much of variation.

9) **Useful Preliminary Tool:** Questionnaire may be used as a preliminary tool for conducting a depth study later on by any other method.

10) **Greater Validity:** Questionnaire has some unique merits as regards validity of information. In methods like interview and observation, the reliability of responses depends on the way the investigator has recorded them. Here they may present biased or prejudiced information of their own. But in questionnaire method, the responses given by the subjects are available in their own language and version. Therefore, it cannot be wrongly interpreted by the researcher.

11) **Anonymity:** Questionnaire ensures anonymity to its respondents. The respondents have a greater confidence that they will not be identified by anybody for giving a particular view or opinion. They feel more comfortable and free to express their view in this method.

12) **Most Flexible Tool for Data Collection:** Questionnaire is no doubt the most flexible tool in collecting both quantitative and qualitative information.

2.3.3.4. Disadvantages of Questionnaire

This method has some disadvantages also:

1) **Limited Response:** One of the major limitations of the questionnaire is that it can be applicable only to those respondents who have a considerable amount of education. It can neither be used for illiterate nor for semi-literate persons. The questionnaire quite often fails to cover very busy and pre-occupied persons among the respondents, lazy and indifferent type of persons. These are the people who constitute a very important segment of the respondents to be covered in the collection of data, but they can be seldom caught. Thus questionnaires are hardly appropriate for a larger section of this type of population.

2) **Lack of Personal Contact:** As in case of questionnaire the researcher does not go to the field, he is not able to establish a proper personal relationship with the respondents. If the respondent fails to understand some of the technical terms or he has any doubt, there is nobody to clarify these technical terms or doubts. Even though the researcher tries in the best possible manner to make the questionnaire a simple, precise and convenient one, the aim and objective of the questionnaire can be much better explained personally than through any other means. Without the proper personal contact it is very difficult to motivate the respondent to fill up the questionnaire.

3) **Poor Response:** In case of mailed questionnaire method, the proportion of return is usually low. The factors which are likely to affect the returns are: the layout of the questionnaire, its size, the organisation conducting the research work, the nature of appeal, the kind of respondents chosen for research, inducement for response etc.

4) **Unreliability:** The information collected through questionnaire cannot be said to be very much reliable or valid. If the subject misinterprets a question or gives an incomplete or indefinite response very little can be done to connect such response.

5) **Illegibility:** Illegible handwriting of the respondent sometimes creates much difficulty for the researcher to understand the responses. Sometimes the respondents erase and over write too much. These create many difficulties in reading the answers.

6) **Incomplete Entries:** Often most of the respondents fill up the questionnaire form very poorly. They sometimes leave out many questions altogether or fill in such a way that it becomes very difficult on the part of the investigator to follow those responses. Other than this, there may be the problem of language, use of abbreviations and ambiguous terms, etc. All these make a questionnaire an incomplete one.

7) **Possibility of Manipulated Entries:** In case of interview the investigator directly interacts with the respondents personal' and intensively in a face-to-face situation. He can judge a respondent, his attitude, understanding of the research topic and, if necessary, can ask some cross-questions to correct various errors.

   So usually the respondent cannot manipulate his answer. But in questionnaire it is very difficult to detect the errors of the respondents. Here the investigator does not have any facility to check the validity and reliability of the information. In the absence of the researcher, the respondents may supply manipulated information.

8) **Useless in Depth Studies:** In questionnaire method, it is not possible on the part of the researcher to conduct an intensive or in-depth study of the feelings, reactions and sentiments of the respondents. All these require a healthy interaction of the researcher with the respondents. But in questionnaire method, the investigator is not present in the field, so nothing can be done to establish rapport with the respondent. Due to this lack of interaction with the respondent, the researcher cannot go into the details of the respondent's life. So through questionnaire method one cannot conduct an in-depth study.

9) **Response from Improper Representative Section of People:** The respondents who return the questionnaires may not constitute a representative section of the entire group. Only mere responsible, research minded or those in favour of the issue may prefer to respond. Some of the important sections of the group may totally remain silent. This vitiates the final conclusions and findings.

10) **Lack of Rapport with the Subject:** There are many people who would not like to share any important information unless and until they are impressed about the rationale of the study and personality of the investigator. The questionnaire does not provide for any opportunity to the investigator to establish rapport with the subject and this cannot attract the respondent for a better response.

11) **Not Suitable for Delicate Issues:** Some of the research areas are so delicate, sensitive, intricate and confidential in nature that it becomes difficult to frame questions on them. It is impossible to put down certain delicate issues in writing.

2.3.4. Checklists

Checklists usually offer a Yes/No format in relation to student demonstration of specific criteria. This is similar to a light switch; the light is either on or off. They may be used to record observations of an individual, a group or a whole class.

2.3.4.1. Types of Checklists

The different types of checklist are described below:

1) **Simple Checklists:** Simple checklists merely list aspects to be considered in the analysis. They function as a guide for conducting the analysis by pointing out issues that are likely be affected, including those that may be less obvious but may still be relevant. They do not provide any other additional support for the analysis.

2) **Descriptive Checklists:** Descriptive checklists add to simple checklists as they do not only list the aspects to be considered but provide additional background information on each aspect. **For example**, they may identify the most important indicators to measure each component.

3) **Questionnaire Checklists:** These are composed of a series of questions that highlight potentially relevant issues. Usually, the checklists first identifies a general issue area (e.g., climate change) and then asks more detailed questions about the concrete impacts of a measure in this issue area (e.g., expected raise of CO_2 emissions) and their likely importance.

4) **Weighting Checklists:** It includes simple devices for assessing importance or significance of suspected aspects. This might be through the use of letter or numeric scales, assigned based on criteria supplied in the checklist, to indicate the importance of an impact. Another approach is to use threshold values, based on statutory criteria (e.g., for water quality standards) or on derived measures (e.g., visitor carrying-capacity for a given locality). The suspected impact can be estimated in broad terms and given a value to represent its significance. This represents a starting point for comparing and ranking alternative policy options.

2.3.4.2. Benefits of Checklists

A checklist is simply a standardised list of the required steps developed for a repetitive task. There are seven benefits to using a checklist:

1) **Organisation:** Checklists can help us to stay more organised by assuring we do not skip any steps in a process. They are easy to use and effective.

2) **Motivation:** Checklists motivate us to take action and complete tasks. Since checklists can make us more successful, it becomes a virtuous circle where we are motivated to accomplish more due to the positive results.

3) **Productivity:** By having a checklist you can complete repetitive tasks more quickly and efficiently, and with fewer mistakes. This gives you more time in the day and assures fewer "fire drills." You become more productive and accomplish more each day.

4) **Creativity:** Checklists allow you to master the repetitive tasks and utilise more brain power for creative activities.

5) **Delegation:** By breaking down tasks into specific tasks, checklists give us more confidence when delegating activities. When we are more comfortable that tasks will be done correctly, we delegate more and become significantly more productive.

6) **Excellence:** Checklists allow us to be more effective at taking care of customers.

7) **Curriculum Planning:** Checklists can be useful for curriculum planning; activities can be planned to encourage certain behaviours that have not yet been observed.

8) **Learning Activities:** For younger students, simple, task-based checklists can help them become accustomed to following steps, adding order to the relative chaos of learning, and offering a pathway to accomplishing complex tasks. For older students, they can do all of the above, and also serve as memory aids as they work on unfamiliar or complicated tasks. Checklists keep students on task. Rather than losing focus and forgetting where they left off or abandoning the task all together, they always know where they are in a task or project.

9) **Saving Lives:** Checklists can literally save lives.

2.3.4.3. Limitations of Checklists

Checklist has some demerits too:

1) Not very detailed,
2) Little information about the context or sequence of events,
3) May miss important information not included on the checklist,
4) Notes if behaviour occurred but not how often it occurs or the duration of the behaviour. Something that happens once may not be very meaningful.

2.3.5. Rating Scales

A rating scale is a set of categories designed to elicit information about a quantitative or a qualitative attribute. In the social sciences, particularly psychology, common examples are the Likert response scale and 1-10 rating scales in which a person selects the number which is considered to reflect the perceived quality of a product.

According to Barr, et. al, "Rating is a term applied to expression of opinion or judgement regarding some situation, object or character. Opinions are usually expressed on a scale of values. Rating techniques are devices by which such judgements may be quantified."

A rating scale is a device by which the opinion concerning a trait can be systematised.

Rating Scales allow teachers to indicate the degree or frequency of the behaviours, skills and strategies displayed by the learner. To continue the light switch analogy, a rating scale is like a dimmer switch that provides for a range of performance levels. Rating scales state the criteria and provide three or four response selections to describe the quality or frequency of student work.

Teachers can use rating scales to record observations and students can use them as self-assessment tools. Teaching students to use descriptive words, such as **always, usually, sometimes** and **never** helps them pinpoint specific strengths and needs. Rating scales also give students information for setting goals and improving performance.

In a rating scale, the descriptive word is more important than the related number. The more precise and descriptive the words for each scale point, the more reliable the tool.

2.3.6. Types of Rating Scale

There are several types of rating scales, generally a teacher, parent, peers and others related with students environment must rate the extent to which that student demonstrate certain desirable and undesirable behaviours.

1) **Numerical Rating scale:** Numerical rating scale is a scale in which numbers are assigned to each trait. If it is a seven point scale. The number 7 represents the maximum amount of that trait in the individual and 4 represents the average. The Rater merely enters the appropriate number after each name to indicate judgments of the person.

A	B	C	D	E	F	G
1	2	3	4	5	6	7

2) **Descriptive Rating Scale:** Descriptive scale is a scale in which descriptive phrases or terms assigned to each trait. The Rater enters the appropriate phrase after each name to indicate judgement of the person.

A	B	C	D	E
Excellent	Good	Average	Below Average	Poor

3) **Graphical Rating Scale:** A straight line may be represented by descriptive phrases at various points. To rate the subject for a particular trait a check mark is made at the particular point.

Low Moral	Good Moral	High Moral	D	E
0	25	50	75	100

4) **Rank Order Scale:** In this type the judge is simply required to place the people being rated in a rank order from high to low on the attitude or opinion in question. A given individual's scale position is given in relation to other people in the sample. The units of the scale are unequal.

2.3.6.1. Ways of Designing a Rating Scale

There are various ways of designing a rating scale:

1) A rating scale may have one or more dimensions.
2) There may be any number of criteria in a dimension.
3) The same rating scale may be used at the beginning and also at the end of instruction. That is, the same rating scale may be used repetitiously.
4) Different rating scales may be used at the beginning of instruction and at the end of instruction.
5) Some dimensions of a rating scale may be used at the beginning of instruction and other dimensions may be used at the end of instruction in the same or adjacent school grades. That is, the second set of dimensions would include sequentially more complex dimensions than the first set.
6) A rating scale may be designed to measure vocal performance or instrumental performance.
7) One teacher may be intended to serve as the sole judge when using a rating scale.
8) Two or more teachers may be intended to serve as multiple judges when using a rating scale.

2.3.6.2. Benefits of Rating Scale

Merits of rating scale are as follows:

1) Easy to use,
2) Takes relatively little time to complete,
3) It is a convenient way to observe many traits at once,
4) Degrees of behaviour/characteristic can be noted, rather than did the behaviour occur or did it not occur,
5) Easy to score for research purposes.

2.3.6.3. Limitations of Rating Scale

Limitations of rating scales are given below:

1) They examine only specific behaviours/traits and may overlook other important behaviours,
2) Ratings are subjective and raters may give biased responses,
3) Not as much detail about the behaviour as other methods (e.g., context of the behaviour),
4) The response categories may be subject to personal interpretations; one person who views the behaviour of the child may believe the behaviour occurs often and another observer may believe that it occurs sometimes.

2.3.7. Cumulative Records

A record system is also called as a cumulative record card, a personal data card and permanent data card, which gives us a picture of the student from many different sources. It is progressively developed and maintained over a longer period of time, and gives a summarised growth record indicating the

direction and rate of development. It shifts the emphasis from one-time or once a year performance in a few academic subjects to the full development regarding all the important aspects of education and general, physical, social and mental development over a longer period of time. Essentially meaningful and functionally adequate information is collected from various sources, techniques, tests, interviews, observations, case study and the like, is assembled in a summary form on a cumulative record card, so that it may be used when the student needs our advice for the solution of some educational or vocational problem.

The cumulative record has been defined as "a method of recording, filing and using information essential for the guidance of students."

According to Jones, a cumulative record is, "A permanent record of a student which is kept up-to-date by the school; it is his educational history with information about his school achievement, attendance, health, test scores and similar pertinent data."

According to Jane Warters, "Periodically the significant information gathered on students, through the use of various techniques – test inventories, questionnaire, observation, interview, case study and the like should be assembled in cumulative record."

2.3.7.1. Characteristics of a Good Cumulative Record

Guidance is provided to students on the basis of accumulated information only. In other words, these cumulative records are extremely useful in providing significant information about students. Hence, it is necessary that they should have the following characteristics:

1) **Contain Simple and Complete Information:** Cumulative record is a permanent record about the student. A good cumulative record should contain complete information about a student's progress as incomplete information does not give a clear picture for proper guidance. Hence, to present a clear picture about a student, there should be a brief account of all the various situations of his student life written in simple language.

2) **Factual Information:** It should be well maintained and up to date. Whenever any new information is obtained about the student it is entered in the card. To ensure the validity of a cumulative record, it is essential that it should contain factual information only. Hence, only the observed facts should be recorded.

3) **Secrecy:** It contains only those information which are authentic, reliable, pertinent, objective and useful It is essential to maintain secrecy of information contained in the cumulative records. New information should not be influenced by previous information.

4) **Re-Evaluation:** It is essential to carry out timely evaluation of the cumulative record. On the basis of re-evaluations, necessary changes can be made and new information can be incorporated in the records.

5) **Continuity:** It is of prime importance in an ideal cumulative record, so that it is easy for anybody to peruse it. Continuity means updating information regularly.

6) **Group-Based Evaluation:** In order to make cumulative record more reliable and valid, facts should be entered after evaluation or verification by a number of different teachers.

7) **Usefulness:** Information contained in the cumulative record should lend itself to easy retrieval and interpretation for more meaningful and extensive use. It presents a complete picture about the educational progress of the student, his past achievements and present standing.

2.3.7.2. Objectives of Cumulative Records

While cumulative records are useful for guidance and counselling, they also help in achieving certain specific objectives which are as follows:

1) **Objective Record:** The main objective of a cumulative record is to make available to the teacher or the counsellor accurate and useful information about a child. However, only a trained person can make proper use of this information. Before teaching or counselling, the teacher or a counsellor obtains information about a child's abilities, achievements and weak areas by perusing his cumulative record.

2) **Instant Information:** A teacher can get instant information about a new child.

3) **Child's Problems:** Cumulative record gives the teacher or the counsellor information about a child's different problems.

4) **Guidance:** Proper guidance can be given after understanding the problems on the basis of information gleaned from the cumulative record.

5) **Better Evaluation:** Cumulative record is also useful in evaluating a child. It supplies data for an objective evaluation. This evaluation is more reliable than a teacher's subjective observation.

6) **Progress:** Evaluation, done on the basis of cumulative record, helps the counsellor in charting a better course for the child's rapid progress.

7) **Identification:** Identification information includes child's name, sex, date of birth, place of birth, community, place of residence, admission number, date of admission, class, section, permanent address, etc.

8) **Family:** Family information includes father's name, birthplace, educational background, occupation, dead or alive, economic and social status of family, number of brothers and sisters, mother tongue, religion, caste, father's income.

9) **Health:** It includes height, weight, physical defects, emotional balance, eyes, nose, ears, chest, family tradition or any disease. There should be a record of periodic medical check-ups also.

10) **Psychological Data:** Information of various types is collected under psychological data like mental level, general mental ability, special mental ability, interests, aptitude, personality traits, emotional and social adjustment, adaptability, attitude, etc.

11) **Personal Qualities:** Five-point scale should be used to measure personal qualities like honesty, hard work, courtesy, self-confidence, sociability, cooperativeness, initiative, emotional stability, leadership and sense of responsibility.

12) **Educational Data:** The following details are included in the educational data:
   i) **Previous School Record:** Achievements in the field of study, marks obtained in different classes, attendance record.
   ii) **Current Academic Record:** Marks obtained in different subjects, interest in studies, place in the class, particulars of failures, learning ability, crafts, skills, etc.
   iii) **Student's Attitude towards Teachers:** Cooperative or otherwise, participation in various events.
   iv) **Vocational Planning:** What are the child's educational and vocational plans.
   v) **Co-Curricular Activities:** Student's participation in sports, literary, cultural and social service activities.
   vi) **Principal's View:** At the end of the year, the principal gives his comments on the student's progress. If needed, he takes the teachers' help.

2.3.7.3. Types of Cumulative Record

Cumulative records are of three types mentioned as follows:

1) **Single-Card Record:** It is a 9″ × 11½″ single sheet information recorded on both sides. This card cannot hold the enough information. For more information, another card has to be appended.

2) **Pocket-Folder Record:** It is a folder with a number of pockets pasted inside. Different information can be kept in different pockets. It is easy to retrieve information from a pocket folder.

3) **Cumulative Folder:** It has a number of pages on both sides of which facts are recorded in ruled boxes. There is provision for writing detailed information as well on the pages. This folder can keep maximum information.

2.3.7.4. Need and Importance of Cumulative Record

The cumulative records about students provide useful information to teachers, counsellors and administrators. The need and importance of cumulative records in guidance are given below:

1) **Importance in Guidance:** The basic principle and assumptions of guidance can be taken into consideration for the individual differences. Cumulative

records reveal such individual differences and indicate the nature and amount of professional assistance needed by individual students of various stages of their development. It is useful in analysing the future needs of the individual student and proper educational and occupational guidance can be offered on the basis of his needs.

2) **Importance in Teaching**
   i) The cumulative records of different students help the teacher in classifying students in accordance with scholastic attitudes and mental abilities.
   ii) They are diagnostic tools to analyse a behaviour problem or an educational one. **For example,** why is a student backward in the class? What steps can be taken to remove his/her backwardness?
   iii) Cumulative record indicate the students who had special help and adjust the teaching accordingly.

The Secondary Education Commission emphasised the importance of cumulative record card in the following words:

"Neither the external examination nor the internal examination, singly or together, can give a complete and correct picture of pupil's all-round progress at any particular stage of his education, yet it is important for us to assess this, in order to determine his future course of study or future vocation. For this purpose, a proper system of school records should be maintained for every pupil indicating the work done by him in the school from day-to-day, from month-to-month, from term-to-term, and from year-to-year. Such school records will present a clear and continuous statement of the attainments of the child in different intellectual pursuits throughout successive stages of his education."

Thus, from a CRC useful, valid and authentic information can be collected like:
1) It helps in deciding upon the vocation and profession for a student.
2) It helps to observe various aspects of child's personality.
3) The data helps when a student leaves the school and gets admission in another school.
4) It helps in identifying an abnormal child and those who are weak in studies.
5) It helps in solving the problems of the child.

2.3.7.5. Tips of Preparing Cumulative Records

While preparing cumulative record card, the following points should be kept in mind:
1) Cumulative record card should be simple and compact, capable of mirroring a student's gradual progress.
2) Cumulative record card should be designed keeping in view the objectives of the school.
3) For designing the cumulative record cards, the class teacher should consult, and take consent and assistance from other subject teachers as well.
4) Cumulative record card should be flexible so that new items can be incorporated in it, if and when required, and changes can be effected according

5) Cumulative record card should be kept at a secure place to enable the teacher to easily access it.
6) There should be a set of rules for filling in the card and making use of the cumulative record card.
7) Cumulative record card can be useful only when the information contained in it is reliable and relevant.
8) Information written in the cumulative record card should be kept secret in deference to the confidence placed by the parents and students at the time of giving information.
9) Teachers should know how to use the cumulative record – it being a difficult task.

2.3.7.6. Types of Information Maintained in the Cumulative Records Cards (CRC)

The types of information which are collected and entered or included in the CRC are as follows:

1) **Identification Data:** Name of the pupil, sex, father's name, admission no., date of birth, class, section, any other information that helps in easy location of the card.
2) **Environmental and Background Data:** Home-neighbourhood influences, socio-economic status of the family, cultural status of the family, number of brothers and sisters, their educational background, occupations of the members of the family.
3) **Physical Data:** Weight, height, illness, physical disabilities, etc.
4) **Psychological Data:** Intelligence, aptitudes, interests, personality qualities, emotional and social adjustment and attitudes.
5) **Educational Data:** Previous school record, educational attainments, school marks, school attendance.
6) **Co-Curricular Data:** Notable experiences and accomplishment in various fields – intellectual, artistic, social, recreational, etc.
7) **Vocational Information:** Vocational ambitions of the student.
8) **Supplementary Information:** It is obtained by the use of standardised tests.
9) Principal's overall remarks.

2.3.7.7. Sources of Collection of Information

Information about every pupil or child for the maintenance in the CRC should be collected from the following sources:

1) **Parents or Guardian's Data Form:** Family background and the personal history of the child may be gathered from the parents who are asked to fill in the form.
2) **Personal Data Form:** In order to obtain information regarding the pupils interest and participation in extra-curricular activities and his vocational

preferences the personal data is of great use. The pupil may be asked to give details of himself. This will supplement the information obtained from the parents data form.

3) **School Records:** These include:
   i) Records of achievement tests.
   ii) Records of other tests.
   iii) Admission and withdrawal record.

4) **Other Sources:** These include:
   i) Personal visits by the teachers.
   ii) Observations made by the teachers.

2.3.7.8. Maintenance of the Record

The maintenance of the Cumulative Record Card should begin when the student enters school and should follow the student from class to class within a school and from school to school as he continues his progress. The class teacher will maintain the Cumulative Record. In view of the fact that he spends much time with the students he will be in a greater position to judge them from different aspects. He will maintain a diary or note-book in which he will note down from time to time his observations about his students. At the end of the year he will make the necessary entries in the Cumulative Record Card (CRC). It is very desirable that he consults his colleagues who also know the pupils. These entries should be made after careful consideration.

2.3.7.9. Format of a Cumulative Records

School Cumulative Record Card

Name of Pupil	.....	Date of Birth	.....
Father's Name	.....	Occupation	.....
Guardian's Name	.....	Occupation	.....
Relationship with the child	.....	Address	.....

Schools Attended

S. No.	Name of School	Month and Year of Joining	Class in which Joined	Month and Year of Leaving	Class from which Left	Reasons for Leaving
1.						
2.						
3.						

Family History

Year	19....	19....	19....
Type of family (whether joint or nuclear)			
No. of members in the family			
Economic status in the family			
Child's position of the family (whether only child, eldest or youngest child, his number among the siblings)			
Any other significant factor			

Physical Data

Year	Height	Weight	Chest Measurement			General Condition
			Normal	Expanded	Contracted	

Medical Report

	Any Serious Illness
19....	
19....	
19....	

Attendance

Year	Possible	Actual	Nature of long absence, if any, with reasons
19....			
19....			
19....			
19....			

Psychological Report if any and Result of Intelligence and Aptitude Test

19....	
19....	
19....	

Scholastic Achievement

Subject	Class..... Year.....		Class..... Year.....		Class..... Year.....	
	Half Yearly	Annual	Half Yearly	Annual	Half Yearly	Annual
English						
Hindi						
Sanskrit						
Mathematics/Arithmatic and Domestic Science						
Physics						
Chemistry						
Economics						
History						
Geography						
Commerce						
Drawing						
Art						
Craft						
Physical Education						

Agriculture						
Practicals						
Total						
Position in the Class						
No. of Students in the Class						

Performance in Co-Curricular Activities

Activities	Average Grade of the Child for each Performance Throughout a Year		
	19....	19....	19....
Sports and Games			
Personal Hygiene			
Literary Activities			
Cultural Activities			
Social Service			

Position of Responsibility Held or Merits Obtained if any

Activities	Year.....	Year.....	Year.....
Studies			
Games			
Bal Sabha			
Scouting			
Social Service			
Any Other			

Vocational Information

Year	Vocational Ambitions of the Student	Counsellor's Report
19....		
19....		
19....		

Personality Traits

Traits	19....	19....	19....
Truthfulness			
Honesty			
Courtesy			
Cooperativeness			
Industry			
Self-confidence			
Emotional Stability			
Initiative			
Sociability			
Reliability			
Signature of the Class Teacher			
Signature of the Head			

2.3.7.10. Uses of Cumulative Record Card

Cumulative record card can be used in both educational and professional areas. Its main uses are as follows:

1) **Helpful in Students' Clarification:** Children should be imparted education according to their mental development. Information given in the cumulative record can help in classifying students.

2) **Helpful in Getting Introduced to a New Class:** When a teacher takes up a new class of students with whom he/she is not acquainted, then in that case cumulative record cards help him in understanding different students. When a student leaves the school and joins a new school, he must take the cumulative record with him to enable the new teachers to have adequate information about his past and guide him accordingly.

3) **Helpful in Making Certificates:** Cumulative record helps the principal in issuing character, behaviour and sports certificates to students.

4) **Helpful in Problem Solving:** Different problems can be solved with the help of cumulative record card. It gives information about a child's intelligence quotient. If a student's intelligence quotient is below average, the teacher modifies his instruction method to suit his level so that the student derives proper benefit from teaching. Certain students have behavioural problems and are difficult to handle, and cumulative record card helps in their proper handling. It also helps in understanding genuine problems of students and finding suitable solutions to them.

5) **Helpful in Preparing Progress Report:** Cumulative record card helps in compiling a student's progress report about his educational and co-curricular activities.

6) **Giving Information to Child Courts:** Cumulative record helps in sending juvenile criminals to child courts and providing past information about the students to them.

7) **Helpful in Employment Exchanges:** Youth employment and counselling services have been initiated in employment exchanges. These services can be fruitful only if they have information about the youth's potential. This information can be obtained from cumulative records.

8) **Helpful in Educational, Vocational and Personal Guidance:** On the basis of information collated in the cumulative record, students can be provided proper educational and vocational guidance.

9) **Helpful in Self-Assessment:** Information contained in the cumulative record card helps a student in evaluating his potentials and drawbacks. By acquiring knowledge of his shortcomings, a student can make suitable amendments to secure his future progress.

10) **Personalised Attention by a Teacher:** A teacher himself prepares cumulative record.

2.4. SELF-ASSESSMENT & FEEDBACK

2.4.1. Self-Assessment

The role of assessment is to gauge the progress that both learner and teacher have made towards achieving the aims that have been set and appraising how this could be done better. Opportunity for feedback, leading to revision and improvement of performance, should constantly be available, without exams and evaluations being used as a threat to study. Grading and correction carried out in the presence of students and providing feedback on the answers they get right and wrong, and why.

Asking children about why they answered what they did assists teachers in going beyond the written answer to engage with children's thinking. Such processes also take away the frightening judgemental quality of marks obtained in a test, and enable children to understand and focus on their mistakes and learn through these mistakes. Sometimes head teachers object, claiming that correction in the presence of the child reduces 'objectivity'. This is a misplaced concern for objectivity, stemming from a competitive system that believes in judging children. Such a concern for objectivity is misplaced in evaluation, which is consistent with educational goals.

Self-assessment is more accurately defined as **"a process by which students monitor and evaluate the quality of their thinking and behaviour when learning and identify strategies that improve their understanding and skills."** That is, self-assessment occurs when students judge their own work to improve performance as they identify discrepancies between current and desired performance. This aspect of self-assessment aligns closely with standards-based education, which provides clear targets and criteria that can facilitate student self-assessment.

Self-assessment involves metacognition, the process of being aware of and reflecting on one's own learning. Self-assessment skills include effective questioning, reflection, problem-solving, comparative analysis, and the ability to share thoughts in a variety of ways. Self-assessment can be used by children of all ability levels and in all areas of learning. In age-appropriate ways, it can be used throughout the primary school and across subjects. Whole class discussions, group situations or one-to-one conferencing are all platforms for self-assessment.

2.4.1.1. Need of Self-Assessment

Self-assessment is done due to following reasons:

1) Self-evaluation builds on a natural tendency to check out the progress of one's own learning.
2) Further learning is only possible after the recognition of what needs to be learned.
3) If a student can identify his/her learning progress, this may motivate further learning.

4) Self-evaluation encourages reflection on one's own learning.
5) Self-assessment can promote learner responsibility and independence.
6) Self-assessment tasks encourage student ownership of the learning.
7) Self-assessment tasks shift the focus from something imposed by someone else to a potential partnership.
8) Self-assessment emphasises the formative aspects of assessment.
9) Self-assessment encourages a focus on process.
10) Self-assessment can accommodate diversity of learners' readiness, experience and backgrounds.
11) Self-assessment practices align well with the shift in the higher education literature from a focus on teacher performance to an emphasis on student learning.

2.4.1.2. Process of Self-Assessment

Self-assessment is conceptualised as the combination of three components related in a cyclical, on-going process:

1) Self-monitoring,
2) Self-evaluation, and
3) Identification and implementation of instructional correctives as needed.

Essentially, students identify their learning and performance strategies, provide feedback to themselves based on well-understood standards and criteria, and determine the next steps or plans to enhance their performance.

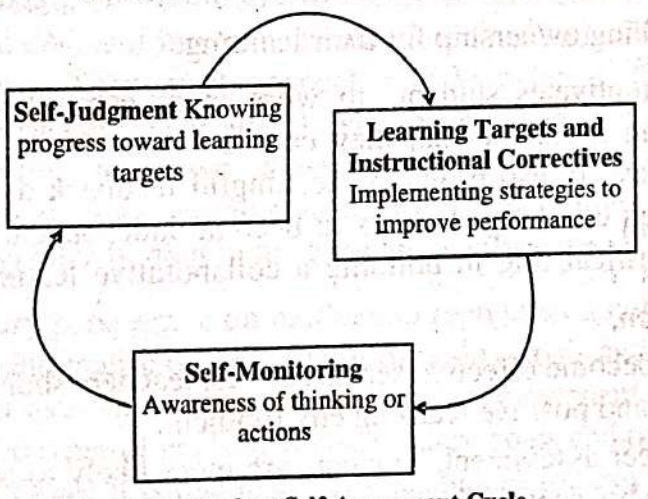


Figure 2.1: Student Self-Assessment Cycle

1) **Self-Monitoring:** It is a skill which is necessary for effective self-assessment. It involves focused attention to some aspect of behaviour or thinking. Self-monitoring students pay deliberate attention to what they are doing, often in relation to external standards. Thus, self-monitoring concerns awareness of thinking and progress as it occurs, and as such, it identifies part of what students do when they self-assess.
2) **Self-Evaluation or Self-Judgement:** A second component of self-assessment is self-judgement. It involves identifying progress toward targeted performance. Made in relation to established standards and criteria, these

judgements give students a meaningful idea of what they know and what they still need to learn. The standards are benchmarks and the criteria are guidelines for interpreting the level of performance students have demonstrated. The development and application of criteria in evaluating current performance enable meaningful evaluations, as long as the criteria are appropriately challenging. **According to Rolheiser and Ross,** "Students who are taught self-evaluation skills are more likely to persist on difficult tasks, be more confident about their ability, and take greater responsibility for their work".

3) **Identification and Implementation of Instructional Correctives:** The third essential step is that students choose subsequent learning goals and activities to improve partially correct answers, to correct misunderstandings, and to extend learning. Because students at this stage need skills in determining learning targets and further instruction that will enhance their learning, they should be aware of options for further goals and instruction. Once the appropriate "instructional correctives," as they are referred to, are complete, students resume self-monitoring.

2.4.1.3. Importance of Self-Assessment

The self-assessment is important in following ways:

1) Self-assessment is essential to learning. It equips the student with the skills to answer effectively each of these questions. When teachers model and promote self-assessment, students develop increasing independence in:
   i) Understanding and developing learning goals and success criteria,
   ii) Assessing what they need to do to achieve the learning goals, and
   iii) Ultimately taking ownership for their learning.

2) Self-assessment motivates students to work more carefully and recognise their own learning needs, so that they can become effective advocates for how they learn best. It also provides meaningful feedback to teachers about those needs. When coaching students to become independent self-assessors, teachers play a critical role in building a collaborative learning partnership with each student.

3) To help students become effective self-assessors, teachers should:
   i) Create a safe and positive learning environment.
   ii) Begin with peer assessment. Students are more likely to accept criticism from peers who speak the language they can readily understand and provide the objectivity needed for effective self-assessment.
   iii) Provide instruction on collaborative peer and self-assessment skills.
   iv) Model the use of assessment tools (e.g., checklists, rubrics) and strategies (e.g., portfolios, learning logs, journals, and conferences). Start with checklists, which are easier to construct and use, before moving on to rubrics.
   v) Provide opportunities for students to practice peer and self-assessment in class, mentor and monitor their students' assessment practices and provide timely feedback.

vi) Focus students' peer and self-assessments on the learning goals and success criteria. Guide students' reflections on their work in relationship to the learning goals and criteria, provide descriptive feedback related to the goals and criteria, and have students work together to understand and act on the feedback.

vii) Engage students in development of success criteria by:
   a) Providing samples of good work to show what it looks like;
   b) Inviting students to co-construct success criteria; and
   c) Providing regular opportunities to pause, reflect, look for proof, connect to the criteria, and make improvements.

2.4.1.4. Theoretical Rationale for Enhancing Self-Assessment

Theories from atleast three areas of study provide convincing rationales for nurturing and enhancing student self-assessment. These areas include:

1) Cognitive and constructivist theories of learning and motivation,
2) Metacognition theory, and
3) Self-efficacy theory.

The above given areas are described in detail as follows:

1) **Cognitive and Constructivist Learning and Motivation Theories:** Self-assessment is an essential component of cognitive and constructivist theories of learning and motivation. **Shepard (2001)** points out that student self-monitoring of learning and thinking is important in the knowledge construction that lies at the heart of such theory. That is, students construct meaning, in part, by self-assessing prior to and during learning. Students organise, evaluate, and internalise when learning, and self-assessment is part of that process. They must connect new knowledge, understandings, and skills with what they have already stored and used. Self-assessment fosters students' ability to make these connections themselves; provides a mechanism to enhance learning in a meaningful, rather than rote, manner; and result is greater student motivation and confidence.

   The goal-theory perspective on motivation represents a cognitive theory about how students internalise different types of ability goals and the effects of those goals on self-assessment, persistence, and achievement. The research has focused on two types of goals, namely, mastery goals and performance goals:

   i) **Mastery Goal:** It is one in which the student focuses on the task at hand and what needs to be done to improve knowledge, understanding, and skill. With this orientation, students reach mastery through such cognitive processes as thinking, self-monitoring, and generating solutions. Additionally, students will tend to immerse themselves in the task and continually check their progress.

   ii) **Performance Goals:** In contrast, performance goals focus on the outcome and whatever can be done to ensure the outcome; the final score or grade receives more attention than attaining improved understanding. This orientation promotes negative self-concepts about ability to perform and reinforces conformity to what will best ensure a positive outcome,

which becomes more important than process or actual improvements in understanding and skills. Obtaining the required score and being judged "proficient" are more important than learning.

A performance goal makes the monitoring and evaluation of learning external; mastery goals make the process of monitoring and evaluating, to some extent, internal. Self-assessment is integral to a mastery goal orientation, for it is a skill that enables students to know how well they are progressing in their knowledge and skills. Conversely, a performance orientation relies on the teacher and others to schedule learning tasks, to determine success or failure, and to evaluate the final product. Improving self-assessment skills promotes a mastery orientation, with all the positives of that process.

2) **Metacognition:** It, which has been widely investigated and reported in both educational and psychological literature, involves the capacity to monitor, evaluate, and know what to do to improve performance. This includes conscious control of specific cognitive skills such as checking understanding, predicting outcomes, planning activities, managing time, and switching to different learning activities. It is a set of skills that relate positively to increased achievement, and such skills can be taught to students. The metacognitive literature provides theory and empirical evidence that supports both self-monitoring and self-evaluation as two of many possible metacognitive skills.

3) **Self-Efficacy:** Self-assessment plays a significant role in developing self-perceptions that lead to greater motivation. It is well established that student engagement depends upon students' self-efficacy beliefs – perceptions of their ability to do well on a specific task, and the value of doing well. Self-efficacy involves students estimating what they can do and the likelihood of successful performance. Such self-perception develops gradually as students connect their successes and failures to factors they believe have caused the result. It is important to emphasise the influence of situation and context upon self-efficacy. Self-perceptions of competence are part of self-efficacy and refer to beliefs about general ability or knowledge and skills to do well (e.g., "I'm good in math" or "I do well in science classes"). Students with high expectations are more likely to persist; those with low expectations often avoid tasks or give up. Positive self-evaluations encourage students to commit more resources to continued study and set higher goals in the future.

Students need to self-assess to know when they are learning, how much effort they must expend for success, when they have been successful, when they are wrong, and which learning strategies work well for them. Accurate self-evaluation enables students to see what they have mastered and identify what needs further work. Students who experience success with moderately difficult and challenging tasks will attribute their success to ability and effort rather than to external attributions such as luck or help from other students. Making these internal attributions is, in turn, based on the ability of students to self-assess and self-evaluate. This knowledge helps students to develop self-efficacy for future performance in similar tasks.

2.4.1.5. Educational Implications of Self-Assessment

For classroom teachers, student self-assessment develops an awareness of which metacognitive strategies to use and when to use them. Teachers and students learn these skills when they establish clear learning goals and articulate evaluative criteria that enable students to assess their own work. Those practices engage students as they actively participate in the learning process and become more connected and committed to the learning outcomes. Student self-assessment also mandates that teachers learn to pass the evaluative responsibilities to their students by scaffolding and modelling goal setting, evaluation, strategy adjustment, and reflection.

Additionally, students who believe that they can successfully complete a task are more motivated and engaged. Teachers should therefore maintain high expectations of performance as students establish goals and work through their self-evaluations. That way, student self-assessment in the classroom establishes clear learning targets, defines evaluative criteria, provides tools for assessment, and allows time for reflection.

1) **Clear Learning Targets and Criteria:** Establishing clear learning targets helps students to understand what they should learn and participate in developing evaluation criteria and quality benchmarks. Students achieved more when they set specific goals for themselves. Student performance can be improved simply by having students self-report their learning. Students must also understand the process goals of reaching the established learning objectives, since they are more satisfied with their performance when they can evaluate their work; providing clear steps enables them to reach their goals and results in higher levels of self-efficacy. Teachers can allow students to make choices from a predetermined range of activities, which individualises instruction while allowing students to work at their appropriate levels.

2) **Self-Evaluation:** Once students understand the goals and criteria, they must have opportunities to evaluate their own performance and make adjustments. Teachers should use this opportunity to convey the concept that mastery is controllable and that the goal is knowledge attainment, not just task completion. Using domain-specific goals and sub-goals, combined with positive attributional feedback, will increase students' persistence toward the greater goal as they feel the sense of accomplishment that comes from applying effective learning strategies. Finally, students must be able to make adjustments to their work prior to graded evaluation. At this point students react to feedback and adjust their strategies, typically through rubrics, rating forms, or visual organizers. These concrete self-evaluation methods provide objective feedback and identify specific areas of strength or weakness. The feedback serves as a form of item analysis that can be further used to guide instruction and better meet the students' needs.

3) **Reflection:** It is a critical part of the self-evaluation process. Reflection helps students think about what they know or have learned while they identify areas of confusion, so they can create new goals. Students benefit from explaining

their work and their own evaluation of quality through reflective activities such as conferences, written correspondence with parents or peers, and written self-reflections or checklists.

To help teachers implement student self-assessment in the classroom, **Rolheiser (1996)** identifies four stages of teaching student self-assessment. At each stage, initiating different levels of teacher and student involvement gradually gives students less structure and specific direction and more responsibility and freedom.

Stage 1: In first stage teachers involve students in determining criteria. Often students brainstorm ideas and negotiate with teachers to arrive at final criteria that are specific, immediately applicable, and moderately difficult. In this early stage it is important to use students' language in naming and describing criteria.

Stage 2: In the second stage the teacher shows students how to apply the criteria to evaluate work samples. Providing examples of evaluated work helps students understand, specifically, the meaning of the criteria and how to use them. Students need to practice classifying products using the established criteria. Cooperative learning groups can effectively facilitate this process.

Stage 3: In the third stage teachers provide students feedback concerning their application of the criteria. At this point it is helpful if they show students qualitatively different products to illustrate how criteria are applied. This process requires feedback not about whether an answer or product is correct but rather about how well students understand and apply the criteria. Discussion allows students to resolve questions and uncertainties about the criteria. Feedback should clearly relate to the criteria and, eventually, students should be able to initiate feedback themselves to justify their ratings and initiate a dialogue with the teacher about self-evaluation.

Stage 4: The last stage involves identifying subsequent learning goals and strategies that can attain the goals. Initially, the teacher determines the goals and strategies; eventually students construct their own goals and strategies with teacher guidance.

Thus, teachers fully integrate self-assessment into their teaching in stages Third and Fourth, when they can give students feedback about self-assessments as well as future instructional goals and learning strategies.

2.4.2. Feedback

Feedback is a two way process. Feedback generally focuses on behaviour or the outcome of behaviour rather than on the inherent characteristics of the person concerned. It leaves that person feeling positive and able to move forward. The timing of the feedback is important. It needs to be given as soon as possible after the event. The greater the delay, the less likely it is that the student will find it useful or be able or inclined to act on it.

Feedback also needs to be clear. Handwritten feedback should be legible. The language should be comprehensive to students. Students need to take care with style and tone as misunderstanding can easily arise. This particularly applies when feedback is written.

Feedback may be defined as the "information provided by the teacher concerning the performance or understanding of the student, with reference to a goal and aimed at improving learning."

2.4.2.1. Characteristics of Feedback

Following are the main characteristics of feedback:

1) Good feedback is relevant,
2) Good feedback is informative,
3) Good feedback encourages dialogue,
4) Good Feedback encourages self-assessment, and
5) Feedback is an essential component of formative assessment.

2.4.2.2. Purpose of Effective Feedback on Student Assessment

Effective feedback is:

1) **Descriptive rather than Evaluative:** Feedback should identify what the student is doing well and what needs improvement and, most crucially, provide next steps to guide the student on how to improve.
2) **Focused:** It is focused on the learning goals and the success criteria.
3) **Limited:** It is limited to a few traits or characteristics of student performance. It is tempting to point out all the areas where improvement is needed; however, feedback is more likely to improve learning when it is focused on a few priorities.
4) **Timely:** It is offered "just in time" and at regular intervals to support students in continuously monitoring their progress toward a learning goal.
5) **Implemented by Students and Monitored by the Teacher:** Students are expected to act on the feedback. This means that they must be provided time and opportunities to respond with teacher support and that teachers need to follow up on the students' responses.

Good feedback effectively affects the learning of learners. It objectives are as follows:

1) Acquire information about progress and review of students.
2) It increases the performance efficiency of students.
3) It promotes for intellectual activities.
4) It develops self-confidence.
5) It gives feedback for self-awareness and self- management.
6) It searches mistakes and qualities of students.

2.4.2.3. Types of Feedback

There are many types of feedback as per the situation such as workplace, business, school, etc., Following are the some different types of feedback which are seen in an educational setting:

1) **Motivational Feedback:** It is used to reward and support positive behaviour. The aim of motivational feedback is to make the learner feel good and

intended to encourage and support the learner. Since it is not intended to move students forward in the learning process, it can be given on summative assessments.

2) **Evaluative Feedback:** This type of feedback is intended to summarise students' achievement. Its' goal is to measure student achievement with a score or a grade. It does not give guidance on how to improve the learner's reasoning. Since it is not intended to move students forward in the learning process, it can be given on summative assessments.

3) **Descriptive Feedback:** It is that which is intended to tell the learner what needs to be improved. Its goal is to improve student achievement by telling the learner how to move forward in the learning process. This feedback is not much effective in getting students to move forward in the learning process.

4) **Effective Feedback:** It is that which is intended to be used by the learner to independently move their reasoning to the next level. Its goal is to get student to internalise the effective feedback to use the suggested strategies independently on future work. Criteria-based phrases are used to describe the strengths and weaknesses of the learner's work.

5) **Intrinsic Feedback:** It is feedback which comes from within own self, e.g., a person engaged in thinking and pondering over ideas, evaluating options and assessing their outcomes. This type of feedback is important for autonomous learners who are at a level where they know themselves what needs to be corrected purely by the feeling of the skill.

6) **Extrinsic Feedback:** It is feedback which a person receives from others, e.g., customer's response to a payment request. This type of feedback is received by seeing and hearing and is used to support intrinsic feedback. Extrinsic feedback is important for beginners/cognitive learners who have yet to develop the feel of the movement. The feedback can be positive or negative.

Some other common types of feedback include:

1) **Positive Feedback:** Received when a movement is correctly performed and is used to reinforce the action. Positive feedback can be intrinsic or extrinsic and is used to motivate performers; if they are told by their coach they are performing a skill correctly they will firstly feel an intrinsic reward for being praised and secondly continue to perform the skill to a high level. Positive feedback is even more essential for beginners to motivate them to continue with the learning process.

2) **Negative Feedback:** Received when a movement is incorrect and in order to prevent the incorrect action from being repeated. Negative feedback can be intrinsic of extrinsic. Extrinsic feedback reduces the chance of bad habits developing if given to cognitive and associative learners. Intrinsic negative feedback is used more for more experienced/autonomous performers who may begin to detect and correct their own errors; they need to be making small, specific corrections.

2.5. PLANNING AND PREPARATION OF AN ACHIEVEMENT TEST (INCLUDING BLUEPRINT)

2.5.1. Introduction

Test construction was originally driven by an interest in the measurement of mental abilities. Their conceptualisation drove the technology that for a long time has been applied to test construction. When achievement began to be measured, the principles of test construction applied were identical to those used in the measurement of abilities.

In the beginning of sixties, the cognitive movement started to question the lines along which achievement had been previously defined and measured. Selection is often the main goal of ability testing, whereas diagnosis at an individual or institutional level, in addition to accountability, is also a goal of achievement testing. These differences and others have led to the development of new tools in test construction and to a divergence from the technology developed in aptitude measurement.

In general, some of these advances are development of criterion referenced tests, attempts to generalise the use of open response as an alternative to multiple choice items, and the increasing role within the educational movement of authentic assessment.

2.5.2. Achievement Test

Achievement is the word preferred in the educational or psychometrics fields. It sometimes characterised by the degree of inference required on the part of the student to give a response, and by the type of reference to a cognitive process made explicit in the measurement tool.

Achievement tests assess the knowledge, abilities and skills that are at the centre of direct instruction in schools. In the Standards for test construction achievement is viewed basically as the competence people have in an area of content. This competence is the result of many intellectual and non-intellectual variables. The scientific study of achievement encompasses data coming from experiments with word lists as well as from the acquisition of complex domains, like computer programming, mathematics, or the way in which people solve physics problems.

At the experimental level, achievement is referred to as acquisition, learning, or knowledge representation, sometimes depending on theoretical biases. Some of the definitions of achievement test are given below.

According to Waters, "Achievement test act as useful aids in diagnosing the student's specific learning needs for identifying his relative strengths and weaknesses."

According to Super, "An achievement test or proficiency test is used to ascertain what and how much has been learnt or how well a task can perform."

According to Freeman, "Achievement test is a test designed to measure knowledge, understanding and skills in a specified subject or a group of subjects."

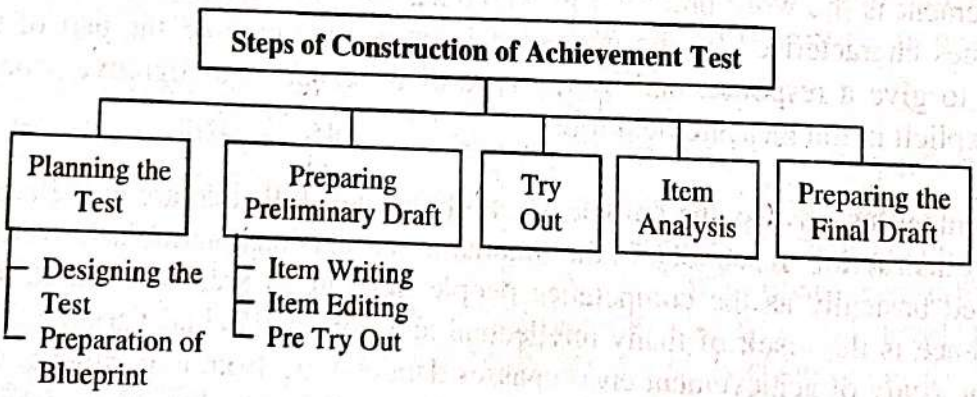
According to N.M. Downie, "Any test that measures the attainments or accomplishments of an individual after period of training or learning is called achievement test. It helps to permute the student to next class."

Achievement tests may be standardised or non-standardised. Standardised test are created by the professional agencies and use the same materials and administration procedures for all students. Non-standardised tests neither have the assessment materials nor has any student-based data. These tried out by a publisher. Data have been collected concerning how well the test is functioning.

The main purpose of achievement test is to measure some aspect of the intellectual competence of human beings. It means that what a person has learned to know or to do. Different people use it in different ways as teachers use achievement tests to measure the attainments of their students, and employers use achievement tests to measure the competence of prospective employees and professional associations use achievement tests to exclude unqualified applicants from the practice of the profession. In any circumstances where it is necessary or useful to distinguish persons of higher from those of lower competence or attainments, achievement testing is likely to occur.

2.5.3. Steps of Construction of Achievement Test

Following are the steps for constructing an achievement test:



1) **Planning the Test:** Planning of achievement test will be carried out with the help of following two steps. These are:
   i) **Designing of Test:** Designing is most important step in the building test. Designer should be careful about planning and making test successful. He should keep this in mind that how and what types of questions are used. He has to decide weightage for different objectives and units in the course. Following points helps designer to design test in systematic way:
      a) Identification of objectives,

b) Measurement of content,
c) Allotment of time,
d) Allotment of marks,
e) Include multiple choice question, and
f) Emphasis on each subject and area of question.

ii) **Preparation of Blueprint:** After designing the preparation of blueprint is started. It is the last stage of the planning of test. Here test constructor put various type of question in blueprint and allots them marks depending on the time. The tester writes down his decisions in the form of a blueprint.

2) **Preparing Preliminary Draft:** Preliminary draft is prepared by following three stages:

i) **Item Writing:** It is an important step in preliminary draft and here blueprint is used as a guide writing this draft. Test conductor should have following points in mind when he writes items for preliminary draft:
a) Each item contains single idea,
b) Questions should be clear,
c) Simple and easy to understand,
d) Double barrelled question should be avoided,
e) Arrangement of items should be from simple to complex, and
f) Subjective question should also be avoided.

ii) **Item Editing:** Then the item should be edited and reviewed by language teacher and also by experts of measurement. Language teacher will check the errors in language and defect in words. By removing defects it is submitting to experts. Experts of measurement measure the level of achievement of items.

iii) **Pre Try Out:** The draft is modified and removes the shortcomings of preliminary draft. In this stage constructer is confident for the usability of test.

3) **Try Out:** To ensure the proper operating of test items and to remove shortcoming, it is essential to have try out of items. This helps in predict how students will work in actual practices. At the try out stage, the test should be so timed that nearly 90% of the sample should be able to attempt all the items of the test. The test sheets alongwith answer sheets are collected and answer sheets are used for scoring with the help of scoring keys. Keep following points in mind while testing in sample:
a) Proper sitting arrangements,
b) Time of administrating the test,
c) Total time required for test, and
d) Proper motivation with the pupil.

4) **Item Analysis:** In this stage test constructer examining the responses of respondents in the sample to each test item. It can also be define as it is a statistical procedure by which the appropriate items are selected for the final draft and poor items are rejected. Item analysis is an analysis of responses made to 'teacher made tests' by the pupil in the class.

5) **Final Draft:** In the final draft questions should be arranged in such way that easy, average and difficult and again starts from easy and so on. By doing this student atleast go through whole test because he know that some of remaining questions are easy. When the test is arranged properly with the help of principles, a clear identity of test is appeared.

6) **Establishment of Reliability, Validity and Norms:** With the selection of good items final draft has been prepared and the final step is the establishment of reliability, validity and norms. These test items administered to a larger sample.
   i) **Reliability:** The reliability of a test measures whatever it measure. There are many methods for computing the reliability of a test and the most appropriate method for computing reliability of achievement test is Split-half method.
   ii) **Validity:** It is very important aspect of test and it can be determined as the degree which is capable of measuring achievements and it is design to do so. Valid test is highly reliable. Validity is measured by four methods.
      a) Face validity,
      b) Content validity,
      c) Concurrent validity, and
      d) Predictive validity.
   iii) **Norms:** It is average score of sample population. These are the level obtained by a particular group of persons on a test. There are many types of norms like age norms, grade norms, percentile norms and standard scores.

2.5.4. Objective Type Test

Objective test items are items that can be objectively scored items on which person selects a response from the list of options. In this form of questions, the answers are completely controlled and so the assessment becomes entirely objective and impersonal. One common misconception about the objective test item is that it is limited to testing specific, often trivial, factual details, which would sometimes lead to the use of an essay or performance test to assess students' comprehension of broader principles or their ability to apply them. However, as **Robert Ebel** pointed out, well written objective tests (especially multiple choice tests) can actually assess such higher-order abilities to some extent. While it is true that some types of knowledge or abilities cannot be assessed by objective tests, educators also should keep in mind that what test items can assess depends largely on the skills and effort of the test constructor, rather the test format *per se*.

Under the objective type, the following is used more often:

1) **Multiple Choice Items:** This type of questions consists of:
   i) **Stem:** The text of the questions which may be a direct or incomplete statement.
   ii) **Options:** The choices provided after the stem. Three to five responses which include:
      a) Key,
      b) Distracters,

These types of questions seem easy to prepare, but in reality it is a challenging task. The following are the suggested steps for constructing multiple choice items.

Questions construction should be in following ways:

i) The question should be as clear and direct as possible (avoid extraneous information).
ii) Provide as much information as possible with as few words as possible.
iii) Avoid trick questions that mislead or potentially deceive.
iv) Instruct students to choose "best answer" if appropriate.
v) Test for only one concept/idea per question.
vi) Begin the test with a few quick and easy questions.
vii) Balance the difficulty level of your test questions.

Suggestion for constructing 'Alternatives' (Item):

i) Avoid patterns in the location and length of correct answers.
ii) Check carefully for grammatical and spelling errors, especially in the distracters.
iii) Avoid answering one question in the test by giving the answer somewhere else in the test.
iv) Present alternatives in a logical order (chronological, numerical, etc.).
v) All distracters should be plausible.

2) **True or False Items:** True or False are the statements which the test taker has to think and decide whether the statement is True or False. This kind of test is used when the teacher wishes to measure a student's ability to find True or False statements. This kind of test can be constructed by keeping in mind the following points:

i) Keep language as simple as possible.
ii) Avoid taking the statement verbatim from the text.
iii) Focus on a single concept or ideas.
iv) Avoid negative statement (especially the double negatives).
v) Avoid long and complex sentences.
vi) Avoid using words 'always', 'never' 'often' and other adverbs that make the statement either True or False.

3) **Match Pairs Items:** This type of test consists of two columns A and B. Matching questions are good for testing learner understanding of relationship. Suggestion for constructing matching test items:

i) Provide more possible options than the questions. The more the possible responses more possibility the student passes the test.
ii) Make five premises with only three responses to choose from. This makes the task challenging.
iii) Sometimes unequal premises and responses are fine to avoid redundancy, but proper instructions must be given to the learners.

iv) Use longer phrases as questions and shorter phrases as options. Longer phrases are helpful because they explain the statement while shorter premises make the answer in an objective mode.

v) Number each question and use alphabetical letters for the options. This will help the learners.

4) **Cloze Items:** This type of test is used to measure reading comprehension, ability to decode incomplete messages by making the most acceptable substitution from the contextual clues available. It involves a piece of text from which a number of words have been removed. In fact, to complete a cloze passage correctly, it requires linguistic, textual and sometimes world knowledge. Suggestion for constructing cloze test items:
   i) The chosen passages should be at a level of the learners.
   ii) The test should be of a style appropriate to the kind of language ability being tested.
   iii) Deletions should be made at about every eighth or tenth word.
   iv) Clear instructions should be devised.

5) **Fill in the Blanks/Completion Type Question:** Fill in the blanks/ Completion type of questions requires productivity skills. Here the learners need to supply word(s) that is linguistically compatible to the context to fill the blanks provided. A possible advantage of this type of questions is that the student must supply with correct answer rather than supplying guessed answers.

2.5.4.1. Characteristics of Objective Type Tests

There are following characteristics of objective type tests as given below:

1) **Objectivity:** Personal prejudices should not effect scoring under a good system of examination. The chief demerit of essay type examination is that they are not objective. The more the number of examiners of an answer book, the more difference in the marks awarded in them. On the other hand, the newest examinations are objective in nature as contrary to it.

2) **Reliability:** It in examination means that if answer sheets are evaluated by another group, no difference should occur in scoring. In other words, when an examination secures the same scoring repeatedly, it would be considered reliable. Objective type examination is reliable.

3) **Validity:** The purport of validity is by its meaningfulness, that is the examination should be able to measure the fact for which it has been created. **According to Cronback,** 'the validity of a testing is that extent upto which it measures for which it has been constructed'.

4) **Classification:** Objective type tests are classifying because questions in these examinations are so selected as to classify students as dull students, average students and bright students.

5) **Extensiveness:** Objective type examinations are true representative of the whole syllabus, that is, in it, the questions from the whole curriculum are given.

6) **Easiness of Marking:** Instructions are given with regard to marking of answer books, so that marking can be done even by an ordinary person.

2.5.4.2. Benefits of Objective Type Test

Several benefits of objective type test are as follows:

1) **Unambiguous:** Good MCQs are designed to be objective. They usually have one (or a few) definite answers that are given as choices for the students to select. Thus there will be no ambiguity in marking due to subjective factors in the questions. Objective MCQs are easy to mark (a set of answer sheets is all that is required from the assessor) and thus do not require experienced tutor to mark them.

2) **Less Time Consuming:** Multiple choice tests often require less time to administer for a given amount of material than would tests requiring written responses. This results in a more comprehensive evaluation of the candidate's extent of knowledge. Even greater efficiency can be created by the use of online examination delivery software. This increase in efficiency can offset the advantages offered by free-response items. That is, if free-response items provide twice as much information but take four times as long to complete, multiple-choice items present a better measurement tool.

3) **Online Assessments:** MCQs can be administered as online assessments, such online assessments can be very effective, and can prompt correct answers directly after completion with clarification and reasoning of the answers.

4) **Reliability:** The objective type tests eqjoy much more reliability as compared to any other test. In these tests, any person who marks the papers, no variation occurs or any influence works.

5) **Validity:** These tests measure only those predetermined ability for which these are constructed. This quality is known as validity.

6) **Comprehensiveness:** Objective type tests are more comprehensive. Questions from various chapters can be asked. Hence, the pupils have to study all the chapters.

7) **Discrimination:** The mqjor quality of objective type test is their ability of discrimination. By these tests, talented and mentally retarted pupils can be easily identified and special provision can be made for their education.

8) **Practicability:** Objective type tests are practicable. These tests do not face any difficulty when these are to be used. These tests consume less pages and are economical.

2.5.4.3. Limitations of Objective Type Tests

Salient limitations of objective type tests are as follows:

1) **Dependence on Presentation:** If student have bad handwriting the examiner may be unable/unwilling to struggle in order to understand his/her answer. Conversely, student may present a well laid out and planned answer that contains a lot of "waffle" or hazy knowledge, yet receives a good mark.

2) **Facility in Writing:** "Those who write fluently, speedily and whose flow of thought comes easily, have an advantage over those who think more slowly (but possibly more deeply) and those who write with less facility (but possibly with better quality content)."

3) **Question Evasion:** If there are several questions in a subjective test, only some of which must be answered, then it is possible for the candidate to avoid questions in areas of the curriculum in which they are weak. It also follows that as candidates are free to choose a subset of the test questions, it becomes difficult to compare candidates as they are effectively taking different tests.

4) **Question Spotting:** A good strategy for preparing to take a subjective test is to look at past papers. Candidates soon spot recurring questions on specific topic areas so that it becomes possible to only revise some of the syllabus and still obtain a respectable grade.

5) **Variation in Marking:** This is possibly the greatest disadvantage to a subjective test – inconsistency in subjective assessment. Research has shown that experienced examiners award widely varying marks not only on the same piece of work marked by other examiners, but on their own marked scripts re-marked after a passage of time.

6) **Used for Assessing Knowledge**: MCQs are typically used for assessing knowledge only, students may often memorise MCQs with rote learning. If assessors wish to use MCQs to assess deeper learning, careful attention (and many practices) on appropriate questions are required.

7) **Used as Formative Assessments:** MCQs are usually used as formative assessments during class. They have a reputation of being easy. Thus students tend to receive higher marks in comparison to other assessments such as essays, reports, and presentations etc., for which a "glass ceiling" of around the 80% mark are often incurred. Care must be taken to design MCQs which have the same level of difficulty as other assessments.

   Obviously, students are unlikely to complain if they receive high marks in a formative MCQ assessment, but for summative assessment, if a different assessment method is used (which is usually the case), then students should be given clear assessment procedures and expectations. It is advisable to give practices on other assessments if such assessments are used for summative assessment.

8) **Guessing with MCQs:** There is a possibility of guessing the correct answer, there are numerous methods to penalise students from guessing, such as negative marking (not recommended as sometimes produce negative effects to students who know the answers), more options to answers, adopting mathematical strategies to normalise marks, giving partial marks to an answer very near the correct answer.

2.5.5. Subjective (Essay) Type Test

In this type of test few questions are given and the students are expected to answer in detail. An attempt is made to judge the students' abilities of expression, creativity, style of writing, language in use, coherence and cohesion, etc. The judgement is done by using rubrics.

According to Arikunto (2007), "Subjective test is generally a test which needs answers in form of essay, explanation or description. Usually in doing this test, students will be given about 90-120 minutes for 5-10 questions When a teacher uses subjective test questions, that means students need to use their mind and feelings to make logical claims."

According to William Weirsama, "Essay test is a test that requires the student to structure a rather long written response upto several paragraphs."

Essay items are useful when examinees have to show how they arrived at an answer. A test of writing ability is a good example of this kind of test that should be given in an essay response format. This type of item, however, is difficult to score reliably and can require a significant amount of time to be graded. Grading is often affected by the verbal fluency in the answer, handwriting, presence or lack of spelling errors, grammar used and the subjective judgements of the grader. Training of graders can require a substantial amount of time and needs to be repeated at frequent intervals throughout the grading.

Essay questions provide a complex prompt that requires written responses, which can vary in length from a couple of paragraphs to many pages. Like short answer questions, they provide students with an opportunity to explain their understanding and demonstrate creativity, but make it hard for students to arrive at an acceptable answer by bluffing. They can be constructed reasonably quickly and easily, but marking these questions can be time-consuming and grader agreement can be difficult.

Essay questions differ from short answer questions in that the essay questions are less structured. This openness allows students to demonstrate that they can integrate the course material in creative ways. As a result, essays are a favoured approach to test higher levels of cognition, including analysis, synthesis and evaluation.

However, the requirement that the students provide most of the structure increases the amount of work required to respond effectively. Students often take longer to compose a five paragraph essay than they would take to compose five one paragraph answers to short answer questions. This increased workload limits the number of essay questions that can be posted on a single exam and thus can restrict the overall scope of an exam to a few topics or areas. To ensure that this does not cause students to panic or blank out, consider giving the option of answering one of two or more questions.

2.5.5.1. Characteristics of Essay Type Tests

Major characteristics of essay-type tests are as follows:

1) **Easy for Construction and Administration:** The construction of this type of questions is simple, because a person's achievement can be measured by one or two-line questions. Because it takes little time in their construction, they are very useful in the solution of immediate problems. Sometimes, a

teacher can construct these questions a few moments before the examination in the examination hall itself. Due to the simplicity of questions, their administration too is quite simple.

2) **Economical:** The next characteristic of these traditional tests is their economy. They are economical from time, finance, individual and material viewpoints. Less time is needed for constructing and solving questions.

3) **Freedom of Thoughts:** A student gets opportunity to express his thoughts freely. He/she can writes anything about an object, process, individual or fact without any hesitation.

4) **Emphasis on Expression of Emotions and Critical Thinking:** With the freedom of expression, emphasis is also given on expression of emotions and critical reflection. A student can express a fact differently on the basis of his unique experiences.

5) **Decision about Writing Style:** This type of tests cultivate writing styles of a student, such as simple language, use of terms, idiomatic language, skill in extensiveness, writing ability, etc.

6) **Study of Higher Mental Abilities:** Essay-type tests make it possible to study higher mental abilities of a student. The problems which require arguments, analysis, explanation, etc., on them these tests can be used successfully, because they measure a student power of thinking, expression and intelligence.

7) **Evaluation of Personality:** These tests are very helpful in the evaluation of personality too. An article written by a person can be used to measure his different aspects of his personality, such as interests, values, attitudes, aptitudes, personality traits, etc.

8) **Suitable for All Science Subjects:** As compared to objective-type tests, essay-type tests can be used in all school subjects. There are certain subjects in which objective-type tests cannot be used; therefore, essay-type tests proves to be useful in them. Therefore, these are used in all school subjects extensively.

9) **Encouragement to Comprehensive Study:** Essay-type tests encourage wide study with the help of different methods. Because a student has to answer a question in 5-6 pages, so he studies intensively, outlines his study, writes briefs and attempts to learn the main points.

10) **Less Possibility of Copying:** Essay-type tests are very large, and there is less possibility of copying due to writing style and intensity of content.

2.5.5.2. Benefits of Essay Type Tests

Following are the benefits of essay type tests:

1) **Based on Extensive Curriculum:** The questions asked in essay type examinations are related to the whole curriculum. At the least, it is attempted that no important part of the curriculum is left out. This examination can be used to determine the knowledge of students in relation to all lessons and developed mental ability.

2) **Freedom of Expression and its Successful Testing:** Students have to give written answers to questions. They use their imagination, logic, etc., to express themselves independently. On the contrary, students have no freedom to write anything of their own in an objective type examination.

3) **Easiness from Viewpoint of Construction:** The making of examination papers for essay type examinations is not a difficult job. It does not require prior training on the specific skill. In fact, any teacher with satisfactory knowledge of a subject can make an examination paper. The paper can be made in very short period of time.

4) **Testing of Important Mental Abilities:** Where the objective type examinations are related with memorising and recognition of the mental abilities, on the other hand, by the essay type examination, the logic, thinking, criticism, expression, etc., faculties of students are also tested besides their memory power.

5) **Suitable for All Subjects:** The essay type examination is suitable for all subjects, and papers for all of them can be prepared. The objective type examination is used only for the testing of a few skills and abilities.

6) **Use of Known Facts in Other Circumstances:** The only objective of imparting experiences in students from the education world is not to make them cram facts as they are, but is to enable them to use the received knowledge in desired circumstances. The objective type examinations do not help much in the achievement of this objective, whereas the essay type examinations creates ample opportunities to use the known facts in narrative, analytic and critical style.

7) **Helpful in Development of Writing Ability and Testing:** The writing ability of students cannot be tested by objective type tests because the answers have only to be marked in them or the answer has to be produced in a couple of words. On the contrary, the essay type examinations not only help to develop writing abilities in students, but also tests the extent to which the writing is organised, ordered, pure, fluent, original, clear, etc.

8) **Saving on Time, Labour and Money:** The construction of objective type tests is comparatively difficult and question-setter have to put in special training and labour. Besides, more money is to be spent in the construction, printing and evaluation. On the other hand, essay type papers can be made easily and time, labour and money are saved on their making.

2.5.5.3. Limitations of Essay Type Tests

There are following limitations of essay type tests as given below:

1) **Emphasis on Cramming:** Only a few important questions are asked from the whole curriculum in an essay type examination. So, students learn a few guessed questions in place of preparing the whole curriculum. If these guessed questions appear in the paper they will pass the exam, else they fail. This is the reason that these examinations are criticised in the education field. This technique is completely unpsychological for the development and evaluation of students.

2) **Limited to Bookish Knowledge:** Essay type examinations test how thoroughly and extensively students have learnt the knowledge of books. This examination does not test their emotions, feelings and other traits and skills. It can also be not known how far they can use bookish knowledge in practical life.

3) **Unclarity of Objectives:** Evaluation and objectives have deep relationship with each other. The chief objective of evaluation is to acquire knowledge regarding achievement of educational objectives. In fact, an examiner should have, before the construction of test papers, the knowledge of achievement of the objectives to prepare the paper for. However, examiners think that they should frame maximum questions from the curriculum as per the objective of the examination. Thus, they overlook real objectives. This is the reason that these examinations fail to evaluate real educational objectives.

4) **Insufficient Representation of the Curriculum:** The main questions are asked in essay type examinations and they do not represent the whole curriculum. Often, ten questions are asked in these papers out of which students have to answer five. The truth remains that only about 50 per cent questions of the curriculum are asked. Due to insufficient representation, suitable evaluation of students' development cannot be carried-out.

5) **End, not Means:** The examination is only a measure for the real circumstances. This real circumstance can be evaluated and decision can be taken for future programme. As a matter of fact, the chief objective of education is the all-round development of student by getting continuous or periodical evidences in which the examination is used as a means. But, today, an examination has come to be accepted as an end in itself. Students have come to think of passing examinations as their sole objective.

6) **Waste of Time and Money:** Much expenditure has to be made in the construction of test papers, their printing, arrangement of answer books, their evaluation, etc. It almost takes a month in their organisation. Much time and money has to be devoted for checking answers.

7) **Difficulty in Suitable and Unprejudiced Evaluation:** No standard has so far been made under the evaluation of essay type examinations on the basis of which the development of students can be measured. Sometimes, students are declared a failure if they lack only a couple of marks or they fail to get a higher division. In addition to this, it has been proved many times on the basis of re-evaluation that various examiners award different marks on the answer book of the same examinee. The self-purpose and the mentality of examiners prove a hindrance in the way of judicious evaluation of examinees.

8) **Unsatisfactory and Doubtful Evaluation:** Sometimes general nature questions are asked in place of questions based on the knowledge of a curriculum in essay type examinations. Due to this, a little dull student finds it tough to proceed further, and on the other, even a student who has memorised the maximum curriculum too fails to get satisfactory marks.

9) **Effect of Language Style and Writing Speed:** It can be seen in essay type examinations. Students with mastery on language can express their thoughts

effectively and students with rapid writing speed get good marks despite their failure to write not much relevant answers. On the other hand, students with maximum knowledge of the curriculum fail to secure good marks in the absence of good writing speed.

10) **Indefiniteness in Respect of Answers:** There is no definite standard of writing answers in this technique of examination. Each student tries to answer according to their own style. They often do not pay attention to orderliness, logic and completeness of knowledge. They generally try to mislead examiners on the basis of their language style. On the other hand, examiners too have no definite standard by which they can ensure which form of answer or draft they should consider the best

11) **Undeveloped Ability to Use Knowledge:** In these examinations, students are unable to use their knowledge in the absence of various mental abilities. So, it has been often seen that the presentation of students is not satisfactory or up to mark when analytical, critical or synthetically questions are asked. They can reproduce the learnt knowledge, but they lack the ability to present examples accordingly to use the aquired knowledge in new circumstances.

12) **Impediment in Physical and Mental Health:** In this method of examination, students often do not study for the whole year. They begin to study a few days before the examination. Excessive studying during this period makes their routine irregular. It affects their health adversely. Besides, they remain anxious and troubled due to the fear whether possible or guessed questions will appear in papers or not.

13) **Absence of Stimuli:** Under essay type examinations, students do not get proper stimuli to gain permanent knowledge. Its chief reason is that students have to memorise the subject matter which has no direct bearing with their real life. Due to this reason, students come to think of passing examination as their sole objective.

2.5.6. Difference between Objective and Subjective Type Test

Differences between objective and subjective type test are given under following **table 2.2**:

Table 2.2: Difference between Objective and Subjective Type Test

Objective Test	Subjective Tests
Objective tests are so called according to their scoring which depends on personal judgements or opinions.	Subjective tests are so called because their scoring depends on personal judgements or opinions.
The techniques used in objective tests multiple – choice items (MCI), True/false items, matching items, transformation sentences, re-arrangement items and fill the blanks or gap filling.	The techniques used in subjective tests include: essay writing, composition writing, letter writing, reading aloud, completion type, and answer these questions.

Objective tests need much time and effort to write the questions because the examiner has to provide the answers as well as the question so that objective test requires more careful preparations than other types of test.	But in subjective test the examiner needs to write few questions without answers.
In objective tests, it seems that kind is more reliable because it gives a stable scoring.	In subjective test, it seems, it is not reliable because it doesn't give a stable scoring.
Objective tests are used to test structures, vocabulary, comprehension, and sound discrimination.	Subjective tests are used to test ideas, culture, coherence and creativity.
Objective tests encourage guessing and it is difficult to write, simple to answer, easy to score, suit for a large number of testees, and this type of test can be scored by a machine.	Subjective test doesn't encourage guessing easy to write, difficult to score and suit for a small number of testee. This type of test can't be scored by a machine.
Objective test can be used to test specific area of language, while, subjective test can be used to evaluate overall achievements. Furthermore, objective tests require recognition more than production.	Subjective tests require production as well as recognition.
An objective test is a type of discrete point test.	Subjective test is a type of an integrative point test.
Objective test is a type of close–ended atomistic, a system–referenced and it applicative test and replicative test.	Subjective test is a type open–ended test, a holistic and replicative and it isn't applicative.
Objective test depends on students' knowledge. It is a valid test which student's need a short time to answer than subjective test.	Subjective test depends on student's experience. It is an invalid test and students need a long time to answer than objective test.

2.5.7. Blueprint

A test blueprint is a specification of what the test should cover rather than a description of what the curriculum covers. The test blueprint is used to guide and target item writing as well as for test form assembly. Use of a test blueprint improves consistency across test forms as well as helping to ensure that the goals and plans for the test are met in each operational test.

A test blueprint should include the test title, the fundamental purpose of the test, the aspects of the curriculum covered by the test, an indication of the students for whom the test will be used, the types of task that will be used in the test (and how these tasks will fit in with other relevant evidence to be collected), the uses to be made of the evidence provided by the test, the conditions under which the test will be given (time, place, who will administer the test, who will score the responses, how the accuracy of scoring will be checked, whether students will be able to consult books (or use calculators) while attempting the test, any precautions to ensure that the responses are only the work of the student attempting the test, and the balance of the questions.

According to Newble and Dawson, 1994, a test blueprint "specifies all the elements of performance relevant to the assessment so that appropriate samples of activity and corresponding methods can be selected according to their relative importance to the overall assessment process."

Preparation of the blueprint helped the investigator to have an objective-based Achievement Test giving due weightage to objectives, content area and forms of questions. To decide the weightage to be given to different content areas, objectives and different forms of questions, experts' opinions of the teachers were taken into consideration.

The content areas listed in the test blueprint, or table of specifications, are frequently drawn directly from the results of a job analysis. These content areas comprise the knowledge, skills, and abilities that have been determined to be the essential elements of competency for the job or occupation being assessed.

In addition to the listing of content areas, the test blueprint specifies the number or proportion of items that are planned to be included on each test form for each content area. These proportions reflect the relative importance of each content area to competency in the occupation.

Following table is the example of blueprint:

Table 2.1: Blueprint

Class-IX **Topic** **Duration40minute**
Max marks-25

Serial no.	Instructional Objective	Knowledge			Comprehension			Application			Skill			Total
	Types of Questions	L	S	O	L	S	O	L	S	O	L	S	O	
1							2(2)							2
2														2
3				2(2)										16
4		10(2)							2(2)			4(2)		14
5				2(2)		4(1)	2(2)			6(6)				8
6						4(2)	4(4)							2
7				2(2)										6
				4(2)	–		2(2)							
				10(2)		8(4)	10(2)	–	2(2)	6(6)	–	4(2)	–	40(32)
				20			**18**			**8**			**4**	**50**

Note: Numbers of questions are indicated inside the bracket and marks are indicated outside the bracket.

L = Long Answer No-1 5 marks Knowledge 40%

S = Short Answer No-5 10 marks Comprehension 36%

O = Objective Type No-10 10 marks Skill 8%

2.5.7.1. Characteristics of Blueprint

Chief characteristics of blueprint are given below:

1) It is a matrix or chart reporting the number and type of test questions.
2) The questions represent the topics in the content area.
3) The questions are based on the learning objective from each topic.
4) It also identifies the percentage (%) weighting of cognitive dimensions.

2.5.7.2. Objectives of Blueprint

Main objectives of blueprint are as follows:

1) To provide conceptual map of examination format and the content area.
2) To guide item collection and development.
3) To provide a clear framework for the researchers to design items which assess the important concept or thinking skill listed in the test blueprint.
4) To provide sources for the formative use of the summative assessment to satisfy the Bloom's taxonomy of educational objective.

2.5.7.3. Constructing a Test Blueprint (Table of Test Specifications)

Following steps are involved in constructing a blueprint:

The test blueprint is made up of a table consisting of basically three main columns as shown in the following table of test specifications:

Table of Test Specifications
Name of Test: .....
Class/Form: ..... Date: .....
Topics to be Tested: .....

Learning Outcomes (from the Science Syllabus)	Bloom's Cognitive Level									Total
	Knowledge			Comprehension			Application			
	E	M	D	E	M	D	E	M	D	
1)										
2)										
3)										
4)										
5)										
Total										

Key: E = Easy, M = Moderate, D = Difficult

1) **Step 1:** Determine the test objectives and the scope of the subject to be tested from the syllabus. The assessment method including not only theory but also any course work and practical work so that the evaluation process will not overlap.
2) **Step 2:** Decide on the test format according to the time available for the test, the item type, number of each type of question and the pupils' ability.
3) **Step 3:** List out all the topics which is going to be tested and the length of time allocated for each topic.

4) **Step 4:** Calculate the percentage to adjust the weight for each topic.
5) Topic hours of interaction × 100 ÷ Total hours
6) **Step 5:** Relate the marks for each type question.

The skill levels in each item can be of the cognitive, affective and psychomotor domains. In this test, the suggested weights for each cognitive level according to Bloom's taxonomy is as follows:

Cognitive Domain	Objective Item	Structural Item
Knowledge	10%	-
Comprehension	30%	10
Application	25%	30
Analysis	25%	20
Synthesis	5%	20
Evaluation	5%	20
Total	100%	100%

2.5.7.4. Uses of Blueprint

It is used in many ways:

1) For the assessment of test specification, i.e., in examination.
2) Evaluating time management and strategy to achieve the desired outcome. Education administrators for curriculum development.
3) Curriculum developers to design comprehensive, sequenced career development learning opportunities.
4) Research and evaluators to design learning plans.
5) Parents/guardians for helping young people to develop their career from early age.

2.5.7.5. Need and Importance of the Blueprint

Blueprint is needed and important for different aspects:

1) It makes the assessment clear, explicit and transparent to everyone involved in the process of learning.
2) It helps to match various competencies with the course content and the appropriate modality of assessment. Effective assessment is possible only when the three elements (Course content, Competencies to be tested and Method of assessment) attain the 'Best fit'.
3) It makes assessment 'fair' to the students as they can have clear idea of what is being examined and can direct their learning efforts in that direction.
4) It helps the teachers in designing the instruction as per the guidelines expected in the curriculum.
5) Ensures that the selected test items "give appropriate emphasis to thinking skills" as "Faculty writing test questions without a blueprint often find that questions asking for simple conceptual knowledge are easier to write than those asking students to interpret, infer, analyse, or thinking other ways."

Subsequently, examiner may have intended to test higher order thinking, but the questions over-emphasise the ability to recall correct facts or recognise correct answers.

6) Blueprint deals with the sampling content, competencies and tools for the assessment in a rational and balanced manner. The aim of blueprinting is to reduce the two major threats to validity.
7) Give feedback on student's progress and teachers delivering the curriculum.
8) From student's point of view, they seek how well they attain the objectives.
9) Provides a guide to both to students and teachers.
10) Determines the reliability and validity of the examination.
11) Bloom's taxonomy helps in developing the written and some aspect of practical questions.

2.6. EXERCISE

2.6.1. Very Short Answer Type Questions

1) What do you understand by formative assessment?
2) Define the summative assessment.
3) Define the observation.
4) What is interview?
5) What do you mean by checklist?

2.6.2. Short Answer Type Questions

1) What is blueprint? Explain in detail.
2) Write a short note on subjective type test.
3) What is difference between formative and summative evaluation?
4) Write a short note on objective type test.
5) What is feedback?

2.6.3. Long Answer Type Questions

1) Discuss in detail assessment tool. Explain characteristics of assessment tool.
2) What are the approaches of assessment? Describe formative and summative assessment.
3) What is questionnaire? Discuss in detail.
4) Focus on self-assessment and feedback.
5) Write a detailed note on 'checklist and rating scale'.

UNIT 3

New Trends and Issues in Assessment

3.1. NEW TRENDS IN ASSESSMENT

Education system of India is full of various complexities. These complexities are present in different nature. Every level of education has its own problems and prospects. However, attempts have been taken to lessen complexities. From ages, time to time various commissions have been constituted to improve and remove these complexities of Indian education system especially, ensuring quality and uniformity in Indian education system.

In the 21st century, we are facing a global economy where information travels at the speed of light and knowledge. Information has become vital to our personal and national well-being.

There is a terrific mismatch between what we are on the brink of today and what is currently in place in both assessment of student learning and in assessment of teaching. A whole series of forces and trends is bearing down on education that portends a sea change. The ground underneath us, is changing dramatically and rapidly.

The new trends in assessment that has emerged are as follows:

1) Semester system,
2) Grading,
3) Credit system,
4) Online examination,
5) Question bank, and
6) Open book exams.

3.1.1. Semester System

A semester system is an academic term. It is a division of an academic year, the time during which a college holds classes. It also might be applicable in the schools and universities. Usually, a semester system divides the year in two parts or terms. Sometimes, it might be trimester or quarter semester.

Literally, semester means six-month period. In India this six-month system is generally followed. In schools we find the year divided in between two (often three) major examinations in and around the vacations. The central universities in India have been long following this from quite some time.

The key facets of the new semester system are as follows:

i) Two semesters of five to six months in duration *versus* academic terms spread over 10 to 12 months.
ii) Credits based on the workload of the learner with one credit point, generally corresponding to 30 to 40 learning hours.
iii) Comprehensive continuous assessment versus end-of-year examinations.
iv) New assessment protocols based on grades rather than marks, and the use of cumulative grade point scores to define overall achievement.
v) Curricular flexibility and increased options for student mobility.
vi) Regular updates to curriculum.

Indian institutions have traditionally worked on the 'academic session,' with grading based on end-of year examinations, as opposed to end-of-semester examinations as is more common in Europe and North America. Among other things, the MHRD hopes the new semester system will lead to increased student engagement throughout the academic year, while also reducing the burden of end-of-year cramming.

3.1.1.1. Objectives of Semester System

Some of the objectives of the semester system are as follows:

1) To broaden the outlook of the students and instill in them a sense of confidence and responsibility.
2) To provide more chances to remain well versed.
3) To show a detailed account of the student's progress graph can be produced in semester system.
4) To acquaint the students with different forms, styles and thoughts in other parts of the country and beyond.
5) To allow greater interaction with teachers and the students will be more focussed on preparing throughout the year.

3.1.1.2. Advantages of Semester System in Education

The advantages of semester system are given under following points:

1) In semester system, students get a chance to study different subjects.
2) In semester system, assignments are given to students which help them to have knowledge other than the defined syllabus.
3) Students have option to study some subjects according to their choice.
4) Semester system allows to synchronise undergraduate studies with postgraduate courses.
5) Teacher and student interaction increases and teachers have more information about their students.
6) Contents of courses are decided by teachers and they can decide them by reviewing student's interests.
7) Students get more vacations because they get a semester break after final exams of every semester.
8) In semester system, credit hours are defined and students have to study just according to the defined credit hours.

3.1.1.3. Disadvantages of Semester System in Education

Following are the disadvantages of semester system:

1) Students have to manage the syllabus in short time.
2) Sometimes, teachers cannot convey the whole knowledge of the subject due to short time.
3) Students do not get time for extra study; as a result they just have basic knowledge of the subject.
4) In semesters system, students do not get chance to re-evaluate their papers, so they have to manage and maintain their grades.
5) There is less time for research, students do not get enough opportunity to research.
6) Time passes very quickly and it does not let students to have complete knowledge about the subject.

3.1.2. Grading

Grading in education is the process of applying standardised measurements of varying levels of achievement in a course. Grades can be assigned as letters generally, A to F, as a range, e.g., 1 to 6, as a percentage of a total number of questions answered correctly, or as a number out of a possible total, e.g., out of 20 or 100. Another way the Grade Point Average (GPA) can be determined is through extra-curricular activities.

Grading is the "process by which a teacher assesses student in learning through classroom tests and assignments, the context in which good teachers establish that process, and the dialogue that surrounds grades and defines their meaning to various audiences."

The free dictionary describes grading as, "A number, letter, or symbol indicating a student's level of accomplishment."

In other words, grading is "a level of academic development in an elementary, middle or secondary school."

Generally, the goal of grading is to evaluate individual students' learning and performance. Although grades are sometimes treated as a proxy for student learning, they are not always a reliable measure. Moreover, they may incorporate criteria such as attendance, participation, and effort that are not direct measures of learning.

Most nations have individual grading systems unique to their own schools. However, several international standards for grading have arisen recently. In the General Certificate of Secondary Education (GCSE) exam taken by secondary school students in, grades generally range from A* (highest) to G (lowest). However, in GCSE Science, Additional Science, Mathematics, Statistics, English Literature, English Language, and any Modern or Classical Foreign Language, there are two tiers (higher and foundation). In the higher tier, grades A* to D can be achieved, while in the foundation tier, only grades C to G can be awarded. Generally, a C or above would be considered a pass and a D or below would be considered a fail by most institutions.

Academic grading in India is based on a percentage system. Generally, at the school level percentages of 85-95 are considered excellent while above 95 is exceptional. At the university level, however, percentage between 69-79 are considered excellent and are quite difficult to obtain. The direct comparison of the percentage of marks obtained at one university with that at another is difficult. Indeed, the difference between universities in terms of marking scale can be as much as 20%, with some requiring an 85% plus for the award of distinction, an approximate equivalent of the Latin honour *summa-cum-laude*, while yet others would award distinction at above of 70%.

In some instances, a score close to 90% is very rare and is virtually impossible. Much of this can be reconciled in the backdrop of the minimum pass score. In a university with a 90% plus for distinction, 60% may be the minimum passing mark. The university awarding distinction at 70% may have a passing mark of 45%.

Thus the comparison of GPA is quite difficult for Indian students elsewhere. A student having 95% will be close to 3.9 on the GPA scale, as would a student with a 75% from a 70% cut-off for distinction institution.

3.1.2.1. Purposes of Grading

Measurement experts explain that educators use grades primarily for administrative purposes:

1) To give students feedback about their progress and achievement,
2) To provide guidance to students about future course work,
3) To provide guidance to teachers for instructional planning, and
4) To motivate students.

3.1.2.2. Importance of Grading

Grading is important in many ways:

1) It evaluates the quality of a student's work.
2) It communicates with the student, as well as employers, graduate schools and others.
3) It motivates how the students study, what they focus on, and their involvement in the course.
4) It organises to mark transitions, bring closure, and focus effort for both students and teachers.
5) It is important for the assessment process –principally in the minds of faculty.

3.1.2.3. Advantages of Grading

Grading has various advantages:

1) **Reduce Pressure of Students:** In a general grading system a student's real scores and its associated marks are not accounted on the official transcript, which denotes that their GPA will not have an effect on the either a pass or a fail mark category. This spares the students from getting pre-occupied and become fussy about getting an elevated letter grade like that of an O, and

permitting them to unwind. It still provides the necessary educational prerequisites for them to land themselves comfortably on a good job and also mould themselves to become more responsible citizens in the future. An even better aspect is that they will also receive some credit for the course that they have studied for all these years in the past.

2) **Description of Grading Pattern:** One of the main advantage of this method is that the studious children are clearly discriminated from the average and below the average type of students but this led to the development and mounting up of an intense pressure amidst the students. The advantages of the grading system are that the development of pressure upon the students in terms of studying has appreciably reduced.

3) **Measuring the Students' Knowledge:** This method is using in the field of education which introduced the notion of measuring the students' knowledge based on their internal assignments, projects, and their answering ability in class and their overall performance in all the major examinations and is not just a solitary examination forced method. Earlier the marks that were obtained in the exams are the only indicator of whether a child is studying or not. But, this system analyses whether a child understands the concept or not.

4) **Gives the Students an Obvious Idea about their Weaknesses and Strengths:** Knowing precisely which subjects are their weak spots, students can easily decide where to toggle their focal point on. In a grading system where the alphabets are the scales, a grade of C or grade of D is known to speak a lot. So, when the total grades arrive these students can easily get to know their forte.

5) **Make Class Work Easier:** Suppose if a student knows that getting a D is enough to scrape through the class assignments section in the marking division, he or she will only focus on getting a D without any fuss. Of course, getting a higher grade than a D lies with the student's prerogative only. The point is that the student does not need to toil themselves to achieve the necessary minimum.

6) **Leads to Better Ideas:** Classes or the courses that are often taught in a classroom medium within the confined premises of a school are highly difficult and are taken in the ultimate sense as getting a pass or a fail in a subject and this builds a sense of responsibility in their minds to work and train hard in their weak spots.

3.1.2.4. Disadvantages of Grading

It has some disadvantages too:

1) **Restrict Sense of Competition:** When all that is required is a mere pass mark, we would neither have the urge to outperform others nor do we want to excel with the overall grades. The A grade speaks a lot about our calibre than a D or a F. With a D or F, we can be only satisfied that we are okay enough in studies, which will make us go lazy.

2) **Inaccurate Representation of Performance and Knowledge Gained:** As we know that, passing in an examination cannot be considered as plausible enough to declare that the some student has gained an immense amount of

knowledge by these exams. An alphabet cannot explain the inner knowledge gained by a student and there is no easy way of gauging a student's level of performance and knowledge in the examinations.

3) **Inappropriate Scoring System:** Suppose, let us consider that the science subject is your weak point and with a tremendous effort, let us say that you got an A or a C for all your attempts, which would have made a vast disparity in your sense of accomplishment. Still, the inner knowledge you have gained via these grades can be nil, as you may have attempted for learning without understanding the concept, with the sole perspective of getting an A or a C.

4) **Lack of Incentives:** The traditional letter grading system considers that every alphabet is an inducement to perform good or better or the best. Getting a B could kindle the students to put an extra effort to get an A and is a step closer to getting the highest mark in a class. But, the highest rank in class tag is going to do, not good for the students. To get the tag, the students will only go for rote learning rather than exploring and explaining the concepts on their own.

3.1.2.5. Cumulative Grade Point Average (CGPA)

CGPA is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed upto two decimal places.

CGPA or cumulative grade point average is a system of grade calculation by finding the average of grade points obtained by a student in his/her academic career. Grade point average is usually calculated for a specific period from middle school to high school to see the average score of the student's performance.

In many universities, the GPA is calculated for undergraduate and graduate programmes and is the grading per semester of marks for subjects as well as grades for extra-curricular activities. However, by the end of the course, the entire span's grades are considered and an average is obtained which is known as CGPA or Cumulative Grade Point Average.

The grading is done in alphabetical form like O, A, B, C, D, E, F.
Where, O = Outstanding,
A = Excellent,
B = Very Good,
C = Good,
D = Average,
E = Below Average, and
F = Fail.

The marks range for each of the alphabetical representation may vary from institute to institute. For some, the O level is 80-85 and above, whereas others may have 90+. This goes on for other categories also.

However, when we say average marks, it is below 60 but above 50. The below average range is 40-49 and in all cases, marks below 40 account to failure. The numerical representation of grades may also vary from different institutes. Some choose to have the 7 point system of 5-10 and 0 is fail. Others may have from 1-7 where 1 is Fail.

Computation of CGPA

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\mathbf{CGPA = \Sigma(Ci \times Si) / \Sigma Ci}$$

Where, Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to two decimal points and reported in the transcripts.

CGPA = Sum of grade points (main 5 subjects) divided by 5
For example: 9+9+10+10+9/5 =47/5=9.4 (CGPA)

Calculation of Percentage from CGPA

To calculate percentage from CGPA, simply multiply it with 9.5 such as CGPA=9.4, overall percentage is $9.4 \times 9.5 = 89.3$ % Marks.

Since CGPA is given as a point in relation with 10, in order to obtain the percentage value, the CGPA has to be multiplied with 9.5. **For example,** if the CCPA of a student is 9.2 then the equivalent percentage of marks would be 87.4% ($9.2 \times 9.5 = 87.4$).

Based on the range of marks, the grade and grade point are determined. The grades include A1, A2, B1, B2, C1, C2, D, E1, and E2, in descending order respectively. The highest grade point one receives on scoring an A1 would be 10.0 while the lowest on scoring a D would be 40.0. It is the CGPA that determines the further admission for a student for higher studies.

Advantages of CGPA

Whenever a new system is introduced there are bound be reactions and counter reactions stating the pros and cons of introducing the system.

1) **Fewer Burdens on the Students:** In school, this system means fewer burdens on the students. Since the grades are not based on the final examination only, but calculated with continuous assessment in consideration alongwith final exam marks, it does not stress the students to burn the midnight's lamp and mug up the portion.
2) **Encouraging the Students:** The pattern of units and assessments related to the units ensures that the child is well prepared at all times and once the unit is over, there is no need to revise it for the future participation in school activities, the student is encouraged to showcase his hidden talents and develop an outgoing personality.

3) **Applying Equal Norms:** As far as colleges and universities are concerned, almost the same norm applies. The stringent attendance rule makes sure that the student attends his lectures on a regular basis and does not miss classes. The group discussions, quizzes, etc., encourages the person to sharpen the brain and wits to emerge a winner. Semester wise study lessens the burden of memorising difficult, long chapters and also imbibes a good habit of daily study to score in continuous assessments.

4) **Boost the Morale of Students:** The grades are generalised in particular marking range and not marks specific. This is enough to boost the morale of students who strive to do better yet feel that they cannot compete with the class toppers. The mention of marks may demoralise them, but here since 95+ as well as 85+ come under the same category of grade point, the lower scoring students feel good that they have managed to come at par with the toppers and some day they too can achieve the high score.

Disadvantages of CGPA

It has some disadvantages too:

1) **It Creates Differences among Students:** Just as there are positive traits for adopting the grading system, there are some negative issues too. Since the grades of the toppers, as well as average students, are sometimes categorised under the same grade, this may hurt the outstanding students as they feel that their special efforts are not recognised as exemplary and average students are given the same leverage.

2) **It Differs Student's Views:** Just as the toppers may resent this arrangement, the average students may think differently. For them, even the slightest of sincere input puts them at par with excellent students, so they feel that they not need any extra work since they will have the same grade advantages as the studious ones.

3) **Decrease in Study:** Since the grades are given per semester in college or unit study in schools, the students study for the assessment to get the required grade and show less interest towards the final exams, as they know that the CGPA is finally their year-long performance and not only the final exam.

4) **Grades are Explanatory:** Another disadvantage is that such grades are just explanatory about the student's overall performance in academics and activities.

5) **Not Ascertaining the True Potential of Students:** It does not ascertain the true potential of the person and a person with lower grades may not necessarily be useless or failure in life.

3.1.3. Credit System

An academic credit system is a standard which is used by universities to measure and assess students' works and efforts during their Bachelor, Master or PhD programme. It is important to understand how credits work and how credits from one academic system are converted to credits from other credit systems (if possible).

In other words, a credit system is a systematic way of describing an educational programme by attaching credits to its components. The definition of credits in higher education systems may be based on different parameters, such as student workload, learning outcomes and contact hours.

3.1.3.1. Objectives of Credit System

Following are the some objectives of credit system:

1) To introduce Choice Based Credit System (CBCS) at undergraduate level,
2) To develop curriculum that would facilitate student centric learning,
3) To promote level of examination, and
4) To improve administrative set-up.

3.1.3.2. Advantages of Credit System

There are many advantages of credit system in education system. The key advantages of credit system are given below:

1) The university adopts such a system which allows their students to choose subjects they want to do first. Hence, students feel free to learn; they have much more freedom in deciding on which subject they wish to do first and next.
2) Keep track of student process and determine when he or she has met the requirements for awarding a specific academic degree.
3) Offer a good estimate of the workload of a programme and how it is distributed between the different higher education activities.
4) Some academic credit systems permit students to transfer different programmes and keep part or all of their previously earned credit points.
5) If a student has not graduated a study programme, but wants to find a job, earned academic credits may be presented to employers as proof of previous studies.
6) Some universities use academic study credits to set programme costs.

3.1.3.3. Disadvantages of Credit System

Credit system has some disadvantages too:

1) In credit system, students are bound to take the foundation subject prior to commencing the main one in next term or semester. **For example,** to study Macroeconomics, it is compulsory for them to preliminarily take Micro economics.
2) Credit system can also be deemed to be a waste of time.

3.1.3.4. Choice Based Credit System (CBCS)

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the higher education system of country. The important measures taken to enhance academic standards and quality in higher education, include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the country. This creates difficulty for the educationists and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades.

The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the Cumulative Grade Point Average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).

CBCS aims to re-define the curriculum keeping pace with the liberalisation and globalisation in education. CBCS allows students an easy mode of mobility to various educational institutions spread across the world alongwith the facility of transfer of credits earned by students.

Majority of Indian higher education institutions have been following the system which obstructs the flexibility for the students to study the subjects/courses of their choice and their mobility to different institutions. There is need to allow the flexibility in education system, so that students depending upon their interests can choose inter-disciplinary, intra-disciplinary and skill-based courses. This can only be possible when Choice Based Credit System (CBCS), an internationally acknowledged system, is adopted. The choice based credit system not only offers opportunities and avenues to learn core subjects but also explore additional avenues of learning beyond the core subjects for holistic development of an individual. The CBCS will undoubtedly facilitate benchmarking of our courses with best international academic practices.

Types of Courses

Courses in a programme may be of three kinds – Core, Elective and Foundation. These kinds are explained below:

1) **Core Courses:** There may be a core course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

2) **Elective Courses:** It is a course which can be chosen from a pool of papers. It may be:
   i) Supportive to the discipline of study,
   ii) Providing an expanded scope,
   iii) Enabling an exposure to some other discipline/domain, and
   iv) Nurturing student's proficiency/skill.

An elective may be "Generic Elective" focusing on those courses which add generic proficiency to the students. An elective may be "discipline centric "or may be chosen from an unrelated discipline. It may be called an "Open Elective."

3) **Foundation Courses:** The Foundation Courses may be of two kinds– compulsory foundation and elective foundation. "Compulsory foundation" courses are the courses which are based upon the content that leads to knowledge enhancement. They are mandatory for all disciplines. Elective foundation courses are value-based and are aimed at man-making. The UGC recommends a 10-point grading system with the following letter grades as given below:

Grades	Grade Points
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

i) A student obtaining grade F shall be considered failed and will be required to re-appear in the examination.

ii) For non-credit courses 'Satisfactory' or "Unsatisfactory' shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

iii) The universities can decide the grade or percentage of marks required to pass in a course and also the CGPA required to qualify for a degree taking into consideration the recommendations of the statutory professional councils such as AICTE, MCI, BCI, NCTE, etc.

iv) The statutory requirement for eligibility to enter as assistant professor in colleges and universities in the disciplines of arts, science, commerce, etc., is a minimum average mark of 50% and 55% in relevant postgraduate degree respectively for reserved and general category. Hence, it is recommended that the cut-off marks for grade B shall not be less than 50% and for grade B+, it should not be less than 55% under the absolute grading system. Similarly cut-off marks shall be fixed for grade B and B+ based on the recommendation of the statutory bodies (AICTE, NCTE, etc.,) of the relevant disciplines.

Characteristics of CBCS

Following are the chief characteristics of CBCS:

1) This is a uniform CBCS for all central and state and other recognised universities.
2) There are three main courses, namely, core, elective and foundation.

3) There are also non-credit courses available which will be assessed as 'Satisfactory' or 'Unsatisfactory'. This is not included in the computation of SGPA/CGPA.
4) All the three main courses will be evaluated and accessed to provide for an effective and balanced result.

Computation of Credit

One credit per semester is equal to one hour of teaching, which includes both Lecture (L) or Tutorial (T) or two hours of practical work/field work (P) per week. A study course can have only L component or only T or P component or combination of any two or all the three components. The total credits earned by a student for each semester is L+T+P.

Advantages of Choice Based Credit System

CBCS has various advantages:

1) The CBCS offers a 'cafeteria' approach in which the students can choose courses of their own choice.
2) The credit system allows a student to study what he prefers in his own sequence as per his interests.
3) They can learn at their own pace.
4) They can opt for additional courses and can achieve more than the required credits.
5) They can also opt for an interdisciplinary approach to learning.
6) Inter college/university migration within the country and outside becomes easy with the transfer of credits. This means that it will be easier for foreign universities to come and offer courses in India.
7) Can opt for one part of the course in one institute and the other part in another institute. This will help in making a clear choice between good and bad colleges/ institutes.
8) The students have more scope to enhance their skills and more scope of taking up projects and assignments, vocational training and including entrepreneurship.
9) The system improves the job opportunities of students.
10) The system will help in enabling potential employers assess the performance of students on a scientific scale.
11) Shift in focus from the teacher-centric to student-centric education.
12) Student may undertake as many credits as they can cope with (without repeating all courses in a given semester if they fail in one/more courses).
13) CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.
14) CBCS makes education broad-based and at par with global standards. One can take credits by combining unique combinations. **For example,** Physics with Economics, Microbiology with Chemistry or Environment Science, etc.
15) CBCS offers flexibility for students to study at different times and at different institutions to complete one course (ease mobility of students). Credits earned at one institution can be transferred to another institution.

Disadvantages of CBCS

CBCS has some disadvantages also:

1) Not very easy to estimate the exact marks,
2) Teachers' workload may fluctuate, and
3) Needs proper and good infrastructure for a universal spread of education.

3.1.4. Online Examination System

Online examination system is a web application that establishes a network between the institutes and the students. Institutes enter on the site the questions they want in the exam. These questions are displayed as a test to the eligible students. The answers enter by the students are then evaluated and their score is calculated and saved. This score then can be accessed by the institutes to determine the passes students or to evaluate their performance.

3.1.4.1. Objectives of Online Examination System

Online examination system is to create a platform for online creation, actual sitting and marking of exams.

1) To enables the admin to create subjects to be undertaken by students,
2) To enables the admin to create test conductor,
3) To enables the admin to create students,
4) To enables the test conductors to create tests to be undertaken by students,
5) To enables the admin to create questions to be undertaken by students,
6) To enables the test conductors to create questions to be undertaken by students,
7) To enables the admin to manage exam results,
8) To enables the test conductor to manage exam results,
9) To enables timing of student tests,
10) To enables exams are marked correctly, and
11) To enables students to check their marks online.

3.1.4.2. Advantages of Online Examination System

The advantages of online examination system are as follows:

1) **Security and Confidentiality:** The security and confidentiality of an exam is critical if the exam is to retain its value. Prepared exams need to be securely kept. Any leakage will definitely compromise the standard of the exam and may result to a cancelation or a retake. All these features are well addressed using an online system because not only is the content of the exam safely locked away in a database, access to the database is only possible with an authorised personnel. A lot of possibilities are also opened up on exam day as it allows you to conveniently make your own test in a secure environment.

   Questions can easily be randomised so that no participants see the same questions in the same order. Questions can easily be mixed as each new question is added to the system's database. The questions can then be randomly drawn from the database. This is why most examination bodies have gradually adopted the online platform.

2) **Accessibility and Flexibility:** Exams can be conducted anywhere. All a student needs is a personal computer with internet connection. A student does not need a long commute to exam venue as long as these requirements are met. This also means that thousands of students can take the same exams over a wide spread of locations. Gone are days, students move from one region or locality to another in the name of sitting the examination. A lot of lives have been lost in the process due to accident and other similar mishaps. In the same vein, examiners also benefit from this. Examiners do not have to bother with the laborious task of marking exams as this is well taken care of by the system. The system actually marks each exam and presents the result to the student at the end of the exam. Examiners are also afforded the opportunity to create online exam through an online examination system that can present examinations in multiple languages. Multiple exams on multiple subjects for multiple courses can also be set. Exams can also be configured for 24/7 availability. This allows candidates to take exams at their own convenience.

3) **Cost Saving:** When an exam is placed online, it results in significant cost savings. The cost of paper, copying, and distribution expenses are all reduced or eliminated. The elimination of paper costs alone is extraordinary. The copying and distribution of assignments to a large class are often unwieldy and inefficient. Administrators anxious to reduce expenditures are likely to strongly favour the transition from paper assignments examinations to using online assessment software.

4) **Time Management:** Online examination systems make use of computers that helps in saving time. With the widespread availability of computers and the internet, there is a general acceptability and endorsement of this system. The lengthy formalities and processes involved in creating question papers, registering candidates for exams, answer sheet evaluation and declaration of results are completely eradicated with the online exam system. Each student is timed precisely and all results are generated instantaneously. In some cases, a candidate may even be able to get an assessment on failed questions.

5) **Statistical Analysis:** On a statistical point of view, compared data can be stored over time. This means that different comparative analysis can be done to analyse the outcomes of exams overtime. Depending on the online exam system used, statistical data can be pulled to analyse different data and create reports.

6) **Less Resource Required:** Organisations conducting online tests require fewer resources eliminating the need for costly resources as well. The more students work off-site via the internet, the fewer students will use the physical campus facilities. This results in a reduced need for faculty and staff. The nature of online testing also reduces the printing of tests and other materials required for teaching.

7) **Offers Access to Students with Disabilities:** A great advantage of online testing is its accessibility to students with disabilities. Computers can be customised to cater to those with various physical disabilities in order to place them on a level playing field with other students.

8) **Easy Grading:** Giving grades for online tests is easier than the conventional way of examination and is time saving advantage for educators. Depending on the type of test given, instructors may be able to enter an answer key into the system once and instantly grade all incoming tests. Even on tests that require grading essay type questions, the submitted exams are organised and easy to read for quicker grading.

3.1.4.3. Disadvantages of Online Examination System

Online examination system has some disadvantages too:

1) **Connectivity Issues:** Connectivity can be a serious disadvantage of online testing. A student's internet connection either in a school lab or at home can drop at any time for various reasons. In some cases this could cause the student to lose work or inadvertently submit tests that are incomplete.

2) **Cheating:** The chances of cheating during an online test are tough to eliminate. In fact, unless an instructor is physically watching someone take the test, it is almost impossible to remedy.

3) **Possibility of Information Lost:** Technology is not always reliable. Information can be lost if a system breaks down.

   In some cases, teachers need some technical expertise to create exams. The costs to set-up an electronic assessment system in a learning institution or business training environment can cost thousands, even tens of thousands. Testing online is not suitable for essay writing and analysis or cognitive thinking testing.

4) **Academic Dishonesty:** This is a serious drawback of typical internet courses. They rely on the honour system and the difficulty of finding or paying someone qualified to do the students work for him.

   There is also the risk of getting caught. This may be small, but no one likes taking even a small risk of being expelled from college for cheating. "Academic dishonesty is extremely serious. Any evidence of such will be turned into the dean's office and may result in expulsion and a permanent mark on your records."

5) **Poor Predictive Quality:** Online examination system has a poor predictive quality because they only judge a student's ability under set conditions and limited time. Many times a student who is otherwise good may get anxious or confused under strict exam conditions and may not perform upto the marks.

6) **Limits the Curriculum:** Many online examination systems encourage teaching to the test practice. This is to say, teaching a fixed curriculum focused on passing a specific exam. This method limits the curriculum to a set range of knowledge and skills. Obviously such practice does not provide much educational benefits.

3.1.5. Question Bank

A question bank is a database of questions that can be shared between and among courses, learning object repositories, and master courses. Question bank is a planned library of test items designed to fulfil certain predetermined purposes. Question bank should be prepared with utmost care so as to cover the entire prescribed text. Question bank should be exhaustive and cover entire content with different types.

Question banks are searchable so that questions meetings specific criteria can be drawn from them to create assessments. Question banking is considered as a part of the examination reform. This question bank helps universities to maintain standard of education at same level in all colleges. Teachers and examiners are continuously involved in creating more and more questions for inclusion thus keeping them professionally involved.

Question banks, if carefully built up can influence curriculum development, guiding in interpreting syllabus, writing objectives, building valid questions are some of the possible gains. Teachers will be trained as item writers. They will develop scientific skills not only in item writing but also in revalidating them. More and more effective methods of teaching and learning can be implemented. Difficulties in students' learning can be diagnosed.

3.1.5.1. Purposes of Question Banks

Following are the main purposes of question banks:

1) To improve the teaching learning process,
2) To obtain students growth through instructional efforts,
3) To improve evaluation process, and
4) To evaluate students' performance.

3.1.5.2. Advantages of Question Banks

Question banks have many advantages, such as follows:

1) Question bank helps universities to maintain standard of education at same level in all colleges.
2) The question bank act as a neutral educational and administrative service for helping teachers and examiners to solve some of the problems with large scale examining.
3) Question banks produce and evaluate questions on a relatively more effective basis.
4) Question banks carry-out concurrent comparability.
5) Question banks match the examinations to the curriculum that is taught and not as tends to happen in the conventional setting the other way around.

3.1.6. Open Book Examination

An open book examination is type of exams, which means that a student can take his/her notes, specified books and other references into the exam room. An "open book examination" is one in which examinees are allowed to consult their class notes, textbooks, and other approved material while answering questions.

This practice is not uncommon in law examinations, but in other subjects, it is mostly unheard of. Radical and puzzling though the idea may sound to those who are used to conventional examinations, it is ideally suited to teaching programmes that especially aim at developing the skills of critical and creative thinking.

This will probably vary with the subject and the lecturer concerned. Open book exams can be a trap because student might think that he/she does not need to concentrate on revising the subject to the same extent as a closed book exam. There are three main areas that a student prepares completely. These are proper preparation, depth knowledge of subject and make complete revision of notes.

A student is given a question to answer, and can refer to books and notes during the exam. These exams may be sat in a classroom or exam hall, but in some cases student might be given the question and asked to complete an essay before a deadline at home.

Open books are designed to test students understanding of a subject and how well they can make an argument more than their memory for facts.

3.1.6.1. Types of Open Book Examinations

There are following two types of open book examinations:

1) **Restricted Open Book Examinations:** In the restricted type of open book examinations, students are permitted to bring into the examination room one or more specific documents approved by the course instructor. In the unrestricted type of open book examinations, students are free to bring whatever they like. In the restricted open book examination, students may be permitted to consult printed documents such as the logarithmic tables, dictionaries, or complete works of **Shakespeare**, but no handwritten material or printed documents which have not had prior approval. One may also need to make sure that the printed documents that students bring do not contain any scribbles on the margin. In this type of examination, the approved documents function more or less as appendices to the question paper itself. These examinations are not radically different from closed book examinations. They do not present any special problems, irrespective of the nature of the course.

2) **Unrestricted Open Book Examinations:** There are no restrictions on what the students can bring in an unrestricted open book examination. They may bring any books (with or without scribbles on the margin), lecture hand outs of the course instructor, or their own hand written notes. The use of such examinations presupposes certain teaching strategies and types of questions. In particular, it demands that the course focuses on a set of intellectual skills, rather than on the information content, and that no content based questions be asked in the examination. If the course instructor has concentrated on handing down currently available knowledge, and the question paper contains traditional content based questions like "Write an essay on the difference between British and American English", the use of the unrestricted open book examinations would be disastrous.

When used properly, it will be pointless for students taking the unrestricted open book examinations to consult any material they have brought, because the questions will be designed in such a way the answer will not be found in the textbooks, hand outs or class notes. An intelligent student who has the experience of such examinations once will not bother to bring anything for the next examinations, since he/she will know that no prepared material will be of any use. The use of these examinations then acts as symbolic gesture that makes the students realise the nature of the course and the examinations, and shocks them into a mode of studying that does not involve cramming.

3.1.6.2. Advantages of Open-Book Examination

Advantages of open-book examination are as follows:

1) It is less demanding on memory (regurgitation of memorised materials) because it is no longer necessary for students to cram a lot of facts, figures and numbers for open-book examination.
2) It provides a chance for students to acquire the knowledge during the preparation process of gathering suitable learning materials rather than simply recalling or rewriting it.
3) It enhances information retrieval skills of students through finding the efficient ways to get the necessary information and data from books and various resources.
4) It enhances the comprehension and synthesising skills of students because they need to reduce the content of books and other study materials into simple and handy notes for examination.

3.1.6.3. Disadvantages of Open-Book Examination

Disadvantages of open-book examination are as follows:

1) It is difficult to ensure that all students are equally equipped regarding the books they bring into the exam with them, because the stocks of library books may be limited and also some books may be expensive to students.
2) More desk space is needed for students during the examination because students often need lots of desk space for their textbooks, notes and other reference materials.
3) Sometimes students may spend too much time on finding out which parts of the books to look for answers instead of applying the knowledge, practical skills and reasoning ability.
4) A lot of students are unfamiliar with open-book examinations. They must be provided with clear procedures and rules.

3.2. FLEXIBILITY IN EXAMINATION

Examinations are the means of assessing or evaluating the entire teaching and learning processes especially as they relate to the learners' performance. At present, Indian school board exams system has become totally inflexible and largely inappropriate for the student and his future. These types of examination system do not serve the needs of social justice. They are based on a 'one-size-fits-

all' principle. They make no allowance for different types of learners and learning environments. They induce an inordinate level of anxiety and stress. In addition to widespread trauma, mass media and psychological counsellors report a growing number of exam-induced suicides and nervous breakdowns. So for avoiding this inflexibility, there is a great need to adopt a flexible examination system, so that all the existing disparities can be wipe-off.

The term flexibility refers to the teacher's capabilities to change the manner in which the examination is made. This includes structure, interaction and primary content type, but it also stretches beyond the assessment situation really, to include factors as rules for the examination, possibilities of making exceptions from these rules, and taking individual factors into account when asking questions or assessing answers. Flexibility should not be seen as a continuum with given poles or categories, but rather as a dimension of variation. It is a measurement of how free the users are to choose and change the manner of the assessment. Consequently, a highly flexible assessment can e.g., still have a closed structure or low interaction, if there is a possibility to deviate from this if the participants so choose.

3.2.1. Defects in the Present Examination System

There is hardly any need to point out that the existing examination scheme is not conducive to the proper development of children. The following are some of its shortcomings, that have been time and again pointed out by various educationists and commissions appointed for the purpose:

1) **Student does not Study through the Whole Year:** For the present examination system, the student is not compelled to exert himself through the entire session, but achieves competency for it by labouring only through the last few weeks before the examination. In this manner, the student does not attain any real ability or capacity even though he passes the examination. He forgets a lesson just as soon or as rapidly as he learns it. During the first two or three months of the session, there is a rare student who is seen at his desk. In this manner from the educational viewpoint, a major portion of a student's time is completely wasted.

2) **Studying from Question-Answer Books and Key Books:** In the present context, a student's ability is gauged from the scores he obtains in the examinations. And for obtaining good marks in the examinations there is no need to wander into a maze of extensive reading and comprehensive knowledge. In every examination paper, the student is required to do four to five questions out of nine or ten that are set. The consequence is that even without having gone through more than one-third of the course prescribed for study, the average student finds three or four questions that he is in a position to answer. And four to ten pages of writing are considered adequate in answer to each question.

3) **Fear of Examination:** In the modern examination system, the examination is taken at the end of the session with the result that the student is fearfully conscious of the examination right through the session.

4) **Success in Examination a Matter of Luck:** In the way examinations are conducted at present, success is more a matter of luck than anything else. His entire future is to be decided in two or three hours. No matter what skill a student has.

5) **Mechanical Method:** In this way, the existing system of education is a machine in which conclusions are reached, no importance being attached to the human elements involved. Hence, people have devised new methods of succeeding in the mechanical set-up. Some students do not bother to put in more than a few week's effort for the examinations, during which they do nothing more than making a cursory study of guess papers and question-answer books.

   As a result, they are in a position to come to grips with the paper, even though there is no element of mastery involved. And in subjects in which the question paper outdoes expectation, and unexpected questions crop, the contingency is overcome by fraternising with the examiner and having their marks secretly increased. And in the case of such a success in any examination, it is only natural for the individual to be devoid of any skill whatsoever in the subject in which he has passed the examination.

6) **Defects Concerning Evaluation of Answer Books:** Under the present system of examination, a student's achievement in any subject is measured by the marks that he obtains during the examination.

7) **Long Examination Period:** The present examination system allows the period of examination to spread over a very considerable period of atleast a month. It is often seen that students get some weeks between two individual examination dates. Such a long period of inactivity has the worst effect upon the student's attitude towards the examination as it tends to lull him towards the seriousness of the matter. Secondly, the provision of time periods between various papers is not at all proportionate. He gets no more than a few hours between two papers while between another two he has a few days at his disposal. Evidently, the opportunity available for the preparation of each subject is unequal.

8) **Wrong Objective:** The present aim of examination is to obtain marks in order to get a degree, not the desire to gain skill in any subject. Hence, the main attention in any examination is concentrated upon getting good marks so that one can have proof of one's ability or skill. There are innumerable methods of obtaining an adequate number of marks in the examination though all of them are not proper.

9) **Defects of the Essay System:** Under the existing scheme of examination, the student is required to answer each question in the form of an essay, with the result that the educational system has acquired all the defects inherent in the essay type examination. In this method the students pay much greater attention to learning answers to questions than to understanding the subject and delving deep into it. In the examination hall, they do no more than reproduce these learned and remembered answers on the answer books.

3.2.2. Suggestions for Improvement in Examination System

Many thinkers, educationists and education commissions have pointed out the above defects in the existing scheme of examinations in this country, but there are many difficulties that hinder the complete replacement of it. The main difficulty is financial besides which the extremely large number of candidates makes it difficult to evolve a different examination system for them. Hence, the practicable solution is to maintain the existing scheme of things and make efforts to effect definite improvements. Main suggestions in this respect are the following:

1) **Certificates should not be Required for Services:** If the tradition of requiring certificates for various jobs and services is given up, and individuals are separately tested for qualities that the job requires, then, people will give-up the race for obtaining certificates and degrees, and turn their attention to development of qualities required in the professions of their choice. It must, of course, be kept in mind that this method is not practicable in all professions nevertheless; it should be used in as many as admit of its use.

2) **Improvement in the Evaluation of Answer Books:** The method and system of examining and evaluating answer books should be improved. The remuneration of evaluating copies should be enough to induce the examiner to attend to them himself, and to do his work efficiently and well. The time allowed to the examiner for evaluating the answer books should be sufficient to allow him to work in peace, so that no haphazard work results from hurry or strain. There should be a definite standard of reference concerning the answers of different questions. Every examiner should be required to send copies that he is to examine as samples so that his standard of judgement can be measured, and he should be requested to evaluate the remaining copies similarly.

3) **Terminal or Monthly Examination:** Nevertheless, student's knowledge of his subject cannot be properly gauged once in a year in a sitting of only three hours. For this it is essential that the teacher should examine the students in the class every fifteen days or a month in the subject-matter that he has taught till then. The results should be announced on the basis of these monthly tests as well as the annual examination. This method will compel the students to spread their labour over the whole year.

4) **Examination in Other Aspects of Development:** The aim of education is not only to impart information but to achieve the complete development of the individual. It is the only information that is examined in the present examinations. Hence, it is essential that the child's physical, emotional and social development also be examined, even though the marks obtained therein may not be made the reason for detaining him if he fails.

5) **Re-Examination:** Examinees, who, for one or the other legitimate reason such as disease, accident, etc., fail to take their examination at the regular time, should be given a chance to be examined once the reason for their abstaining from the regular examination has been confirmed. Their efforts during the entire year should not be allowed to waste.

6) **Discouragement to Rote Learning:** Questions in the examination papers should be such as to discourage the practice of rote learning but to encourage the expression of the student's skill in the subject.

7) **Change in Questions:** Questions should vary radically from year to year so that the practice of basing preparation and guess papers on questions asked in previous years and then rote learning answers to them is discouraged and ultimately discarded.

8) **Covering Entire Course:** Questions in the paper should cover every aspect of the curriculum even if more than one question is given and the solution of one is required. Such methods will induce the students to study all that is prescribed rather than making a selection from it.

9) **Paper Scheme:** During the period of examinations, the distribution of papers should be equitable and proportionate, the normal period of inactivity not stretching over more than one or two days. Only one paper should be set for one day.

10) **Sufficient Number of Examiners:** The number of examiners should be considerably increased so that all of them can conveniently judge a smaller number of copies in the period of one or two weeks provided them for the purpose.

3.2.3. Examination Reforms in India by Commissions

In order to reform the examination system in our country, the **Mudaliar Commission** laid stress on the use of objective type tests and internal assessment. Kothari commission too repeated these reforms. This commission boldly suggested that the certificate of the student should bear his complete performance but there should be no remark to the effect that he has passed or failed in the whole examination. This is very good suggestion and can be easily implemented.

As the first practical step in changing the present pattern of examinations, the **All India Council for Secondary Education** was set-up by the Central Ministry of Education in October 1995. It gave top priority consideration to resolve the problem of examination system. The well-known International Commission on Education sponsored by UNESCO in 1992 gave their valuable comments and suggestions for reforming the system of examination.

The **National Policy on Education, 1986** emphasised on continuous and comprehensive evaluation and the introduction of semester system from the secondary stage.

The National Policy on Education, 1986 recommended a new approach to examinations in the following words:

1) "Assessment of performance is an integral part of any process of learning and teaching. As part of sound educational strategy, examinations should be employed to bring about qualitative improvement in education.

2) The objective will be to recast the examination system so as to ensure a method of assessment that is a valid and reliable measure of student development and a powerful instrument for improving teaching and learning; in functional terms, this would mean:
   i) The elimination of excessive element of chance and subjectivity;
   ii) The de-emphasis of memorisation;
   iii) Continuous and comprehensive evaluation that incorporates both scholastic and non-scholastic aspects of education, spread over the total span of instructional time;
   iv) Effective use of the evaluation process by teachers, students and parents;
   v) Improvement in the conduct of examination;
   vi) The introduction of concomitant changes in instructional materials and methodology;
   vii) Instruction of the semester system from the secondary stage in a phased manner; and
   viii) The use of grades in place of marks.

The **Programme of Action (POA)** suggested several specific short- term and long-term measures for carrying out examination reform at the school level as well as at the university level. It also suggested that, "to formulate a national examination reform work, the Department of Education would, inter-alia, constitute an inter institutional committee with representations from UGC, NCERT, AICTE and state level organisations including Board of Secondary Education."

The POA has also made some strategies for implementation, which are as follows:

1) **Elementary Stage:**
   i) The Minimum Levels of Learning (MLLs) in language tongue) Mathematics and Environmental Studies for classes 1 to V have been developed by MHRD at the national level. Similar exercise to develop these in the remaining area and classes of elementary curriculum will be carried out.
   ii) Since no detention policy is envisaged at the primary stage, the main function of evaluation will be diagnostic in nature so as to provide remedial help to the pupils.
   iii) The concerned agency in each state will prepare a flexible scheme of Continuous Comprehensive Evaluation (CCE) at the elementary stage, so as to make the evaluation process an integral part of teaching and learning at this stage.

2) **Secondary Stage:**
   i) Each State Board will lay down expected levels of attainments at classes IX to XII and prescribe appropriate courses, of studies to accomplish these levels in terms of knowledge and or comprehension, communication skills, understanding, application, analysis, synthesis, judgements, etc.
   ii) In each state, the concerned agency will prepare a flexible scheme of continuous comprehensive examination for the secondary/ senior secondary stage to suit a variety of specific situations obtaining in different regions and types of schools. Certain models have been developed by NCERT and other agencies which could be looked into for guidance.

3) **Higher Education Stage:**
   i) Selection tests for admissions to all professional and technical courses will be conducted on an all-India basis.
   ii) Each university will prepare broad guidelines for grading to be followed by individual colleges/ institutions and departments under its jurisdiction. Orientation programmes may be organised to familiarise the teachers with the grading system.
   iii) The movement towards entrance tests for admission to institutions of higher education will be encouraged and promoted by UGC and State Government. The services of the National Evaluation Organisation (NEO) should be utilised by the university system for developing, designing and administering entrance tests for admission.

3.2.4. Reducing Examination Stress and Anxiety

It should be remembered that examinations are artificial situations created for the convenience of the system and not the individual learner. They are relied on because more holistic assessment is usually unavailable due to cost and manpower constraints, given their artificiality and time-bound and 'one-shot' nature. It is not surprising that exams in their current form will induce anxiety. Even so, the recent increases in news reports of students getting seriously affected by pre-board or board examination anxiety and committing injury to themselves or others is disturbing.

Adoption of more comprehensive and credible system of internal assessment would reduce some of the stress felt during external exams. The choice the student would have of taking two or three of his more anxiety inducing subjects at the easier standard level and at a time of his convenience, would also help. In addition, following measures can be recommended for reducing exam anxiety and its often-morbid consequences:

1) A lot of stress is related to the excessive length of the question papers. Shorter exams that leave time for deliberation and periodic rest would help.
2) The exam length usually 3 hours per subject should be reduced to 2.5 hrs for higher level exams and 2 hours for standard level exams. It should be remember that the paper setter's quest to cover all sections of the syllabus is an illusory one in any case. As importantly, the numbers of answers expected and the quantity of response in the given time should be reduced. Exams should be set so that 95% of all students should be able to complete it and have time left for a quick review.
3) Questions that require students to draw on two or more areas of the syllabus would also allow more comprehensive testing within lesser time. In addition to constituting good educational practice by calling on candidates to make relevant connections between materials from different chapters. But this is a much-needed skill but rarely tested in Indian board exams.
4) A shift in emphasis from 'short answers' to multiple choice questions designed to test real understanding of core concepts, that would help reduce student anxiety. In addition to allowing greater differentiation at the top end.

5) Unless the school lacks a very basic infrastructure, students should be able to take the exam in their home school in order to reduce stress caused by additional travel and unfamiliar environments.
6) A shift in emphasis to testing competencies and away from memory would certainly reduce stress, in addition to aiding the validity of exams.
7) A long-term move towards open-book exams can be envisaged.
8) Candidates doing chemistry paper should be given the periodic table and bond angle values.
9) Examinees in Math and Physics should be given some trigonometric identities and other formulae which otherwise have to be learnt by rote. The focus of questions should, likewise, move to genuine applications from mere 'plug-in'-type problems.
10) The term fail should be eliminated. It should be recommended that the word 'fail' not appear on mark sheets, and be replaced by phrases such as 'unsatisfactory', or, better, 'needs more work to attain desired standards'. The word 'fail' carries a social stigma and often victimises a student for systemic deficiencies in teaching, textbook availability, etc.

3.3. EXAM ON DEMAND

3.3.1. Concept of Exam on Demand

Exam on demand are those exams which one can demand any time by sending an exam enrolment form and DD if applicable, for which the slots can be booked within the given dates. National Institute of Open Schooling has been working on the concept of On-Demand Examination (ODE) at Secondary Level since 2003 in the area of its feasibility and operationalisation. The novel concept of ODE is a great step in the direction of flexibility to the open and distance learning.

The basic concept of on demand examination is that NIOS student can walk into the examination center as and when he/she feels ready for the examination. NIOS re-introduced the ODES at secondary level in 2005. With the success of ODE at secondary level, NIOS started the On Demand Examination in Senior Secondary also from October 2007.

At present, ODES is being conducted at NIOS HQ at NOIDA and at its Regional Centres/Sub Centres of NIOS in the following subjects at Secondary and Senior Secondary level:

1) **Secondary:** Hindi (201), English (202), Sanskrit (209), Mathematics (211), Science and Technology (212), Social Science (213), Economics 214), Business studies (215), Home Science (216), Data Entry Operations (229), Psychology (222), Indian Culture and Heritage (223) and Painting (225).

2) **Senior Secondary:** Hindi (301), English (302), Sanskrit (309), Mathematics (311), Physics (312), Chemistry (313), Biology (314), History (315), Geography (316), Political Science (317), Economics (318), Business Studies (319), Accountancy (320), Home Science (321), Psychology (328) ,Sociology (331), Painting (332),Environmental Science (333), Data entry Operations (336) and Introduction to Law (338).

Medium of Question Paper

The Question Paper will be in English and Hindi Medium Only. However the Regional Medium Candidates want to appear through the On Demand Examination will have a choice of answering the Question Paper in the respective Regional Medium and no Regional Medium Question Paper will be provided in On Demand Examination.

3.3.2. Genesis of On Demand Examination (ODE) in NIOS

The National Institute of Open Schooling (NIOS) conducts two examinations during April and October every year. While trying to enhance flexibility in the timing of summative assessment, NIOS came up with the innovative concept of ICT based On-Demand Examination (ODE), where assessment takes place when the learner considers himself/herself ready to take an examination on one or more subject. Not only is ODE independent of time but it also allows the learners to improve their performance till they are satisfied with the mastery level set by them individually. Thus, ODE has extended and enhanced the dimension of openness in the open schooling system where examination is self-paced and degree of performance is learner controlled. Undoubtedly such a system provides a non-threatening evaluation system *vis-a-vis* the traditional fixed schedule public examination. ODE reduces pre examination stress.

3.3.3. Characteristics of ODE

Following are the significant characteristics of ODE:

1) ODE allows the student to take examination when he/she is ready. Readiness depends on the student and not on the institution.
2) ODE permits the student to choose the date of his/her examination.
3) ODE reduces the threat of failure in examination.
4) ODE removes frustration, loss of self-esteem, peer group ridicule, and depression that are generally characterised by the Term-End Examination.
5) Since under ODE, information about result is immediate, success even bits is a strong motivating factor.
6) Under ODE, the degree and level of performance is decided by the student who can reappear in the examination as many times as she/he wants, till satisfied.
7) ODE is also helpful in containing malpractices in examinations, as it is a system where the tools for evaluation are unique for individual student. The question paper for each student is different having comparable difficulty level.
8) ODE respects the individuality and sovereignty of the student.

3.3.4. Framework of ODE

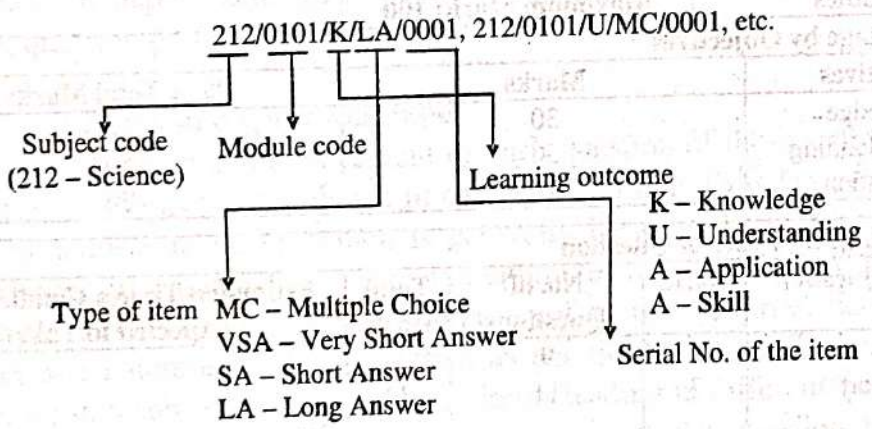
The planning and operational aspects of the On-Demand Examination (ODE) are as follows:

1) Development of the question bank based on the Designs and Blueprints.
2) Development of software application programme.
3) Generation of question paper and the corresponding marking scheme.

3.3.4.1. Development of Question Bank

For the implementation of On-Demand Examination (ODE), a comprehensive Item/Question Bank in each subject has been developed which is based on the question paper design and the blueprint of the subject. The blueprint of a subject contains many cells. As per the question paper design, the desired cells are activated/marked. The quality of the items/questions in the question bank is crucial in execution of the testing through ODE. This process facilitates development of quality question bank. The focus of the questions/items is on application rather than mere rote memorisation. Moreover, while framing the question/item, the dimension of competency is kept in mind in order to test higher order abilities/proficiencies like reasoning and analysis. The questions/items are categorised according to their form, expected level of difficulty, topic, competency being evaluated and usage and testing record.

35-40 items having comparable difficulty level which have been developed for each of the activated/marked cells of the blueprint. The items/questions were prepared involving the subject experts. The database of such items/questions forms an item/question pool. The question bank contains various types of questions such as multiple choice questions, short answer questions, very short answer questions and long answer questions as per the question paper design and blueprint of the subject. The question paper is of equivalent standard with those of the regular examinations of NIOS and of other boards of school education. For identification, each item is given a code which indicating the subject, the content area to which the item belongs, the objective being tested, the type of question and the serial number of the item. **For example:**



The database of the question bank contains the Item Code, Item Description, Marks attributed to the item and the Value points for the Marking Scheme.

3.3.4.2. Development of Software Application Programme

A software application programme has been designed and developed by the in-house technical team. ODE application is a Graphical User Interface (GUI) package, which has been designed in a user-friendly manner where user can do the required activities by selecting different options available in the different pull down menus. All the activities related to ODE have been given in different menus available in the ODE application package. The main function of the ODE application package is to generate a unique yet comparable question paper for

each learner registered for ODE. While generating such a unique question paper, items are taken randomly from the item bank so that no two sets of question papers are same or repeated. The compilation of the marking scheme is another main function of the ODE application package besides maintaining the user profile, data transfer and data backup. The marking scheme is compiled for each question paper. The marking scheme is compiled by the system after two days of conduct of the examination to facilitate evaluation of the answer booklet.

3.3.4.3. Generation of Question Paper

For each subject question paper, a paper design is prepared. This is a policy statement governing the question paper ensuring balance in various aspects of the question paper. The generation of the question paper is based on the following inputs:

1) Question paper design and blueprint,
2) Number of items in a question paper, and
3) Total number of items in the question bank.

Question Paper Design and Blueprint

The design of a question paper considers setting per cent weightage to the following parameters:

1) Learning objectives,
2) Types of question,
3) Content areas in a subject, and
4) Difficulty level.

Sample Question Paper Design

Subject: Business Studies	Class: X Maximum Mark: 100	Time: 3 Hours

1) Weightage by Objectives

Objectives	Marks	% of Total Marks
Knowledge	30	30
Understanding	50	50
Application	20	20

2) Weightage by Types of Question

Types of Question	Marks	No. of Questions	Total Marks	Estimated Time a Candidate is Expected to Take
MCQ	1	9	9	10
VeryShort Answer	3	11	33	60
Short Answer	5	6	30	50
Long Answer	7	4	28	50
		30	**100**	**170 + 10 = 180**

3) Weightage by Contents

Modules	Marks
i) Business Environment	12
ii) Structure of Business Organisation	14
iii) Service Sector and Business	16
iv) Banking and Insurance	14
v) Selling and Distribution	16
vi) Consumer Awareness	16
vii) Career Opportunities in Business	12

Based on this design, a blueprint is developed. The Blueprint is a three dimensional grid, which allocates the number of questions and marks to each module/unit of the subject, the learning objective and the type of question. Such a blueprint defines how many items are to be taken from each content unit, for each learning objective and for each type of item. Following is an example of blueprint:

Table 3.1: Sample Blueprint

Subject: Business Studies														Class: Secondary (10th)	
Maximum Marks: 100														Time: 3 hours	
S. No.	Objective ⇨ / Content Unit ⇨ / ⇩ Forms of Questions	Knowledge				Understanding				Application and Skill				Total
		LA	SA	VSA	MCQ	LA	SA	VSA	MCQ	LA	SA	VSA	MCQ	
1)	Business Environment				1(1)	7(1)		3(1)	1(1)					12(4)
2) 3) 4)	Structure of Business Organisation	7(1)			1(1)		5(1)		1(1)					14(4)
5)	Service Sector and Business		5(1)		1(1)			3(1)	1(1)		5(1)		1(1)	16(6)
6)	Banking and Insurance			3(1)			5(1)	3(1)				3(1)		14(4)
7)	Selling and Distribution			3(1)	1(1)			3(1)	1(1)		5(1)	3(1)		16(6)
8)	Consumer Awareness			3(1)		7(1)		3(1)				3(1)		16(4)
9) 10) 11)	Career Opportunities in Business		5(1)			7(1)								12(2)
	Sub Total	7(1)	10(2)	9(3)	4(4)	21(3)	10(2)	15(5)	4(4)		10(2)	9(3)	1(1)	
	Total	**30(10)**				**50(14)**				**20(6)**				**100(30)**

Figures within brackets indicate the No. of items.
Figures outside brackets indicate the Marks.

The question papers generated on the basis of the same design/blue print are parallel question papers.

Number of Items in a Question Paper

The blueprint presents the placement of each question of the question paper in a grid. It also assigns the weightage to each cell and thus fixes the total number of items in a question paper, which is generally between 30 to 35 for a subject. While generating a question paper, the computer randomly picks up a question item from about 35 to 40 questions in each cell of the blueprint. Each item has a distinct serial number and is classified as per the blueprint. Thus each student appearing in a subject will get different items leading to different question paper. However, since the blueprint guides generation of the question paper by the computer, the weightage of each question paper set is maintained in terms of content, objectives and the types of questions.

Total Number of Items in the Question Bank

For each subject, a data bank of the questions has been created as per the design and the Blueprint provided for the purpose. The number of items in the question bank is crucial in determining the number of different question papers that can be generated. The larger the size of the question bank, the higher is the number of different sets of question papers. In the existing question bank, about 1000 to 1200 items have been developed in each subject and computerised to form an item bank for that subject.

The number of distinct question papers generated in a subject using the question bank is very large. To have an idea, let us suppose the following inputs in a subject:

1) Total number of questions in the item bank = 1000
2) Total number of questions in a randomly generated question paper = 32
3) The number of modules/units from which these questions are to be taken = 07
4) The number of objective areas from which these questions are to be taken = 04
5) The number of types of questions included = 04

Then as per the formula of permutation and combination, the number of different question papers that can be randomly generated is:

$$= \frac{^{1000}C_{32}}{^{32}C_7 \times {}^{32}C_4 \times {}^{32}C_4} \quad = 5.3 \times 10^{44} \text{ (approx.)}$$

If the number of items in each cell increases, the number of different question papers will also increase. However, the chances of repetition of a particular question depend on the number of questions available in that particular cell. The probability of repetition of a question = 1/number of questions available in that particular cell.

The items/questions in the question bank are reviewed and revised regularly on ongoing basis in order to reduce the probability of repetition depending upon the usage and testing record of the items/questions. Quality questions are also appended in the question bank for enrichment of the question bank.

Implementation Strategies for ODE in NIOS

Field Testing

The implementation of ODE has been done after due filed trialing of the question bank. Sample questions were prepared and field testing was conducted among the NIOS learners. The result of the field testing was positive and was equivalent to the public examinations. After having established the feasibility and ground level viability of the ODE, NIOS started the On-Demand Examination (ODE) Centre at the NIOS Headquarters in Delhi on experimental basis in February, 2005. There is overwhelming response from the students to take examination through ODE. More than 25000 students have appeared under ODE from one testing centre at NIOS headquarter.

Conduct of Examination

1) At present, a student can appear in the following subjects through ODE:
   i) **Subject at Secondary Level:** Hindi, English, Sanskrit, Science and Technology, Mathematics, Social science, Economic, Business studies, Home science, Psychology, Typewriting (English), Typewriting (Hindi), and Word processing (English).
   ii) **Subject at Senior Secondary Level:** Hindi, Mathematics, Physics, Business studies, Home science.
2) The question paper is bilingual (Hindi and English medium). However, the student is free to write the examinations in any of the scheduled languages irrespective of the medium opted for study at the time of admission.

3) The generation and printing of question paper is done on the day of the examination and is given to the students 10 minutes before the examination.
4) There is arrangement of overseeing invigilation and recording conduct of ODE through close circuit camera (CCTV) installed in the examination hall.
5) At the end of the examination the question papers and answer booklets are collected. The students are not allowed to leave the examination hall without returning these items.
6) Practical examination under ODE is conducted at the study centre (Accredited Institution) notified to the students well in advance every Friday.

Declaration of Result and Certification

The modus operandi of evaluation is the same as followed by the Examination Boards. The evaluation is done by a panel of evaluators in on the spot evaluation mode. Each question paper is given a unique fictitious QB Code. The evaluation is based on the NIOS scheme of examination. The result is declared and published through NIOS website (www.nos.org or www.nios.ac.in) during the first week of every month.

3.3.5. Advantages of ODE

The advantages of ODES can be stated as follows:

1) Allows the student to get assessed when he/ she is ready. Readiness depends on the student and not on the institution.
2) Attempts to remove the stress of appearing in examinations, whether for all subjects or in one subject at a fixed time and schedule.
3) Attempts to remove the threat of failure in examination.
4) Removes frustration, loss of self-esteem, peer group ridicule, depression, etc.
5) Knowledge of results is almost immediate and success, even in one subject, is a strong motivating factor.
6) Degree and level of performance is decided by the student who can reappear in the examination as many times as one wants, till satisfied.
7) Malpractices will be reduced, as it is a system where the tools for evaluation are unique to an individual student. Every question paper for each student is having different comparable difficulty level.
8) Respects the individuality and sovereignty of each student.

3.4. DIAGNOSTIC AND REMEDIAL TEACHING

3.4.1. Diagnostic Teaching

Diagnostic teaching is an approach that works through helping students to learn to detect, understand and correct misconceptions in their own and their fellow students work. Many students who appear to understand a topic at the end of the teaching unit do not retain that understanding even for a few months.

Better long-term learning depends on developing a robust understanding with many connections to other topics and applications.

Diagnostic teaching helps in:

1) Supporting teachers describes a strategy for helping teachers acquire the skills needed for effective diagnostic teaching.
2) Gaining the skills describes a strategy for teachers working on their own.
3) Classroom materials provide the resources that teachers use in the classroom; they address five topics areas that many students find difficult, i.e., Decimals and Fractions, Number Operations, Functions and Graphs, Algebra and Geometry.
4) PD materials provide the additional resources for a sequence of professional development sessions.

3.4.1.1. Purposes of Diagnostic Teaching

1) To support those who wish to tackle students lack of long-term learning though a diagnostic teaching approach.
2) To design curriculum unit and lessons.
3) To differentiate assessments on non-mastered standards.
4) To isolate and prioritise standards for mastery.

3.4.1.2. Phases of Diagnostic Process

This form of teaching, which will be referred to as "the diagnostic process", consists of atleast four integral phases. These phases are:

1) Determining the needs of individual learners;
2) Specifying instructional objectives which, when they are achieved, will help the pupil to satisfy his needs;
3) Prescribing and guiding learning opportunities to help the pupil to achieve his objectives; and
4) Assisting in the process of evaluating the pupil's progress toward achieving his goals.

The diagnostic process requires a great deal of skill and effort from the professional teachers. Alone, the teacher cannot adequately perform all the necessary functions of diagnosis and prescription. However, with assistance from service personnel in the school, diagnostic teaching can become a reality. The role of the curriculum specialist is a critical one. He can contribute greatly to the improvement of instruction by helping the teacher to accomplish his tasks as a diagnostician.

1) **Determining Needs:** The teacher's function in determining individual needs is a complex task. **Saylor and Alexander** point to the existence of seven basic needs for all individuals:
   i) The physiological needs,
   ii) The safety needs,
   iii) Belongingness and love needs,
   iv) Esteem needs,
   v) Need for self-actualisation,
   vi) The desire to know and understand, and
   vii) The aesthetic needs.

The task of the diagnostic teacher, in relation to these needs, is to determine the status of the individual pupil in his attempt to satisfy these needs, and which of these needs is most demanding at a given time. The entire diagnostic process depends upon the accurate identification of this status.

The role of the curriculum specialists, in helping the teacher in this phase, will be determined by what the teacher requires to accomplish this task. The most outstanding requirement of the teacher is, and logically so, time to plan with individual pupils. This requirement will run through all phases of the diagnostic process. The curriculum specialist can be of great assistance by providing extra time through reducing class loads, providing clerical assistance, and eliminating routine functions from the teacher's schedule.

Another important task for the curriculum specialist is to make the data available to teachers, or means of acquiring data about pupils which is necessary for determining pupil needs. This should take the form of supplying test data that is available, providing services for testing students, and providing test batteries which could be used for this purpose.

Not of least importance is the role, the curriculum specialist should play as liaison between the teacher and other service personnel. He must arrange for the services of social workers, psychologists, physicians, nurses, and guidance workers where these personnel can be of assistance in assessing needs of individual learners.

2) **Specifying Instructional Objectives:** The teacher's task in specifying instructional goals is a two-fold process:
   i) The teacher must provide alternative suggested goals which, if achieved, would assist the pupil to satisfy his needs.
   ii) The teacher must help the pupil to understand these goals by stating them in terms of expected behavioural outcomes. Only then can the student select those objectives which he would most like to achieve, and clearly realise the outcomes expected from achievement of the goal.

   The curriculum worker can assist the teacher by providing extensive lists of behavioural objectives which can help pupils to satisfy specific needs. Such lists are available in curriculum guides, resource units, and resource guides, in addition to various professional and instructional materials. Most important, the curriculum specialist can offer suggested lists of objectives which are appropriate for specific needs. The teacher can then select those which are most appropriate for individual learners.

3) **Prescribing Learning Opportunities:** The teacher prescribes instructional activities and materials suitable for the learner, which will help the pupil to achieve his chosen objective. These opportunities for experience will vary according to the objectives and the characteristics of the learner. An activity that might help one pupil to achieve an objective might be of little value to

another pupil due to his unique nature. The teacher's task is to differentiate between those opportunities which are useful for a given pupil in achieving a given objective. Once he has prescribed the appropriate activities and materials, the teacher must become a logistician for the guidance of these experiences. Often this must be accomplished individually with pupils, occasionally with small groups or the total class.

The curriculum specialist's role in helping teachers prescribe learning opportunities is also partially logistical in nature. His first task, however, is to provide a wealth of suggested activities and materials which are appropriate for achieving specific instructional objectives.

Alongwith the list of suggested activities and materials, the curriculum worker should provide relevant data about their appropriateness for certain learner characteristics.

4) **Evaluation:** Evaluation is a two-pronged process for the teacher:
   i) Evaluation is necessary to assess needs, and,
   ii) To evaluate the pupil's progress towards achieving his objectives.

Assessment of needs has already been covered, although evaluation of progress begins the process all over. Evaluation of progress must be carried on continuously throughout the diagnostic process.

This stage can only be carried out if the objectives have been stated in terms of expected behavioural outcomes. Stated in such a way, the teacher can help the pupil to determine his degree of achievement of the objective. This can be done in many ways, depending upon the objectives. Devices especially appropriate for evaluating progress are standardised tests, paper-pencil essay and objective tests, rating scales, checklists, logs or diaries, and direct or self-observations. Evaluation of this type can provide for re-setting goals and prescription of new learning opportunities.

The curriculum specialist can be especially useful in assisting teachers with pupil progress evaluation. He can help teachers to state their instructional objectives behaviourally. He can do this by frequently asking the teacher what behavioural outcomes he expects from his pupils. Perhaps a final way to help the teacher in evaluating pupil progress is to give individual and group guidance to teachers building new measuring devices. The curriculum worker can provide the needed assistance for finding new and better ways to evaluate.

Diagnostic teaching is imperative if we wish to attain lasting improvement of instructions. This process consists of atleast four phases – determining individual needs, selecting goals, prescribing and guiding learning experiences, and evaluation. The teacher has major responsibility for the direction of the diagnostic process, but the curriculum specialist should play a vital role.

To facilitate the diagnostic process, the curriculum specialist should perform the following functions to help the teacher:

1) Provide time for teacher-pupil planning by reducing class size, providing clerical assistance, and eliminating routine functions from the teacher's schedule,
2) Provide data, and means for acquiring data about pupils,
3) Serve as liaison between teacher and service personnel,
4) Provide extensive lists of behavioural objectives keyed to the needs to which they are related,
5) Provide suggested activities and materials keyed to the objectives to which they relate,
6) Provide data about the relevance of resources to the characteristics of learners,
7) Organising logistics to make resources readily available to teachers,
8) Help teachers to state objectives behaviourally,
9) Provide extensive files of evaluation devices keyed to the objectives to which they relate, and
10) Provide assistance to teachers to create new and better methods of evaluation.

3.4.2. Remedial Teaching

The term remedial teaching stands for the teaching or instructional work which carried out to provide remedial measures for helping the students in getting rid of their common or specific weaknesses and some other measures also carried out for such diagnosis. Diagnosis, thus, provides a solid base for hypothesising the general and specific causes which underlying the weakness or learning difficulties of the student. It is true that as the diagnosis so is the remedy for the removal of the difficulty.

Remedial teaching is a complicated process which requiring the remedial teacher to carry out various activities related to helping the slow learners, including, identification of the slow learners, diagnosis of individual learning difficulties, construction of remedial materials and tools, organising and conducting small group teaching and evaluation of learning outcomes. It also requires the remedial teacher to possess certain attitudinal characteristics related to dealing with the affective aspects of the slow learners. As such, the organisation and management of the remedial programme in the primary schools require the service of specially trained teachers with adequate knowledge and competence in the many aspects related to the teaching of the slow learners.

Remedial teaching is the use of activities, techniques and practices to eliminate weaknesses or deficiencies that the slow learner is known to have.

According to Yoakam and Simpsom, "Remedial teaching has for its purpose the development of effective techniques for the correction of errors in all types of learning."

According to Melton, "Remedial education programme is as an educational programme that schools routinely use to bring low achieving students academic performance closer to the standards of their grade in school".

According to Smith and Wallace, "It is the learning and teaching programme designed to bring students who are lagging behind upto the level of achievement realised by their peers."

According to Chakuchichi and Badza, "Remedial education is necessary where the learner is cognitively average or above average in intellectual ability and is therefore able to quickly assimilate the missed concept and relate it to the rest of the topic or area of study."

According to Yoakam and Simpsom, "Remedial measure based upon analysis of errors in mechanics of learning will fail unless the physical, emotional and social defects of the child are successfully treated."

3.4.2.1. Objectives of Remedial Teaching

Its' main objective are as follows:

1) To remove the weaknesses and disabilities of students related with learning,
2) To create self-confidence,
3) Remove the learning barriers, and
4) Provide an ideal model of learning.

3.4.2.2. Organisation of Remedial Teaching

The organisation of remedial teaching for the needy students takes place in different following forms:

1) **Class Teaching:** In this system of remedial teaching, the usual Composition and structure of the class is not disturbed. The teacher teaches a particular lesson/unit. A point again and again, emphasises, repeats the experiments or uses some specific teaching aid in order to remove the difficulties and deficiencies of the learners in terms of class as a whole is benefited through such type of remedial teaching.

2) **Group Tutorial Teaching:** In this, the student of the class are divided into some homogeneous group called tutorial group on the basis of their common learning difficulties and identical weaknesses or deficiencies in the acquisition of the learning experiences in some or the other areas or aspects of the subject. These groups are then taught separately by the same teacher or different teachers according to the nature of the difficulties and deficiencies.

3) **Individual Tutorial Teaching:** In this system, every learner who feels learning difficulty of one or the other nature is attended individually for overcoming his deficiencies or weaknesses. It is one to one coaching, help and guidance that is rendered by teaching to learner and when needed by him in order to actualise his potentialities to the maximum. Therefore, in this type of remedial teaching, maximum consideration may be provided to the principle of individual difference in the direction of the best result in the task of teaching and learning.

4) **Supervised Tutorial Teaching:** In this system of remedial teaching, the responsibility of overcoming the learning difficulties and removing deficiencies in some learning areas is headed over to the learners themselves. They have to work at their own for removing their difficulties and

deficiencies. The role of the teacher is confined to observe and supervise the learning activities and to provide as much help as necessary to carry on them on their path of self-learning and self-correction. This type of supervision can be made on the individual as well as for tutorial group levels.

5) **Auto-Instructional Teaching:** This type of remedial teaching consists of auto-instructional programmes and activities. In this, the learner is provided with basic auto-instructional and self-learning material and equipments like programmed learning text books and Package, auto-learning modules, teaching machines and computer-assisted programmed instructions, etc. This material helps the pupil to gain sufficient practice and drill work in the areas of his weakness and acquire necessary confidence in overcoming his difficulties and deficiencies through the well programmed self-instructional material.

6) **Informal Teaching:** Informal science education and teaching suitable planned and assimilated with the formal science education of the school may go in a big way to act as a source and means of remedial education to the needy students. The activities connected with such informal education in the form of excursions or trips, collecting material for the science museum, improving science apparatus, working on useful scientific projects, engaging in the scientific hobbies, establishing aquarium, vivarium, terrarium, botanical garden, zoo and nature study corner in the school campus and participating in the science club activities, etc. Make the study of the students and provide unique and special opportunities to learn and practise the facts and principles of science.

3.4.2.3. Strategies of Remedial Teaching

There are different types of strategies used in remedial teaching:

1) **Individualised Educational Programme (IEP):** The individualised educational programme aims to reinforce the foundation of learning, help pupils to overcome their learning difficulties and develop their potentials. Individualised educational programme should include short-term and long-term teaching objectives, learning steps, activities and reviews to ensure that the programme is implemented effectively. Teaching can be done in small groups or for individual. If necessary, remedial teachers, other teachers, student guidance officers/teachers, parents and pupils alike are to participate in designing the programme. Remedial teachers hold meetings regularly to evaluate the effectiveness of work and gather opinions for refinement.

2) **Peer Support Programme:** Remedial teachers may train-up pupils who perform better in a certain subject to become 'little teachers' and who will be responsible for helping schoolmates with learning difficulties in group teaching and self-study sessions as well as outside class. Peer support programme helps pupils to reinforce their knowledge, and develop their communication and cooperation skills as well as good interpersonal relationship. To enhance the effectiveness of the programme, remedial teachers must provide training to the pupils concerned before hand and make regular reviews on its effectiveness. Generally speaking, this programme is more suitable for pupils of higher grades.

3) **Reward Scheme:** The reward scheme has positive effect in enhancing pupils' motivation. It aims at guiding pupils to set their own objectives and plans, and positively reinforcing their good performance. No matter what reward is provided, the most important thing is to help pupils cultivate an interest in learning and gain a sense of satisfaction and achievement during the learning process. When designing the rewards offered, remedial teachers should take note of the following:
   i) Set clear and specific targets (e.g., requirement on the score of dictation and number of assignments submitted),
   ii) Set achievable objectives,
   iii) Give diversified rewards (including verbal commendation) or prizes to accommodate pupils' interest; give rewards instantly,
   iv) Review and revise the reward scheme regularly, and
   v) Invite parents to help children improve their work.

4) **Handling Students' Behavioural Problems:** Remedial teachers should observe the following when dealing with the behaviour problems of students:
   i) Always observe the performance of students in class and their behaviour in groups.
   ii) Establish close relationship with students, develop mutual trust and listen carefully to what they say.
   iii) Help students to understand the effect of their behaviour on the other as well as their own selves.
   iv) Keep in close contact with parents to find out the cause of students' behavioural problems.
   v) Help students to build up self-confidence and a healthy self-image.
   vi) Give positive reinforcement to students' good behaviour, and do not pay undue attention to their misbehaviour.
   vii) Do not try to change all the deviant behaviour of students at once.
   viii) Teachers should list out the problems and set the priorities with an aim to improve one or two of them at a time.
   ix) Refer the cases to student guidance officers/teachers for follow-up action if the behaviour problems of students continue or become serious. If necessary, student guidance officers/teachers may refer the case to the Psychological Services Section of the Education Department for individual assessment and remedial services.

3.4.2.4. Importance of Remedial Teaching

Remedial teaching is important in many ways:

1) **Identify Common Steps and Resources that can be Used for Different Levels of Remedial Study:** Teachers identify several sets of steps and resources for atleast two different levels of student need in the identified academic area.

2) **Remediation makes Provision for Intervention:** Remediation is an important component of inclusive education as it makes provision for intervention or support to help all students attain their achievement goals.

3) **Helps Teachers to Organise Specific Remedial Work:** A remediation plan helps teachers to organise the specific remedial work after they have identified the specific problem areas and have linked them to steps that can produce attainable results.

4) **Promotes Own Learning:** Remedial plan involves students in their own learning, a teacher-student conference is held to go over the details of the remediation plan to make certain the students understand what they are expected to achieve.

5) **Involves Parents:** The remediation plan is shared with parents so that they are equally involved and they understand the steps which their children should take to improve their performance in class.

3.5. ICT

3.5.1. Introduction

ICT plays an important, valuable and critical role in education. ICT usage has become very common but its full potential is yet to be discovered. It is a helpful tool for creating good governance in the working of any organisation. Developing countries have now understood the importance of ICT and have started adapting to it as a basic tool for good governance. The ICT mediated governance is also known as "e-governance".

The manual examination system faces problems of accuracy and cause delay in timely results' declaration. ICT in shape of Campus Management System (CMS) is an effective tool for integrating and automating the activities of examination system to bring reliable, efficient, transparent and robust e-governance solutions for universities.

3.5.2. Meaning and Definitions of Information and Communication Technology (ICT)

ICT stand for information and communication technology. Information and Communications Technology (ICT) refers to all the technologies which are used to handle telecommunications, broadcast media, intelligent building management systems, audio-visual processing and transmission systems, and network-based control and monitoring functions.

According to Blurton (2002), ICT is defined as "A diverse set of technological tools and resources used to communicate, create, disseminate store, and manage information." These technologies include computers, the internet, broadcasting technologies (radio and television), and telephony.

According to Daintith, John, ICT can be defined as, "A branch of engineering dealing with the use of computers and telecommunications equipment to store, retrieve, transmit and manipulate data."

According to Ifueko Omoigui Okauru, "ICT is the digital processing and utilisation of information by the use of electronic computers. It comprises the storage, retrieval, conversion and transmission of information."

ICT supports activities which involving information. Such activities include gathering, processing, storing and presenting data. Increasingly these activities also involve collaboration and communication.

3.5.3. Characteristics of ICT

Chief characteristics of ICT are as follows:

1) **Combination of Hardware and Software Technology:** ICT in education is any hardware and software technology that contribute in the educational information processing. In the context of present era, ICT mainly comprises of computer technology with its hardware, like, personal computer machine, infrastructure required for setting up internet facility and also software like, CD ROM including various programme packages, e-learning strategies, etc.

2) **Information Technology:** ICT in education is any information technology that focuses on the acquisition, storage, manipulation, management, transmission or reception of data required for the educational purpose. **For example**, the information about students' records, their admissions, updates of their auricular and co-curricular activities.

3) **Exchange of Information:** ICT in education is any technology that deals with the exchange of information or in other words communication in the teaching learning process. Uses of electronic learning technology like, teleconferencing, power point presentations, CD ROM are Communication technology which is the part of ICT.

4) **Applied in the Educational Process:** ICT in education is any educational technology that is applied in the educational process. It encompasses hardware approach like use of machines and materials, Software approach like use of methodologies and strategies of teaching learning and Systems approach that uses the management technology that deals with the systematic organisation of the hardware and the software. Different software packages for the use in different department of education; e.g., library software, administration software, software related to managing the entire teaching learning process.

5) **Support Material:** ICT in education is the support material in the hands of the human resource involved in the educational process in order to enhance the quality of education.

6) **Application of Science:** ICT in education comprises of the application of science of Online and Offline learning with the help of the computer technology.

3.5.4. Objectives of ICT

The followings are the objectives of ICT implementation in education:

1) To implement the principle of life-long learning / education.
2) To increase a variety of educational services and medium / method.
3) To promote equal opportunities to obtain education and information.
4) To develop a system of collecting and disseminating educational information.
5) To promote technology literacy of all citizens, especially for students.
6) To develop distance education with national contents.
7) To promote the culture of learning at school (development of learning skills, expansion of optional education, open source of education, etc.).
8) To support schools in sharing experience and information with others.

3.5.5. Advantages of ICT

ICT has various advantages. These are as follows:

1) **Individualisation of Learning:** This means that people learn as individuals and not as a homogenous group. ICTs allow each individual to relate to the medium and its content.
2) **Interactivity:** It is the way in which a person can relate to the content, go forward and backward in the content, start at any point depending upon prior knowledge instead of always in a sequential way.
3) **Lower Unit Cost:** ICT reduces the cost of education from very high to very low.
4) **Distance and Climate Insensitive:** It does not matter where you are, or how the weather is, you can still access and learn from ICTs.
5) **Multi-purpose:** ICTs especially the computer and internet based can be useful in many ways; to help diagnose and solve problems, for accessing information and knowledge about various related themes.
6) **High Speed Delivery:** There is high speed instant delivery of information at very low cost.
7) **Uniform Quality:** If content is well produced and is of good quality, the same quality can be delivered to the rich and the poor, the urban and the rural equally and at the same low cost.

3.5.6. Disadvantages of ICT

ICT has some disadvantages too. These are as follows:

1) **High Infrastructure and Start-Up Costs:** It costs money to build ICT systems and to maintain them.
2) **Tend towards Centralised Uniform Content in Economies of Scale:** The larger the numbers, the lower the cost. This means that sometimes we try to reach large numbers so we make content common, not taking into account individual differences.
3) **Problem Sensitive:** Address problems in a general way, but cannot, without special effort, solve local and culturally sensitive problems?

4) **Problems of Access and Remain:** Not everyone has equal access; so not everyone benefits equally from the use of ICTs.

5) **Tend to Create New Class of Knowledge:** Those who have access and knowledge through the media become richer and those who do not become poorer, widening the "knowledge or digital gap" between rich and poor.

6) **Essential Delivery Systems:** A medium is different from the content; and often we forget that we can deliver any content, because ICTs are essentially meant only to deliver content, not to change attitudes or bring about behaviour change.

7) **Hard to Assess Impact:** Learning from ICT delivered content is difficult to assess since such learning is of a multidimensional and long-term kind.

3.5.7. Meaning and Definitions of E-examination

Information Communication Technologies (ICT) refers to the computer and internet connections used to handle and communicate information for learning purpose.

E learning is a learning programme that makes use of an information network such as the internet, an intranet (LAN) or extranet (WAN) whether wholly or in part, for course delivery, interaction and/or facilitation. Web-based learning is a sub-set of e-learning and refers to learning using an internet browser such as the blackboard or internet explorer.

The origin of e-examination would naturally be traced to the further deployment of the potentials of the internet and the intranet.

The e-examination is a welcome innovation because the conventional examination is plagued with several pitfalls such as examination leakages, impersonations, inadequate supervisors, demand for gratification by markers so that results can be influenced, bribe taking by supervisors or invigilators, and the most devastating of these is the delay and/or in many cases, non-release or delay of examination results especially where there are large classes or public examinations.

El Emary and Al Sondos (2006) state that as the schools around the world establish connections to the internet and teachers and students gain proficiency with navigating through the vast quantity of readily available information, the true educational potential of the World Wide Web can finally begin to be understood. The web can be a dynamic tool capable of assisting educators in propelling learning exciting and competing levels and of bringing education to any students, anywhere, at any time.

One of the potentials of the web is the ability to conduct examination through electronic means. Many scholars have hinted on the advantages of the deployment of e-examination.

Ayo *et. al.* (2007) defines e-examination as a system that "involves the conduct of examinations through the web or the intranet."

Nowadays the role of Information and Communication Technology (ICT), especially internet in the education sector plays an important role, especially in the process of empowering the technology into the educational activities. Education sector can be the most effective sector to anticipate and eliminate the negative impact of ICT. Technology (internet) in another side can be the most effective way to increase the student's knowledge.

3.5.8. Advantages of E-Examination

E-examination has various advantages:

1) It removes the human errors involved in the process of examination.
2) It eradicates the compilation and physical movement of examination scripts.
3) It would also eradicate examination malpractice from the part of the students.
4) E-examination reduces the large proportion of workload on examination, training, grading and reviewing, thus bringing the ability for the institution to release examination results in record time.

3.5.9. Possibilities of E-Examination System

ICT based examination system have lot of benefits and possibilities in the Indian context. Indian examination system is presently in the process of change from manual to ICT based. Integration of ICT can improve the whole functioning of the concerned universities and also help in improving the student satisfaction from the system. ICT based examination systems has following possibilities and will help in functioning of the examination branch by:

1) Improving the coordination between different branches concerned with the conduct of examinations.
2) Improving the quality of services provided to the students by the examination branches of the universities.
3) Helpful in bringing transparent examination system which can be assessed by the students, parents and appointing agencies easily.
4) Introducing e-exams by adopting the technology to simplify the examination process by computer aided control.
5) Less dependence on the manpower and help in reducing the burden of the examination branch.
6) Cost effective in long run for the universities and education boards integrating ICT in the examination system.
7) Helpful in communicating with the students, teachers, paper setters, evaluators and parents.
8) Easy to monitor the whole examination process by the concerned authorities while sitting in their offices.
9) Less chances of examination malpractices and making the whole system very fair.
10) Environmental friendly examination system by reducing the consumption of paper.

3.5.10. Challenges of Integrating ICT in E-Examination System

Some of the main challenges of integrating ICT in the e-examination system are listed below:

1) Lot of investment is needed on the part of universities and school examination boards as technology is quite costly.
2) Lack of ICT trained people is another challenge, for which proper training programmes in a regular manner are to be organised.
3) Less initiative taken by the state universities to integrate ICT in the examination system due to lack of funds.
4) Maximum student population of the country is living in the rural areas and not has access to the new technologies.
5) Changing the mindset of the people presently using manual system and making them trained.
6) Orienting students to adopt new technology before shifting to the ICT based examination system.

3.5.11. Strategies to be Adopted in Conducting E-Examination

Being aware of the significant role of ICT (internet) in education sector, especially in the e-examination activities, education authorities should be wise enough in implementing the strategies to empower ICT in supporting the teaching and learning process in the classroom. ICT is not just the bloom of the educational activities, but also it will be the secondary option to improve the effective and meaningful e-examination process.

The main purpose of the strategy for information and communication technology implementation in e-examination is to provide the prospects and trends of integrating Information and Communication Technology (ICT) into the general educational activities. There are some unavoidable facts in the modern education:

1) The ICT has been developing very rapidly nowadays. Therefore, in order to balance it, the whole educational system should be reformed and ICT should be integrated into educational activities.
2) The influence of ICT, especially internet (open source tool) cannot be ignored in our student's lives. So, the learning activities should be reoriented and reformulated, from the manual source centred to the open source ones. In this case the widely use of internet access has been an unavoidable policy that should be anticipated by schools authorities.
3) The presence of multimedia games and online games by internet has been another serious problem that should be wisely handled by the educational institutions. The students cannot be exterminated from this case. They can have and do with it wherever and whenever they want. Schools, as a matter of fact, do not have enough power and time to prevent or stop it after school times. In such situation, education institutions play an important role to eradicate these problems. One of which is by facilitating the students to do edutainment or educational games. Schools can let their students be familiar

with educational games adjusted by their teachers. Besides, they can also support and facilitate their students to have their own blogs in the internet. A lot of web blog providers are free to the users, such as Word Press. In their blogs, the students can create and write something, like an article, poem, news, short stories, features, or they can also express their opinion by an online forum provided in the internet. They are able to share experiences throughout their blogs to others from all over the world.

4) The implementation of ICT in education has not been a priority trend of educational reform and the state paid little attention to it. Therefore, there should be an active participation, initiative and good will of the schools and the government institutions to enhance ICT implementation at school.

5) The teachers should be the main motivator and initiator of the ICT implementation at schools. The teachers should be aware of the social change in their teaching activities. They should be the agent of change from the classical method into the modern one. They must also be the part of the global change in learning and teaching modification.

3.6. ISSUES IN ASSESSMENT

3.6.1. Assessment at Different Stages

In India the school system is divided mainly in three levels, i.e., primary, secondary and higher education. Thus the assessment is done the basis of level of education, such as follows:

1) **Assessment in Pre-Primary and Primary Stages:** Throughout the early primary stage, there should be no formal periodic tests, no awarding of grades or marks, and no detention. From the pre-primary level until Class II, assessment must be purely qualitative judgments (made by the teacher) of children's activities in various domains and an assessment of the status of their health and physical development, based on observations through everyday interactions. On no account should they be made to take any form of test, oral or written. From Class III to Class VI, rather than term-wise examinations, there could be short tests from time to time, which should be seen by children as a part of the teaching process and not as a fearful constant threat. A variety of methods may be used, including oral tests, written tests and observations. Grades or marks alongwith qualitative judgements of achievement and areas requiring attention are essential at this stage. Children's own self-evaluation can also be a part of the report card from Class V onwards. Term-wise examinations could be commenced from Class VII onwards when children are more psychologically ready to study large chunks of material.

   i) **ECCE and Classes I and II of the Elementary Stage:** At this stage, assessment must be purely qualitative judgements of children's activities in various domains and an assessment of the status of their health and physical development, based on observations through everyday interactions. On no account should they be made to take any form of test, oral or written.

ii) **Class III to Class VIII of the Elementary Stage:** A variety of methods may be used, including oral and written tests and observations. Children should be aware that they are being assessed, but this must be seen by them as a part of the teaching process and not as a fearful constant threat. Grades or marks alongwith qualitative judgements of achievements and areas requiring attention are essential at this stage. Children's own self-evaluation can also be a part of the report card from Class V onwards. Rather than examinations, there could be short tests from time to time, which are criterion based. Term-wise examinations could be commenced from Class VII onwards when children are more psychologically ready to study large chunks of material and, to spend a few hours in an examination room, working at answering questions. Again, the progress card must indicate general observations on health and nutrition, specific observations on the overall progress of the learner, and information and advice for the parents.

2) **Class IX to Class XII of the Secondary and Higher Secondary Stages:** Assessment may be based more on tests, examinations and project reports for the knowledge-based areas of the curriculum, alongwith self-assessment. Other areas would be assessed through observation and also through self-evaluation. Reports could include much more analysis about the students, various skill/knowledge areas and percentiles, etc. This would assist them by pointing out the areas of study that they need to focus on, and also help them by providing a basis for further choices that they make regarding what to study thereafter.

3.6.2. Design and Conduct of Assessment

Assessments and examinations must be credible, and based on valid ways of gauging learning. As long as examinations and tests assess children's ability to remember and recall textbook knowledge, all attempts to redirect the curriculum towards learning will be thwarted. Often children's learning is restricted as teachers do not accept their answers if they are different from what are presented in the guidebooks. Questions that are open-ended and challenging could also be used.

Designing good test items and questions is an art, and teachers should spend time thinking about and devising such questions. The interest and ability of teachers to design good questions can be promoted through district or state-level competitions. All question papers must be designed graded for difficulty in order to permit all children to experience a level of success, and to gain confidence in their ability to answer and solve problems.

There have been successful demonstrations that such examinations can be carried out on a large scale, and that teachers can themselves be trusted with moderating the results of such examinations. In this way, the assessment of projects and lab work can also be made credible and sound. It is important that after receiving their corrected papers, children rewrite the answers and that these are again reviewed by teachers to ensure that children have learnt and gained something out of the ordeal.

Schools begin 'ranking' children as early as their pre-primary years as a way of inculcating in them a competitive spirit. Such a competitive drive has several negative side effects on learning; often superficial learning is sufficient to create and maintain impressions, and over time students lose their ability to take initiative or do things for the fulfilment of one's own interest; hence, areas that cannot be 'marked' are neglected. This has unhealthy consequences for classroom culture, making children individualistic and unsuited to team work. There is an absurd and unnecessary importance given to term examinations, often accompanied by extreme arrangements of invigilation and secrecy. While the physical and psychological effects of this may not be readily visible until middle school, they frequently lead to high levels of stress in children, and cause early burnout. Schools and teachers need to ask themselves whether there is really much to be gained out of such practices and to what extent learning requires such systems of marking and ranking.

Steps to Design and Conduct Assessment

Following steps are to be taken to design and conduct assessment:

1) **Prepare Candidates:** For assessing a candidate, he should provide complete knowledge and prepare them. It is the responsibility of an assessor how he completely prepares candidates.

2) **Select and Prepare Assessors:** To select an assessor is also a vital issue. While selecting an assessor it is kept in mind that he/she should worthy for the assessment. He should be able to understand worth of the assessment. He/she creates such an environment where a candidate finds himself free and supportive.

3) **Identification of Desired Traits:** Assessor should be identify desired traits of the candidate. Assessor determines that traits which he/she wants to assess.

4) **Variety of Exercises:** After determining the desired traits he/she try to remove defects of the traits.

5) **Break Time:** In assessment the time interval also is matter of discussion. It should be given more importance.

6) **Thoughts and Review:** Assessor clears all the critical elements and review them.

3.6.3. Curricular Areas that cannot be Tested for Marks

Each area of the curriculum may not lend itself to being 'tested'; it may even be antithetical to the nature of learning in the curricular area. This includes areas such as work, health, yoga, physical education, music and art. While the skill-based component of physical education and yoga could be tested, the health aspect needs continuous and qualitative assessments.

Currently, this has the effect of making these subjects and activities less important in the curriculum; these areas are inadequately provided for in terms of material resources and curricular planning, and marked by a lack of seriousness.

Further, the time allocated for them is also frequently sacrificed to accommodate special classes. This is a serious compromise with parts of the curriculum that have deep educational significance and potential.

Even if marks cannot be given, children can be assessed for their development in these areas. Participation, interest, and level of involvement, and the extent to which abilities and skills have been honed, are some markers that can help teachers to gauge the benefits of what children learn and gain through such activities.

Asking children to self-report on their learning can also provide teachers with insight into children's educational progress and give them feedback on improving curriculum or pedagogy.

3.7. EXERCISE

3.7.1. Very Short Answer Type Questions

1) What is grading?
2) What is remedial teaching?
3) What is diagnostic teaching?
4) Define ICT.
5) Define question bank.

3.7.2. Short Answer Type Questions

1) Write a short note on semester system.
2) Write a short note on question bank.
3) Describe the advantages and disadvantages of grading.
4) What is credit system?
5) Describe advantages and disadvantages of ICT in examination.

3.7.3. Long Answer Type Questions

1) Discuss and describe new trends in assessment in detail.
2) Describe online examination and open book examination system in detail.
3) Focus on flexibility in examination.
4) Write a detailed note on exam on demand.
5) What are the issues of assessment?

UNIT 4

Statistical Methods and Interpretation of Scores

4.1. STATISTICS

4.1.1. Meaning and Definitions of Statistics

The origin of the word 'statistics' can be traced back to either the Latin word ***'Status'*** or the Italian word ***'Statista'*** or German word ***'Statistik'***. All the three words mean, 'an organised political state'.

In early years 'Statistics' was regarded as the 'science of statecraft', because it was mainly used by the administration to keep track of births, death, crop yield, taxes, etc. It was referred to as the 'science of king' or 'king' as it was used as a tool for government record collection. In present time, statistics is regarded as an important tool for decision-making in uncertain times.

According to Bowley, "Statistics are numerical statement of facts in any department of enquiry placed in relation to each other".

According to Yule and Kendall, "By statistics we mean quantitative data affected to a marked extent by multiplicity of cause".

According to Boddington, "Statistics is a science of estimates and probabilities".

According to A.L. Bowley, "Statistics may rightly be called the science of averages".

According to Wallis and Roberts, "Statistics is a body of methods for making decisions in the face of uncertainty".

According to Croxton and Cowden, "Statistics may be defined as the collection, presentation, analysis and interpretation of numerical data".

4.1.2. Types of Statistics

Statistics can be classified into two main categories:

1) **Descriptive Statistics:** This includes the methods of data collection, presentation and characterisation of a set of data. All these help in describing the various features of the collected sample data. Descriptive statistics includes graphical representation and quantitative measures. **For example,** graphical representation includes bar charts, line graphs and pie charts whereas measures of central tendency, dispersion, skewness and kurtosis denote quantitative measures.

2) **Inferential Statistics:** It includes the methods that help in characterising a population or help in decision-making which is based on the sample results of the population. Sample and population are two relative terms. The larger unit about which analysis is to be done is referred to as 'population' or 'universe' and the fraction or a portion of that population/ universe is called 'sample'.

4.1.3. Characteristics of Statistics

Basic characteristics of statistics are as follows:

1) Statistics are averages of numerical data. Single or isolated figures cannot be considered as statistics as they cannot help in analysis or drawing of conclusions. Single death or birth does not comprise statistics but a number of such figures help in determining the average death or birth rate.
2) Generally, statistics contains quantitative information which means it is always expressed numerically. Qualitative facts can never be measured numerically and therefore it cannot give accurate interpretations. Hence, this can never be considered as statistics.
3) Statistics are affected by various causes or factors. One cause or factor cannot be said to be responsible for the results after analysis of a given set of data.
4) Statistical data is collected in a systematic manner for a predetermined purpose. This means that the reason and plan for data collection is predetermined.
5) Statistical data may be used for comparative studies. **For example,** for comparing the efficiency of two departments in an office, the performance appraisal can be used.

4.1.4. Need and Importance of Statistics in Educational Assessment

The field of education has a number of challenges in terms of policy planning, and statistics are particularly important as they often provide some of the only objective information that administrators use when making organisational and curricular decisions.

Test score trends are one of the most commonly used statistics in the field of education. They are used to evaluate the effectiveness of classroom teachers and the validity of the tests themselves as well as the effects of various risk factors on educational outcomes. Standardised tests take their value from the fact that all students in a particular state or region take them, showing competency in a way that individual grades cannot because grades vary by teacher.

Statistics is not only a subject in its own right but it is also applied to diverse other subjects, including the sciences, geography, psychology, business and economics. Consequently assessment may need to cover a very wide-ranging set of topics and activities taught within a statistics curriculum.

There are four types of assessment that we identify in relation to statistics:

1) **Diagnostic assessment:** It seeks to identify the starting position of students, to identify gaps and thus enables these to be filled.

2) **Formative Assessment:** It seeks to use assessment for improvement, to indicate strengths and weaknesses and to give both student and teacher insight into the progress being made; formative assessment can also contribute some marks to overall assessment.

3) **Summative Assessment:** It seeks to evaluate overall achievement, usually at the end of the course. With mid-course summative assessment it is possible to use the resulting feedback for formative purposes.

4) **Evaluative Assessment:** It is the final putting together of results and it involves the whole assessment of the programme of study. Its aims include the satisfaction of society, the institution, the teachers and, hopefully, the candidate. Such assessment covers the quality assessment of the course itself.

In a statistical context there will inevitably be a range of topics requiring assessment. These follow from the fact that statistics as a subject provides a paradigm for problem solving and it is a methodology for doing science and many other subjects. Thus, the assessment of statistics should include assessment of:

1) Understanding the statistical Problem-Solving Approach (PSA).
2) The course content, e.g., technical aspects of statistics.
3) The process of doing statistics, e.g., undertaking an analysis that may include estimating parameters.
4) The use of global skills, e.g., the use of appropriate statistical software.
5) Personal and transferable (key) skills, e.g., skills inherent in statistical problem-solving.
6) Critical abilities such as those required in looking at the practical aspects of surveys.
7) Communication of statistical results and conclusions.

Thus, the need and importance of statistics in educational assessment can be understood by following points:

1) **Understand the Purpose and Logic of Statistical Investigations:** Students (and practitioners) often fail to fully understand the logic of statistical inference or its role in experimental research. Students should understand the nature of and processes involved in a statistical investigation and considerations affecting the design of a plan for data collection. They should recognise how, when, and why existing statistical tools can be used to aid an investigative process. They should be familiar with the specific phases of a statistical inquiry which include – formulating a question, planning a study, collecting, organising, analysing and displaying data, interpreting and presenting findings, and discussing conclusions and implications of the study.

2) **Learn Statistical Skills:** Students need to learn important skills that may be used in the process of a statistical investigation. These skills include being

able to organise data, compute summary measures, construct and display tables and different representations of data.

3) **Understand Probability and Chance:** Students need to develop an understanding of concepts and words related to probability, and understand probability as a measurement of uncertainty. They need to know how to develop and use models to simulate events, and how to produce data to estimate probabilities.

4) **Develop Statistical Literacy:** Students need to learn what is involved in interpreting results from a statistical investigation. This includes how to pose critical and reflective questions about numerical argument, data reported in the media, and project reports from their classroom peers (e.g., How reliable are the measurements used? How representative was the sample? Are the claims being made sensible in light of the data and sample?).

5) **Develop Useful Statistical Dispositions:** Students should develop an appreciation for the role of chance and randomness in the world and for statistical methods and planned experiments as useful scientific tools and as powerful means for making personal, social, and business-related decisions in the face of uncertainty. Students should learn to use critical reasoning when faced with an argument that purports to be based on data. This includes reports or conclusions from a statistical investigation, survey, or empirical research.

6) **Develop Statistical Reasoning:** Statistical reasoning may be defined as the way people reason with statistical ideas and make sense of statistical information. This involves making interpretations based on sets of data, representations of data, or statistical summaries of data. Students need to be able to combine ideas about data and chance, which leads to making inferences and interpreting statistical results. Underlying this reasoning is a conceptual understanding of important ideas, such as distribution, centre, spread, association, uncertainty, randomness, and sampling.

7) **Understand Mathematical Relationships:** Students should develop an understanding, intuitive and/or formal, of the main mathematical ideas that underlie statistical displays, procedures, or concepts. They should understand the connection between summary statistics, graphical displays, and the raw data on which they are based. **For example,** they should be able to explain how the mean is influenced by extreme values in a data set and what happens to the mean and median when data values are changed.

8) **Master Procedural Skills:** Students need to master the "component skills" that may be used in the process of a statistical investigation. This mastery includes being able to organise data, compute needed indices (e.g., median, average, confidence interval), or construct and display useful tables, graphs, plots, and charts, either by hand or assisted by technology (e.g., a calculator, graphing calculator, or computer).

9) **Student Evaluation:** Traditionally, assessment has been primarily used to assign grades to give periodic feedback on student learning. Assessment

methods used to assign grades include quizzes and exams, homework exercises, and often computer lab activities. As statistics instruction begins to change in response to calls for reform, newer methods of assessment are being used to measure students' understanding of probability and statistics and their ability to achieve goals such as being able to explore data and to think critically using statistical reasoning. These alternative assessment approaches, such as projects, portfolios, and journals, better capture how students think, reason, and apply their learning, rather than merely having students tell the teacher what they have remembered or show that they can perform calculations or carry out procedures correctly. Given the different purposes for administering a student assessment (e.g., to provide a grade, to provide individual feedback, to evaluate statistical reasoning, to stimulate student reflection), the instructor needs to select an appropriate assessment method for a particular purpose.

10) **Efficient Management:** In most cases, data produced in school environments is not stored on a single platform. This dispersion of information, of course, hampers the work of administrators. In this sense, one of the greatest advantages of the application of statistics to education is the optimisation of school management. The organisation of students' data and grades, e.g., allows for administrators to better evaluate any school-wide issues that emerge. From there, it is much easier to find solutions, set goals and achieve the proposed objectives. As a matter of fact, today, the use of apps for school performance greatly helps teachers and students in this task, but it is important for school administration to have a strong commitment to the implementation of these technologies, and for us to develop more complex and standardised software.

11) **Personalised Teaching:** Applying statistics in education also enables educators to construct a superior learning experience within the classroom. With a large number of students in the classrooms, it is more difficult to know each one individually. Educators can utilise data analysis from assessments, such as formative assessments, to inform their teaching strategies to better target each individual student. This data can help point educators to possible benchmarks that need to be reviewed before being assessed, or others in which the students are already demonstrating mastery. Student data from assessments can also help educators differentiate their teaching strategies, targeting different learning styles or level of readiness, so that each student is able to learn at the pace and in the manner that best fits him/her.

12) **Reduction of School Dropout Rate:** Student dropout rate is one of the biggest problems faced by educational institutions today – especially at the higher level. Every year large numbers of students drop out of school, and this happens for a number of reasons. Researchers say that every year, over 1.2 million students drop out of high school in the United States alone. However, this problem can be better understood by applying relevant statistical analyses. Cross-referencing data for a given student can help identify if he or she is a potential dropout. From there, it is possible to create customised campaigns in order to improve students' perception of their courses and education in general.

4.1.5. Uses of Statistics

Statistics is the study of numerical information, which is called data. Statistics is used in different fields, such as:

1) People use statistics as tools to understand information.
2) Learning to understand statistics helps a person react intelligently to statistical claims.
3) Statistics are used in the fields of business, maths, economics, accounting, banking, government, astronomy, and the natural and social sciences.
4) Businesses use statistics to find customer preferences, check the quality of products, market products, estimate costs and make decisions.
5) Statistics help to make mathematical theories more accurate.
6) Economists use statistics to find the relationship between supply and demand, the relationship between imports and exports, the inflation rate, the per capita income, and the national income rate.
7) Accountants use statistics to see how well a company is doing, discover trends and create projections for the next year.
8) Bankers use statistics to estimate the number of people depositing money *versus* the number requesting loans.
9) The government uses statistics federally and locally to make budgets, set the minimum wage and discover the cost of living.
10) Astronomers use statistics to estimate the distance between objects in space and the timing of interstellar events.
11) People working in the natural and social sciences use statistics to form theories on what they are studying, whether it is estimating large populations, predicting the weather or studying the human brain.

4.1.6. Limitations of Statistics

Major limitations of statistics are as follows:

1) **Statistics does not Deal with Individual Measurements:** The study of individual measurements lies outside the range of statistics as it deals with aggregates of facts. **For example,** marks obtained by a single student in a class have no statistical significance but the average marks received by the students of the same class are relevant to statistics.

2) **Statistic Deals only with Quantitative Characteristics:** Statistics deals with the quantitative statements of the facts. Various characteristics cannot be expressed quantitatively and hence statistics is unable to analyse these characteristics. Qualitative characteristics such as honesty, efficiency, intelligence, blindness and deafness cannot be studied statistically.

3) **Statistical Results are True only on an Average:** Conclusions or inferences which are drawn after statistical study may not be true universally but only under certain conditions.

4) **Statistics is only One of the Methods of Studying a Problem:** In all conditions it is not necessary that statistical tools give the best solution. In a

statistical problem it is important to take a country's culture, religion and philosophy into consideration.

5) **Statistics can be Misused:** Statistics may be misused when statistical conclusions are based on incomplete information. This may lead to incorrect conclusions.

6) **Statistics does not Reveal the Entire Story:** Statistics only simplifies and analyses complex data but does not give the real picture of the background about the data.

7) **Statistical Relations do not Necessarily bring out the 'Cause and Effect' Relationship between Phenomena:** Statistics tells the relationships between variables but does not define which one is the cause and which one is the effect. It only reveals the association between the two variables. It is the explainer who has to find the type of relationship existing among the various variables.

8) **Statistics is Collected with a given Purpose and cannot be Indiscriminately Applied to any Situation:** The relevance of a statistical result in one situation does not guarantee its utility in another. Usage of secondary data leads to incorrect drawing of conclusions. It is therefore necessary to thoroughly scrutinise statistical data before inference.

4.2. DATA

4.2.1. Introduction

The facts and figures, collected for analysis and summarised for presentation and interpretation, are known as data. Data collected in a particular study are referred to as the data for the study.

Usually data is the collection of raw information that can be qualitative as well as quantitative. There are several examples like, the number of patients being admitted daily in a hospital, number of births and deaths in a year, the number of candidates that are registered for post-graduation in a university, etc.

4.2.2. Types of Data

Depending upon the utilisation of the sources, any statistical data is classified under two categories, these are:

1) **Primary Data:** The data that is original and collected for the first time is called **primary data**. To conduct a specific inquiry or study by the investigator, the data collected is called primary data. It is original in character which is generated by an individual or any organisation or research institution by conducting a survey. Primary data is important for all area of research because it provides the accurate information about the results of an experiment or observation. It is the specific information collected by the person who is conducting the research. Case studies, true experiments and

studies being randomly controlled are the channels of obtaining primary data. Other experts analyse this information on deciding to test the validity of the data by repeating the same experiments.

2) **Secondary Data:** The **secondary data** is that which has been collected already and has passed through the statistical process. The data that has already been collected and analysed earlier by some agency for personal usage and then being used by a different agency is called **secondary data**. It is the data which is neither collected directly by the user nor especially for the user and the conditions not known to user, e.g., government reports. There are many purposes for which secondary information has been collected already through other internal sources or some other organisation might have collected them and published.

4.2.3. Organisation of Data

The data are organised in following manner:

4.2.3.1. Raw Data

Raw data is information obtained by observing values of a variable. Data obtained by observing values of a qualitative variable are referred to as qualitative data. Data obtained by observing values of a quantitative variable are referred to as quantitative data. Quantitative data obtained from a discrete variable are also referred to as discrete data and quantitative data obtained from a continuous variable are called continuous data.

For example, a study is conducted in which individuals are classified into one of sixteen personality types using the Myers-Briggs type indicator. The resulting raw data would be classified as qualitative data.

4.2.3.2. Variable

A variable measure is a product characteristic that is measured on a continuous scale such as length weight, temperature, or time.

For example, the amount of liquid detergent in a plastic container can be measured to see if it conforms to the company's product specifications. Or the time it takes to serve a customer at McDonald's can be measured to see if it is quick enough. Since a variable evaluation is the result of some form of measurement, it is sometimes referred to as a quantitative classification method. An attribute evaluation is sometimes referred to as a qualitative classification, since the response is not measured. Because it is a measurement, a variable classification typically provides more information about the product – the weight of a product is more informative than simply saying the product is good or bad.

Types of Variables

On the basis of the characteristics of facts, variable may be divided into following:

1) **Quantitative Variable:** They are those variable which can be measured directly such as age, income, production, marks, height, weight, etc.

Quantitative variable are often represented numerically in the form of means, percentages, or frequency counts. Such variable are often referred to as "measurement" variable, referring to the fact that we often like to measure the amount or extent of some behavior, trait, or disposition. In contrast, quantitative research is typically designed to test relatively specific predictions. Quantitative research aims to investigate its various details.

Types of Quantitative Variable

Various types of quantitative variable are as follows:

i) **Continuous Variable:** They are those variable in which there is no break in continuity and it may take any numerical value within a certain interval. **For example,** Data relating to age, height, or weights of persons. The age of different students may vary within the range of 4 to 23 years, etc.

ii) **Discontinuous or Discrete Variable:** Discrete variable is that whose values are individually distinct and discontinuous. There is no range of the variable and there is a definite difference between the two values of the variable. **For example,** Data relating to individuals in a family, number of accidents on each day in a month, number of books on a library shelf, etc.

2) **Qualitative Variable:** They are also called 'categorical variable'. They include variable relating to such facts which cannot be measured directly but counted or categorised on the basis of presence or absence of attributes. The term qualitative research methods refers to a variety of ways of collecting information that is less amenable to quantification and statistical manipulation.

Goal of qualitative research is to arrive at some general, overall appreciation of a phenomenon—highlighting interesting aspects and perhaps generating specific hypotheses.

Qualitative research thus provides an initial description of a phenomenon.

For example, literates, illiterates, unemployed, honest, etc., are the facts which are called attributes. Qualitative variable are classified on the basis of descriptive characteristics or attributes. **For example,** population may be classified on the basis of males or females or males may be classified on the basis of marital status, i.e., married or unmarried.

Types of Qualitative Variable

Various types of qualitative variable are as follows:

i) **Nominal Variable:** They are the outcomes of classification into two or more categories of the attributes such as classification of students according to sex (males or females) or workers according to skill (as skilled or unskilled) are examples of such variable. In nominal variable, it is always possible to assign every item to any one class and makes a summation of the items belonging to each class. The counted variable so obtained are called nominal variable.

ii) **Ranked or Ordinal Variable:** They are the result of assigning ranks to specify orders in the list of integers. **For example,** 15 candidates appear in an interview and they are assigned the order of merit for 1 to 15 on the basis of their performances. The order variables so obtained are called ranked variable or ordinal variable.

4.2.4. Methods of Organising Data

Tests, experiments and survey studies in education and psychology provide us valuable data, mostly in the shape of numerical scores. These data in their original form, have little meaning for the investigator or reader. For understanding the meaning and deriving useful conclusion, the data have to be organised or arranged in some systematic way. The organisation and arrangement of original data or computed statistics in a proper way for deriving useful interpretation is termed organisation of data. In general, this task can be carried-out in the following ways:

1) Organisation in the form of statistical tables,
2) Organisation in the form of rank order, and
3) Organisation in the form of frequency distribution (distribution into suitable groups).

4.2.4.1. Statistical Table

In this form of arrangement, the data are tabulated or arranged into rows and columns of different headings. Such tables can list original raw scores as well as the percentages, means, standard deviations and so on. This organisation of data into statistical tables may be understood through the following examples:

Example 1: Literacy survey of the village Bohar made by the students of B. Ed., C.R. College of Education, Rohtak for age group 15-35.

Literacy Status	Upper Caste Hindu			Backward Classes			Scheduled Caste/Tribe		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Literate	2650	550	3200	1208	312	1520	453	52	505
Illiterate	2702	3498	6200	1625	1515	3140	404	606	1010
Total	**5352**	**4048**	**9400**	**2833**	**1827**	**4660**	**857**	**658**	**1515**

Example 2: Pass percentage of the High Schools of Rohtak City in the High School Public Examination.

High schools of Rohtak City	Name of School	Pass Percentage	Girls' Pass Percentage	Boys' Pass Percentage
	A			
	B			
	C			
	D			
	E			
	.			
	.			
	.			
	N			

General Rules for Constructing Table

Following are the main rules for constructing a table:

1) **Suit the Purpose:** A table should be in keeping with the object of statistical enquiry.

2) **Scientifically Prepared:** The table should be prepared in a systematic and logically organised manner, simple and compact so that it is readily comprehensible. It should be free from all sorts of over-lapping and ambiguities.

3) **Clarity:** A table should be easily understandable, complete and self-explanatory.

4) **Manageable Size:** A table should be so designed that it is neither too long and narrow nor too short and broad. If needed, it should be adjusted to the space provided for the purpose.

5) **Columns and Rows should be Numbered:** The number of rows and columns in a table must be numbered for reference.

6) **Suitably Approximated:** If the figures are large, they should be suitably approximated or rounded. The method of rounding should be indicated along with the units of measurement such as a weight in thousand tonnes rounded to the nearest whole number.

7) **Attractive Get-Up:** A table should have an attractive get-up which appeals to the eye and the mind so that the reader may grasp it without any strain. The rows and columns could be separated by single, double or thick lines depending on the broad classes and sub-classes used. Related percentages are given close to corresponding columns and rows. Whereas columns are invariably separated by lines the rows may or may not be so separated.

8) **Units:** The unit designations should be given at the top of the table below the title such as 'price in rupees' and 'weight in tonnes'. If there are different units for different items then they should be mentioned in respective columns and rows.

9) **Averages and Totals:** The averages and percentages should, as far as possible, be given to the right or at the bottom of the columns containing original figures. Totals and sub-totals of both columns and rows and, if necessary, the cross totals of each such group should be given.

10) **Logical Arrangement of Items:** There should be logical and systematical classification of items in the table. Items may be arranged:
    i) Alphabetically,
    ii) Geographically,
    iii) Chronologically,
    iv) Conventionally, and
    v) In order of magnitude,
    vi) In ascending or descending order.

11) **Proper Style:** It is not advisable to use too many styles of letters in a table. Large capital letters and bold face type may be used for headings, stubs, captions, and small letters may be used for prefatory notes, footnotes and, source notes. Proper style helps in adjusting the size of the table.

4.2.4.2. Rank Order

The original raw scores can be successfully arranged in an ascending or a descending series exhibiting an order with respect to the rank or merit position of the individual. For this purpose, we usually adopt a descending series, arranging the highest score on the top and the lowest at the bottom.

Example 3: Fifty students of the B. Ed. class obtained the following scores (roll number-wise) on an achievement test. Tabulate this data in the form of a rank order:

62, 21, 26, 32, 56, 36, 37, 39, 53, 40, 54, 42, 44, 61, 68, 28, 33, 56, 57, 37, 52, 39, 40, 54, 42, 43, 63, 30, 34, 58, 35, 38, 50, 38, 52, 41, 51, 44, 41, 42, 43, 45, 46, 45, 47, 48, 49, 45, 46, 48

The rank order tabulation of this data will be as follows:

S. No.	Scores	S. No.	Scores	S. No.	Scores	S. No.	Scores
1	68	14	51	27	43	40	37
2	63	15	50	28	43	41	37
3	62	16	49	29	43	42	36
4	61	17	48	30	42	43	35
5	58	18	48	31	42	44	34
6	57	19	47	32	41	45	33
7	56	20	46	33	41	46	32
8	56	21	46	34	40	47	30
9	54	22	45	35	40	48	28
10	54	23	45	36	39	49	26
11	53	24	45	37	39	50	21
12	52	25	44	38	38		
13	52	26	44	39	38		

4.2.4.3. Frequency Distribution

Frequency distribution is a series when a number of observations with similar or closely related values are put in separate bunches or groups, each group being in order of magnitude in a series. It is simply a table in which the data are grouped into classes and the numbers of cases which fall in each class are recorded. It shows the frequency of occurrence of different values of a single phenomenon.

According to Croxton and Cowden, "Frequency distribution is a statistical table which shows the set of all distinct values of the variable arranged in order of magnitude, either individually or in groups, with their corresponding frequencies side by side".

Thus a frequency distribution has two parts, on its left there are sizes or magnitudes of values and on its right the number of times a value or a group of values has repeated.

Formation of Frequency Distribution

Following steps are involved in the formation of a frequency distribution:

1) **Find the Range of the Data:** The range is the difference between the largest and the smallest values i.e., L–S.

2) **Decide the Approximate Number of Classes:** There are no hard and fast rules for number of classes. Most of the cases we have 5 to 20 classes. **H.A. Sturges** has given a formula for determining the approximation number of classes.

$$K = 1 + 3.322 \log_{10} N$$

where,

N = Total number of observations

Log_{10} = Logarithm of the total number of observations

K = Number of class intervals

For Example: If the total number of observations is 50, the number of classes would be

$K = 1 + 3.322 \log_{10} N$

$K = 1 + 3.322 \log_{10} 50$

$K = 1 + 3.322 (1.69897)$

$K = 1 + 5.644$

K = 6.644 or 7 classes approximately

3) **Determine the Approximate Class Interval Size:** The size of class interval is obtained by dividing the range of data by number of classes and denoted by h class interval size

$$h = \frac{\text{Range}}{\text{Number of Classes}}$$

In case of fractional results, the next higher whole number is taken as the size of the class interval.

4) **Decide the Starting Point:** The lower class limits or class boundary should cover the smallest value in the raw data. It is a multiple of class interval.

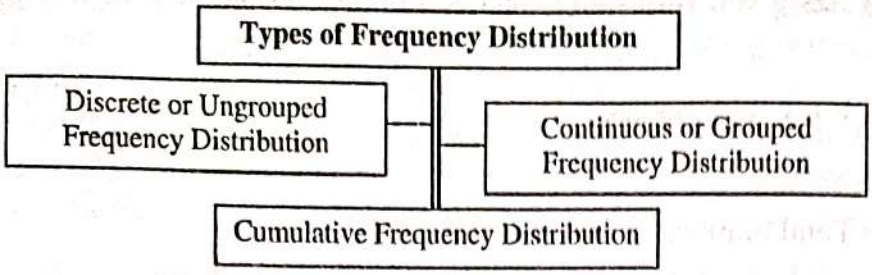
For example, 0, 5, 10, 15, 20 etc... are commonly used.

5) **Determine the Remaining Class Limits (Boundary):** When the lowest class boundary of the lowest class has been decided, then by adding the class interval size to the lower class boundary, compute the upper class boundary. The remaining lower and upper class limits may be determined by adding the class interval size repeatedly till the largest value of the data is observed in the class.

6) **Distribute the Data into Respective Classes:** All the observations are marked into respective classes by using **Tally Bars (Tally Marks)** methods which is suitable for tabulating the observations into respective classes. The number of tally bars is counted to get the frequency against each class. The frequency of all the classes is noted to get grouped data or frequency distribution of the data. The total of the frequency columns must be equal to the number of observations.

Types of Frequency Distribution

Basically there are three type of frequency distribution:



1) **Discrete or Ungrouped Frequency Distribution:** In this form of distribution, the frequency refers to discrete value. Here, the data are presented in a way that exact measurement of units is clearly indicated. The process of preparing this type of distribution is very simple. We have just to count the number of times a particular value is repeated, which is called the frequency of that class. In order to facilitate counting prepare a column for tally marks. In another column, place all possible values of variable from the lowest to the highest. Then put a bar (vertical line) opposite the particular value to which it relates.

   To facilitate counting, blocks of five bars are prepared and some space is left in between each block. We finally count the number of bars and get frequency.

   Example 4: In a survey of 40 families in a village, the number of children per family was recorded and the following data obtained.

1	0	3	2	1	5	6	2
2	1	0	3	4	2	1	6
3	2	1	5	3	3	2	4
2	2	3	0	2	1	4	5
3	3	4	4	1	2	4	5

   Represent the data in the form of a discrete frequency distribution.

   Solution: Frequency distribution of the number of children

Number of Children	Tally Marks	Frequency
0	𝍸	3
1	𝍸 |	7
2	𝍸 𝍸	0
3	𝍸 𝍸 |||	8
4	𝍸 𝍸 ||||	6
5	𝍸 𝍸 𝍸	4
6	𝍸 |	2
Total		**40**

2) **Continuous or Grouped Frequency Distribution:** Continuous series is one where measurements are only approximations and are expressed in class intervals, i.e., within certain limits.

According to Boddington, "The variable which can take any intermediate value between the smallest and longest value in the distribution".

In a continuous frequency distribution the class intervals theoretically continue from the beginning of the frequency distribution to the end without break. The continuous frequency distribution can always be distinguished from the discrete frequency distribution in that it will contain two limits upper limits and lower limits of each class interval while the discrete frequency distribution will possess only one list of classification of values.

A collection of items, which cannot be exactly measured, but placed within certain limits, is called continuous series.

For example, Wage distribution of 100 employees

Weekly Wages (₹)	Number of Employees
50-100	4
100-150	12
150-200	22
200-250	33
250-300	16
300-350	8
350-400	5
Total	**100**

Basic Components of Continuous Frequency Distribution

The following are some basic technical terms when a continuous frequency distribution is formed or data are classified according to class intervals:

i) **Class Limits:** The class limits are the lowest and the highest values that can be included in the class. **For example,** take the class 30-40. The lowest value of the class is 30 and highest class is 40. The two boundaries of class are known as the lower limits and the upper limit of the class. The lower limit of a class is the value below which there can be no item in the class. The upper limit of a class is the value above which there can be no item to that class. Of the class 60-79, 60 is the lower limit and 79 is the upper limit, i.e., in the case there can be no value which is less than 60 or more than 79.

The way in which class limits are stated depends upon the nature of the data. In statistical calculations, lower class limit is denoted by L and upper class limit by U.

ii) **Class-Intervals:** The difference between the lower limit and the upper limit of the class is known as the class-interval; e.g., in the class 10 – 20, the class-interval is 10 (i.e., 20 –10). The formula to find the class-interval of a given problem is:

$$i = \frac{L - S}{k}$$

where, L = Largest item,
S = Smallest item,
k = The number of classes

For example, if the marks of 50 students are varied between 10 and 80 and if we want to form 7 classes, then the class-intervals would be:

$$i = \frac{L-S}{k}\ ; L = 80, S = 10, k = 7 = \frac{80-10}{7} = \frac{70}{7} = 10$$

Therefore, the class-intervals would be 10 – 20, 20 – 30, 30 – 40, 40 – 50, 50 – 60, 60 – 70, and 70 – 80.

Types of Class Intervals

There are three methods of classifying the data according to class intervals namely:

a) **Exclusive Method:** When the class intervals are so fixed that the upper limit of one class is the lower limit of the next class; it is known as the exclusive method of classification. **For example,** consider the following data, which are classified on the basis of this method:

Expenditure (₹)	No. of Families
0-5000	60
5000-10000	95
10000-15000	122
15000-20000	83
20000-25000	40
Total	**400**

From the above table, it is clear that the exclusive method ensures continuity of data as much as the upper limit of one class is the lower limit of the next class. In the example, there are 60 families whose expenditure is between ₹0 and ₹4999.99. A family whose expenditure is ₹5000 would be included in the class interval 5000-10000. This method is widely used in practice.

b) **Inclusive Method:** In this method, the overlapping of the class intervals is avoided. Both the lower and upper limits are included in the class interval. This type of classification may be used for a grouped frequency distribution for discrete variable like members in a family, number of workers in a factory, etc., where the variable may take only integral values. It cannot be used with fractional values like age, height, weight, etc. **For example,** consider the following table which described the inclusive method

Class Interval	Frequency
5-9	7
10-14	12
15-19	15
20-29	21
30-34	10
35-39	5
Total	**70**

Thus, to decide whether to use the inclusive method or the exclusive method, it is important to determine whether the variable under observation in a continuous or discrete one. In case of continuous variables, the exclusive method must be used. The inclusive method should be used in case of discrete variable.

c) **Open End Classes:** A class limit is missing either at the lower end of the first class interval or at the upper end of the last class interval or both are not specified. The necessity of open end classes arises in a number of practical situations, particularly relating to economic and medical data when there are few very high values or few very low values which are far apart from the majority of observations. The **example** for the open-end classes as follows:

Salary Range	No. of Workers
Below 2000	7
2000 - 4000	5
4000 - 6000	6
6000 - 8000	4
8000 and above	3

iii) **Range:** The difference between largest and smallest value of the observation is called the range and is denoted by 'R', i.e.,

R = Largest value – Smallest value

R = L – S

iv) **Mid-Value or Mid-Point:** The central point of a class interval is called the mid value or mid-point. It is calculated by adding the upper and lower limits of a class and dividing the sum by 2.

$$\text{i.e., Mid-Value} = \frac{L+U}{2}$$

For example, if the class interval is 20-30 then the mid-value is

$$\frac{20+30}{2} = 25$$

v) **Frequency:** Number of observations falling within a particular class interval is called frequency of that class. **For example,** Let us consider the frequency distribution of weights of persons working in a company.

Weight (in kgs)	Number of Persons
30-40	25
40-50	53
50-60	77
60-70	95
70-80	80
80-90	60
90-100	30
Total	**420**

In this example, the class frequencies are 25, 53, 77, 95, 80, 60, and 30. The total frequency is equal to 420. The total frequency indicates the total number of observations considered in a frequency distribution.

vi) **Number of Class Intervals:** The number of class interval in a frequency is matter of importance. The number of class interval should not be too many. For an ideal frequency distribution, the number of class intervals can vary from 5 to 15. To decide the number of class intervals for the frequency distributive in the whole data, we choose the lowest and the highest of the values. The difference between them will enable us to

decide the class intervals. Thus the number of class intervals can be fixed arbitrarily keeping in view the nature of problem under study or it can be decided with the help of **Sturges' Rule**. According to him, the number of classes can be determined by the formula:

$$K = 1 + 3.322 \log_{10} N$$

where N = Total number of observations
$\log_{10}$ = Logarithm of the number
K = Number of class intervals

Thus if the number of observation is 10, then the number of class intervals is

$$K = 1 + 3.322 \log 10 = 4.322 \cong 4$$

If 100 observations are being studied, the number of class interval is

$$K = 1 + 3.322 \log 100 = 7.644 \cong 8$$ and so on.

vii) **Size of the Class Interval:** Since the size of the class interval is inversely proportional to the number of class interval in a given distribution. The approximate value of the size (or width or magnitude) of the class interval 'C' is obtained by using sturges rule as:

$$\text{Size of class interval(C)} = \frac{\text{Range}}{\text{Numberof class interval}} = \frac{\text{Range}}{1+3.322 \log_{10} N}$$

Where, Range = (Largest Value – Smallest Value) in the distribution.

3) **Cumulative Frequency Distribution:** A cumulative distribution of frequencies shows the number of data items with values less than or equal to the upper class limit of each class. While a cumulative relative frequency distribution gives the proportion of the data items and a cumulative percentage frequency distribution shows the percentage of data items with values less than or equal to the upper class limit of each class.

Table 4.1: GCS Scores of Table Sharing the Cumulative Frequency

GCS Score	Frequency (Number of Patients)	Cumulative Frequency (Cumulative Number of Patients)
3	10	10
4	5	15
5	6	21
6	2	23
7	12	35
8	15	50
9	18	68
10	14	82
11	15	97
12	21	118
13	13	131
14	17	148
15	6	154

The cumulative frequency for each category tells us how many subjects there are in that category, and in all the lesser-valued categories in the table.

For example, 35 patients had a GCS score of 7 or less.

4.3. GRAPHICAL PRESENTATION OF DATA

4.3.1. Introduction

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

In a graphic mode of presentation the points or lines of various kinds are used to represent data. Each graph paper has thick lines for each division of an inch or cm. and thin lines for smaller parts of the same. A graph, of whatever size, is divided into four quadrants but normally the first quadrant is used unless there are minus figures to be shown on either of the axis. The horizontal axis is called the XX' axis and the vertical axis the YY' axis. These intersect at a central point called the origin indicated by 0 (zero).

The minus quantity of any variable shown on horizontal axis will be on the left of the origin; the minus quantity of any variable shown on the vertical axis will be indicated in the lower portion of the origin. There are four quadrants which show how the points will figure in each quadrant with + or – signs as **shown figure 4.1.**

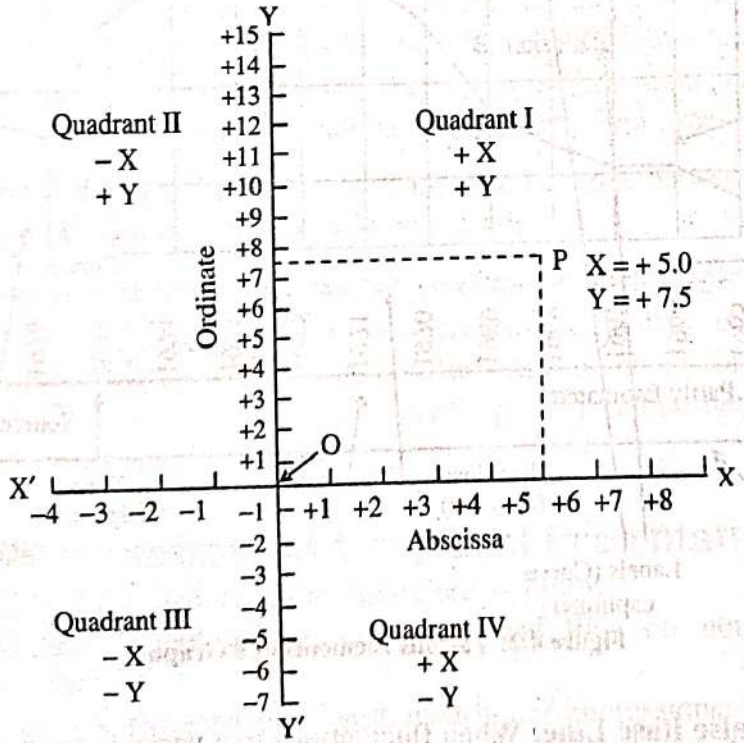


Figure 4.1

A point (5, 7.5) has been plotted in the Quadrant I, 5 has been read on horizontal axis and on the positive side and 7.5 has been read on the vertical axis, again on the positive side.

4.3.2. General Rules for Graphical Presentation

While graphing statistical data, the following points should be consider:

1) **Title:** Every graph must have a clear and comprehensive title so that what facts are presented in the graph may be known.

2) **Structural Framework:** The independent variables should always be measured along the X-axis and dependent variables along the Y-axis. The scale on Y-axis should begin from zero as origin. For actual plotting of the data, it should be remembered that every value of the independent variable, there is a corresponding value of the dependent variable.

3) **Choice of Scale:** It should be made such that it accommodates the whole data.

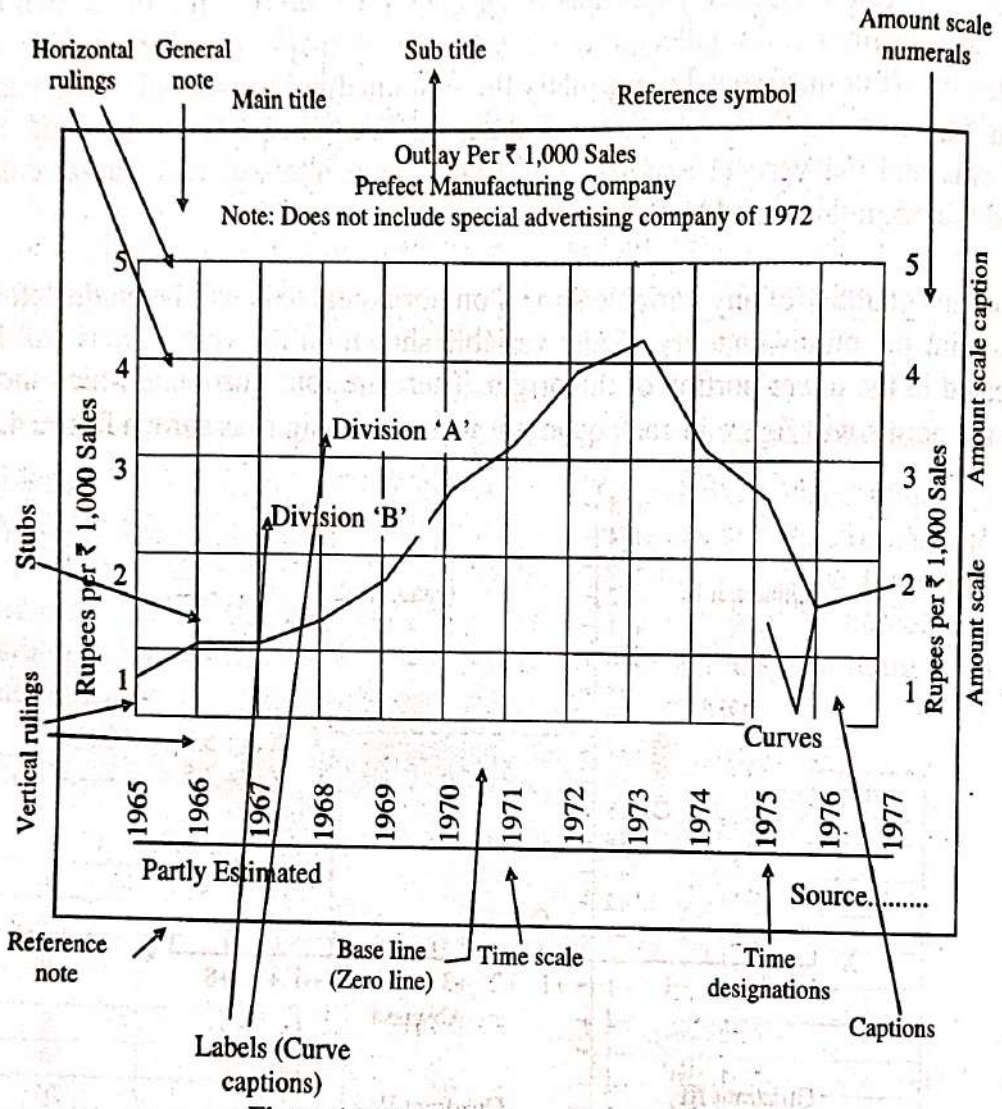


Figure 4.2: Various Elements of a Graph

4) **Use of False Base Line:** When fluctuations in a variable are small relative to its size and it is desired to view these fluctuations properly, the vertical scale may be stretched. This can be done if, instead of showing the entire scale from zero to the highest value, only as much need be shown as is necessary for the purpose. The portion which lies between zero and the lowest value of the variable is left out. This omission is indicated by a scale break.

5) **Use of Ratio or Logarithmic Scale:** For showing proportional changes, ratio or logarithmic scale should be used.

6) **Line Designs:** If more than one line is plotted on the same graph, it is necessary to distinguish those by different patterns as shown in the figure.

7) **Caption:** The scale caption for the X-axis is placed under the centre of the horizontal axis. The scale caption for the Y-axis is placed at the top or the middle of the Y-scale.

8) **Index:** An index should be given to show the scale and the meaning of different curves.

9) **Source:** The source note should indicate the source of information.

4.3.3. Advantages of Graphical Presentation

The advantages of graphical presentation are as follows:

1) **Graphs are Attractive, Interesting and Impressive:** A graph is more attractive than a table or figures. As the features of data become visible at a glance in a graph, one can study very easily the tendency and fluctuation of data.

2) **No Knowledge of Mathematics Required:** Even a common man can understand the message of data from the graph. To understand a graph, no special knowledge of mathematics is needed.

3) **Simplest Method of Presenting Data:** Graphical method is probably the simplest method of presenting statistical data to such an advantage. It saves time and energy of both, the statistician as well as the observer. **For example,** a busy business executive hardly has time for study of data relating to sales, purchase, cost or profit and find out their trend. If these data are presented on a graph, the basic trend can be understood in a very short time.

4) **Comparison is Made Easy:** Comparisons can be made between two or more phenomena very easily with the help of a graph.

5) **Certain Statistical Measures can be Ascertained with Care:** With the help of special kind of graphs, positional averages like median, quartiles, mode, etc., can be determined. Graphic presentation of statistical data is also helpful in interpolation, extrapolation and forecasting. Correlation between two sets of data can be studied.

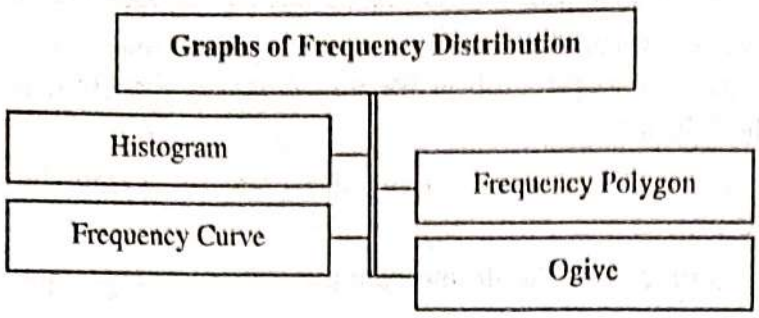
4.3.4. Disadvantages of Graphical Presentation

The disadvantages of graphical presentation are as follows:

1) Many people are not accustomed to it and they do not attach much importance to it.
2) Graphic presentation may often give misleading impressions. Much depends upon the scale taken. Two different scales may show different fluctuations in the data.
3) Accuracy is rather not possible in a graph.
4) Graphs cannot be quoted in support of some statement.
5) Only one or two characteristics can be depicted in a graph. If more features are shown, the graph becomes difficult to follow.

4.3.5. Graphs of Frequency Distributions

The most commonly used graphs for charting a frequency distribution for the general understanding of the details of the data are as follows:



4.3.5.1. Histogram

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

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

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

Advantages of Histogram

The advantages of histogram are as follows:

1) Each rectangle shows distinctly separate class in the distribution.
2) The area of each rectangle in relation to all other rectangles shows the proportion of the total number of observations pertaining to that class.

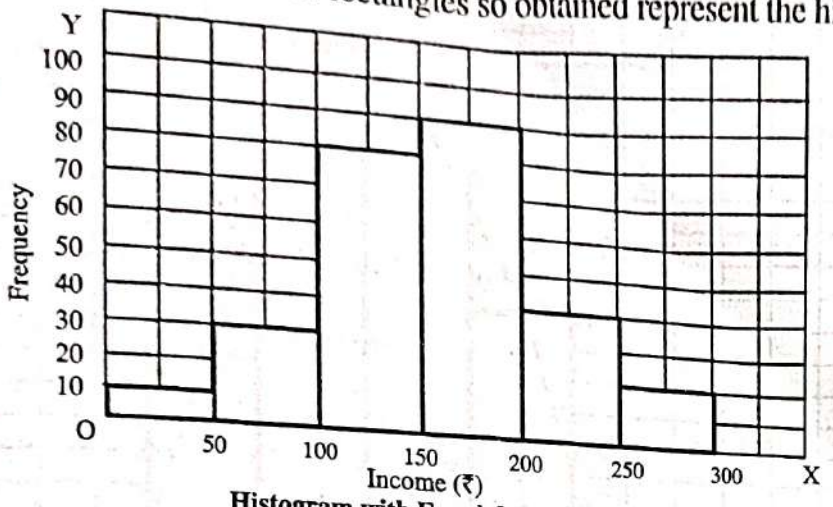
Example 5: Represent the data given below by histograms:

Income in Rupees	Frequency
0 – 50	10
50 – 100	30
100 – 150	80
150 – 200	90
200 – 250	40
250 – 300	20

Solution: The following step is involved for construction of graph:

1) Let the scale for OX-axis be 1cm. = 50 (income in ₹) and the scale for OY-axis be 1cm. = 10 units of frequency.

2) The rectangles are drawn taking into consideration 1cm. = 50 (income in ₹) as width and the respective frequencies (being represented in the scale of 1 cm. = 10 units frequencies). The set of rectangles so obtained represent the histogram.



Histogram with Equal Class-Interval

4.3.5.2. Frequency Polygon

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

Advantages of Frequency Polygon

Advantages of frequency polygon are as follows:

1) The frequency polygon is simpler as compared to its histogram.
2) The frequency polygon shows more vividly an outline of the data pattern.

As the number of classes and the number of observations increase, so also the frequency polygon becomes increasingly smooth.

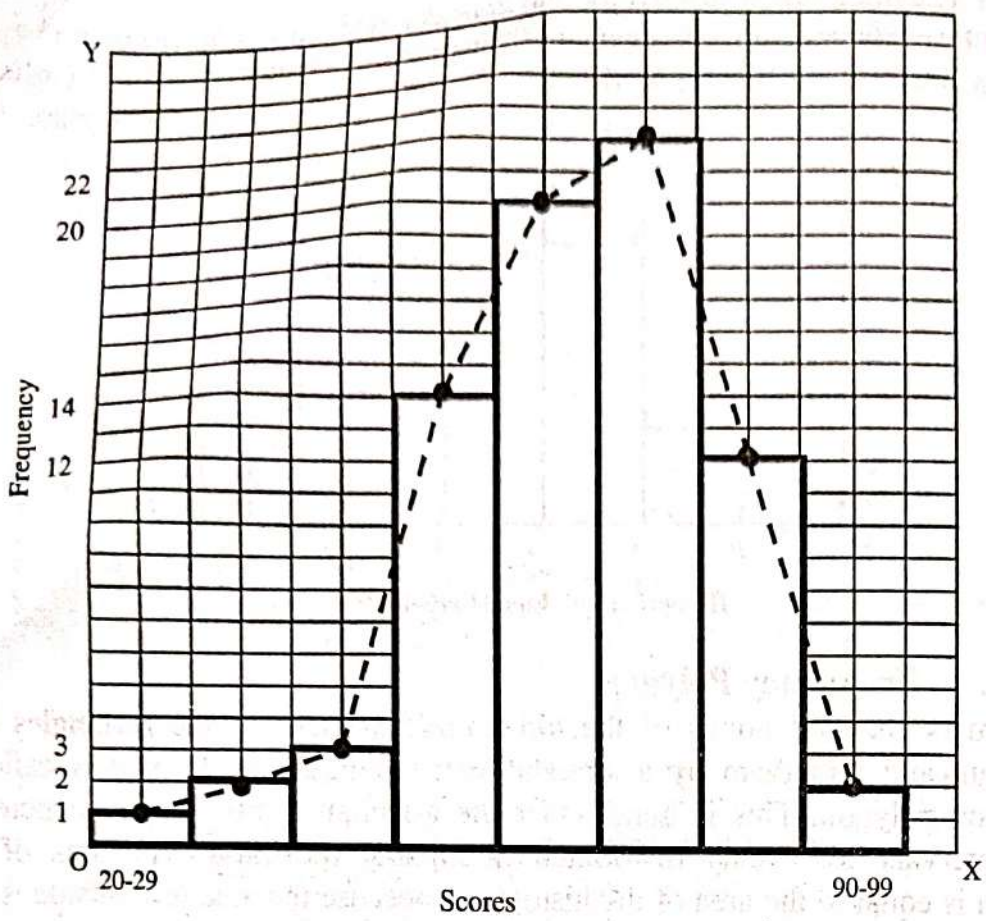
Example 6: Illustrate the following by a frequency polygon:

Scores	Frequency	Scores	Frequency
90 – 99	02	50 – 59	14
80 – 89	12	40 – 49	3
70 - 79	22	30 – 39	2
60 - 69	20	20 – 29	1

Solution: The following steps are involved for construction of graph:

1) For the purpose of simplification and to have the things in order, the scores and frequencies may firstly be re-written as:

Scores	Frequency
20 – 29	1
30 – 39	2
40 - 49	3
50 - 59	14
60 – 69	20
70 – 79	22
80 - 89	12
90 - 99	2



Frequency Polygon

2) A suitable scale is to be adjusted for both the OX and the OY axis:
OX-axis (Scores): 1 cm = 10 group (scores).
OY-axis (Frequency): 1 cm = 2 unit of frequency.
3) On the basis of the above scales, the histogram is drawn.
4) The mid-values in the upper surfaces of the rectangles are plotted and then they are joined. It gives the frequency polygon.

4.3.5.3. Frequency Curve

If the middle point of the upper boundaries of the rectangles of a histogram is corrected by a smooth freehand curve, then that diagram is called frequency curve. The curve should begin and end at the base line.

Example 7: Draw a frequency curve from the following frequency distribution:

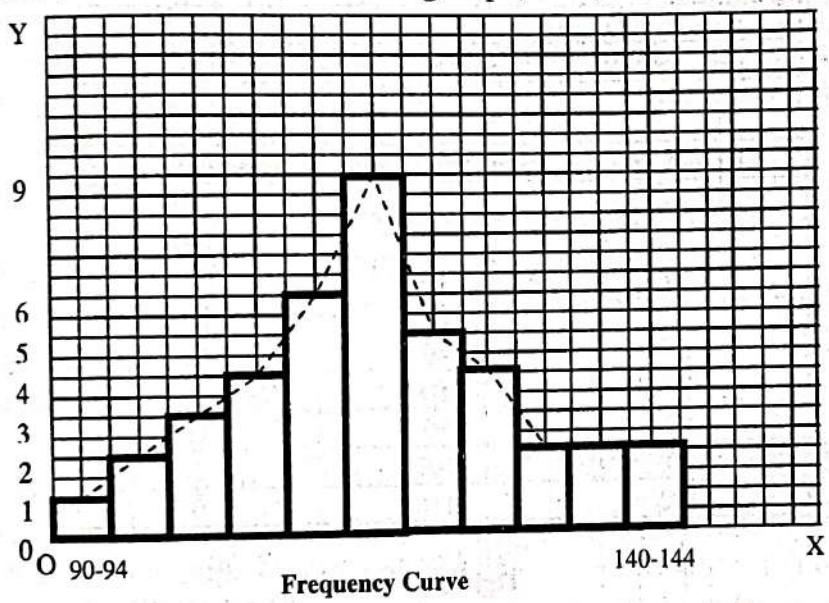
Scores	Frequency
140 – 144	2
135 - 139	2
130 – 134	2
125 - 129	4
120 – 124	5
115 – 119	9
110 – 114	6
105 – 109	4
100 – 104	3
95 – 99	2
90 – 94	1

Solution: The following step is involved for construction of graph:

1) The class groups are given in the descending order. So, if the graph is plotted 'as it is', the advantage of the 'continuity and order' may be seriously hampered. Moreover, in that case, the frequency curve would be 'unrepresentative'. Therefore, in this case, the groups are re-written in a proper and systematic form as:

Scores	Frequency
90 – 94	1
95 – 99	2
100 – 104	3
105 – 109	4
110 – 114	6
115 - 119	9
120 – 124	5
125 – 129	4
130 – 134	2
135 – 139	2
140 – 144	2

2) The scores (as the groups) are represented on the OX-axis. In this particular case, the scale is taken as 1cm. = 5 group (score).



Frequency Curve

3) The frequencies are represented, as a variable factor, on the OY-axis. The scale is taken as 1cm = 1 unit of frequency.
4) The rectangles are first drawn on the basis of the values given and taking into consideration the scales adjusted.
5) Then the upper-end mid-points are plotted.
6) Finally, considering all these, a freehand curve is drawn. The curve so obtained is known as the frequency curve. It is very commonly used in the study of various subjects.

4.3.5.4. Cumulative Frequency Curves or Ogives

When cumulative frequencies are plotted on a graph, then the frequency curve obtained is called 'ogive' or 'cumulative frequency curve'. Ogives determine median, quartiles, percentiles, etc. The class limits are shown along the X-axis and cumulative frequencies along the Y-axis. In drawing an ogive, the cumulative

frequency is plotted at the upper limit of the class interval, the successive points are later joined together to get an ogive curve. There are two methods of constructing ogives, *viz.*,:

1) Less than ogive, and
2) More than ogive.

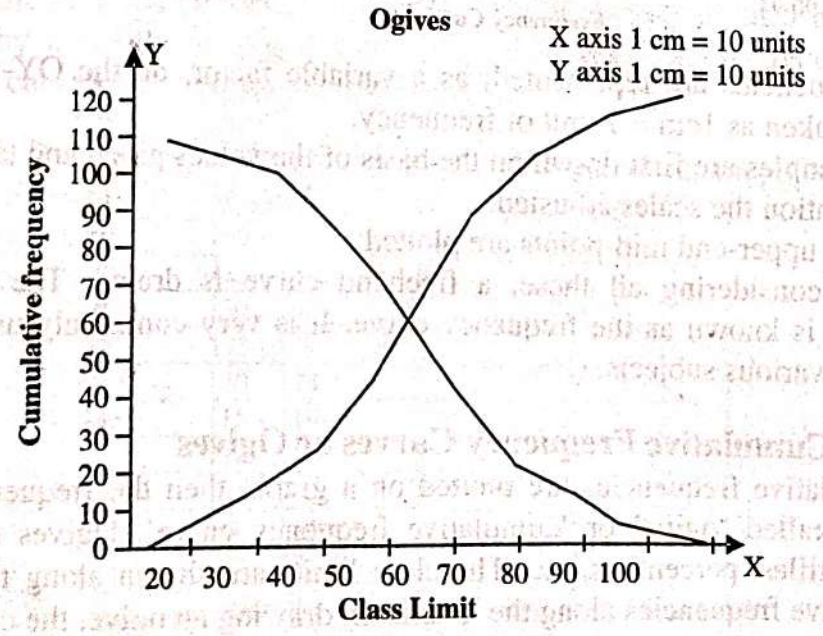
In less than ogive method we start with the upper limits of the classes and go adding the frequencies. When these frequencies are plotted, we get a rising curve. In more than ogive method, we start with the lower limits of the classes and from the total frequencies we subtract the frequency of each class. When these frequencies are plotted we get a declining curve.

Example 8: Draw the less-than and greater than Ogives for the following data:

Class Interval	Frequency
20-30	4
30-40	6
40-50	13
50-60	25
60-70	32
70-80	19
80-90	8
90-100	3

Solution:

Class Limit	Less than Ogive	More than Ogive
20	0	110
30	4	106
40	10	100
50	23	87
60	48	62
70	80	30
80	99	11
90	107	3
100	110	0



4.4. MEASURES OF CENTRAL TENDENCY

4.4.1. Meaning and Definitions of Measure of Central Tendency

Measure of Central tendency is also known as 'measure of central value' or 'measure of location' or 'average of first order'. It is a statistical measure and calculates the location or position of central point to explain the central tendency of the whole quantity of data.

According to Simpson and Kafka, "A measure of location is a typical value around which other figures congregate."

According to M.R. Speigal, "Average is a value which is typical or representative of a set of data."

According to Clark and Sekkade, "Average is an attempt to find one single figure to describe whole of figure."

4.4.2. Properties of Good Measures of Central Tendency

Following are the properties of ideal measures of central tendency:

1) It should be rigidly defined.
2) Its definition should be in the form of a mathematical formula.
3) It should be easy to understand and calculate.
4) It should remain unaffected by the extreme values.
5) It should be capable of further algebraic treatment.
6) It should be based on all items in the series.
7) It should be capable of being used in further statistical computation or processing.
8) It should possess sampling stability.

4.4.3. Types of Measures of Central Tendency

In statistics, there are various types of measures of central tendency. Some of which can be broadly classified as follows:

1) Mathematical Average
2) Positional Average

4.4.3.1. Mathematical Average

Mathematical averages are those averages which are calculated by taking into account the values of all the items in a series. When values of all the items in a series are considered in the calculation of average then it is called mathematical averages.

1) **Mean:** Mean is also known as Arithmetic Mean (A.M.). To calculate the mean, summate all the observations and divide it by the total number of observations. Mean is denoted by $\overline{X}$.

$$\text{So, } \overline{X} = \frac{\text{Sum of all the observations}}{\text{Number of observations}} = \frac{\sum X}{N}$$

2) **Geometric Mean:** The geometric mean of 'N' numbers is defined as the "N^{th} root of the product of 'N' numbers." If all the values of a series are multiplied and then N^{th} root of the product is extracted, then the geometric mean is obtained. Symbolically:

$$G.M. = \sqrt[N]{(X_1) \times (X_2) \times (X_3) ..... \times (X_n)}$$

3) **Harmonic Mean:** The harmonic mean is the reciprocals of averaged numbers. It is defined as the reciprocal of the arithmetic mean of the reciprocal of the individual observations. Under certain conditions, harmonic mean is a better measure of central tendency, e.g., computation of average speed, average price, etc.

Mathematically,

$$H.M. = \frac{N}{\frac{1}{X_1} + \frac{1}{X_2} + \frac{1}{X_3} + ... + \frac{1}{X_N}}$$

where,

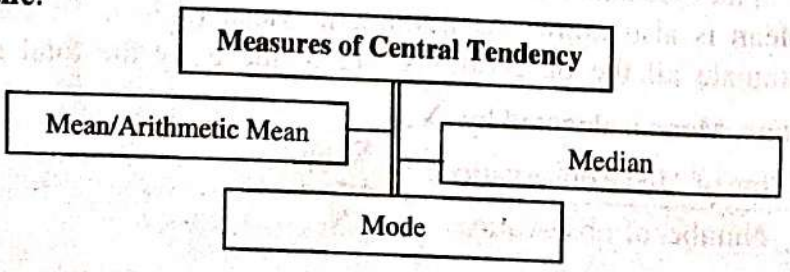
N = Number of observations;

X_N = Value of observation

4.4.3.2. Positional Average

Positional average is the average which depends on the position of the items, rather than the values of the items.

1) **Median:** When N observations are grouped and arranged in the sorting order (ascending or descending order) according to their values, then the central value of the observation is known as median. It is denoted by M or Me.
2) **Mode:** Mode is the value of the variable for which the frequency is maximum and it is denoted by Z or Mo.
3) **Quartiles:** The measure of central tendency which divides a group of data into four sub-groups or parts, then it is called quartile. The three quartiles are denoted as Q_1, Q_2, and Q_3.
4) **Deciles:** If the values of the observation in a data set are arranged in ascending or descending order and divided it into ten equal parts by using nine points on the scale of observations, then it is called **decile.**
5) **Percentiles:** If the values of the observation in a data set are arranged in ascending or descending order and divided it into hundred equal parts by using ninety nine points on the scale of observations, then it is called **percentile.**



4.5. MEAN/ARITHMETIC MEAN

4.5.1. Introduction

Mean is also known as Arithmetic Mean (A.M.). To calculate the mean, summate all the observations and divide it by the total number of observations. Mean is denoted by $\overline{X}$.

So,

$$\overline{X} = \frac{\text{Sum of all observations}}{\text{Number of observations}} = \frac{\sum X}{N}$$

According to W. I. King, "The arithmetic average may be defined as the sum or aggregate of a series of items divided by their number".

For example, the arithmetic mean of the four numbers 32, 40, 44 and 36 is given by,

$$\overline{X} = \frac{32+40+44+36}{4} = \frac{152}{4} = 38$$

4.5.2. Characteristics of Arithmetic Mean

The main characteristics of arithmetic mean are as follows:

1) The sum of the deviations of the individual items from the arithmetic mean is always zero. This means $\sum(X-\overline{X})=0$, where X is the value of an item and $\overline{X}$ is the arithmetic mean. 'Since the sum of the derivations in the positive direction is equal to the sum of the deviations in the negative direction, the arithmetic mean is regarded as a measure of location.'
2) The sum of the squared deviations of the individual items from the arithmetic mean is always minimum. In other words, the sum of the squared deviations taken from any value other than the arithmetic mean will be higher.
3) Since the arithmetic mean is based on all the observations in a series, a change in the value of any observation will lead to a change in the value of the arithmetic mean.
4) In the case of a highly skewed distribution, the arithmetic mean may get inaccurate on account of a few items with extreme values. In such a case, it may not represent the characteristic of the distribution.

4.5.3. Advantages of Mean

1) Simple to calculate and understand.
2) Some value is always determined, i.e., it is never indefinite.
3) Can be used in other algebraic calculations.
4) No need of sorting or arrangement (ascending or descending order).
5) It is stable and not affected by the variation of sampling.

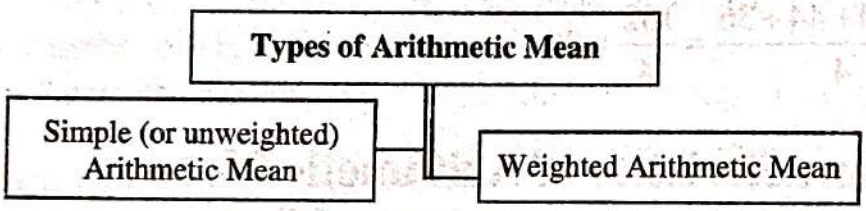
4.5.4. Disadvantages of Mean

The disadvantages of mean are as follows:

1) Mean is greatly affected by the extreme values. **For example,** mean of 3, 7 and 200 is 70. Here, no value is present near this 70; hence this average is of no use.
2) Sometimes mean may provide confusing impressions. **For example,** in a hospital, per day average number of patients admitted is 5.7. Here given information is useful but does not provide the actual item because some values are of no use when expressed in fraction or decimal.
3) The 'mean' cannot be predicted by just inspecting the sample item.
4) If a single value is missing, mean cannot be calculated.
5) In case of open-end classes, mean cannot be calculated.
6) Graphical representation of mean is not possible.

4.5.5. Types of Arithmetic Mean

There are two types of arithmetic mean:



4.5.6. Methods of Calculation of Arithmetic Mean

The methods for calculating arithmetic mean vary according to various types of series such as:

1) Calculation of Arithmetic Mean - Individual Series
2) Calculation of Arithmetic Mean - Discrete Series (Ungrouped Data)
3) Calculation of Arithmetic Mean - Continuous Series (Grouped Data)

4.5.6.1. Calculation of Arithmetic Mean - Individual Series

The methods used are as follows:

1) **Direct Method:** The direct method of calculating arithmetic mean in the case of individual series involves the following steps:
   i) Add the various given values of the variable X and find the total value which is denoted by ΣX.
   ii) Divide this total value (ΣX) by the number of observations (N) i.e.,

$$\overline{X} = \frac{X_1 + X_2 + X_3 + \ldots\ldots + X_n}{N} = \frac{\Sigma X}{N}$$

Example 9: The weekly wage of 5 workers is as given below:
1350, 1400, 1450, 1370, 1480

Find arithmetic mean.

Solution:

Computation of Arithmetic Mean

Serial Number	Weekly Wages (in ₹)
1	1350
2	1400
3	1450
4	1370
5	1480
N = 5	ΣX = 7050

$$\bar{X}=\frac{\sum X}{N}=\frac{7050}{5}=₹1410$$

2) **Short-Cut Method:** With the use of short-cut method also, arithmetic mean can be calculated. The calculation of arithmetic mean by short-cut method includes the following steps:

i) Any value may be taken as an assumed mean of the data. This assumed value is also known as working mean or arbitrary average (A = Assumed mean).

ii) Subtract assumed mean from each value of the observation (d = X – A).

iii) All the deviations are added and it is denoted by (Σd).

iv) Apply the formula:

$$\bar{X}=A+\frac{\sum d}{N}$$

where, $\bar{X}$ = Arithmetic mean ; A = Assumed mean;
$\sum d$ = Sumof the deviatior, N = Number of items.

Example 10: Calculate mean from the following data:

Years	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Price of Rice (in ₹)	40	50	55	80	58	60	75	35	45	52

Solution: Let the assumed mean be A = 50

Years	Price of Rice (X)	d = (X – 50)
2001	40	–10
2002	50	0
2003	55	5
2004	80	30
2005	58	8
2006	60	10
2007	75	25
2008	35	–15
2009	45	–5
2010	52	2
N = 10		Σd = 50

$$\bar{X}=A+\frac{\sum d}{N}=50+\frac{50}{10}=50+5=₹55.$$

4.5.6.2. Calculation of Arithmetic Mean - Discrete Series (Ungrouped Data)

The methods used are as follows:

1) **Direct Method:** In the discrete series, the sum of items is determined by multiplying each value with the respective frequency. The values got after multiplication are totalled up. To find the arithmetic mean, total value is divided by the total number of items. Following are the steps which are involved in the calculation of mean:
   i) Multiply each item by its frequency, denoted by (fX).
   ii) Add all the fX, denoted by (ΣfX).
   iii) ΣfX is divided by the total number of items.

The formula is $\bar{X}=\frac{\sum fX}{\Sigma f}$

where,

$\bar{X}$ = Arithmetic mean
ΣfX = The sum of products
Σf = Total number of items

Example 11: Find average wages of 10 workers:

Daily Wage (in ₹)	4	6	10	11	14	Total
No. of Workers	2	1	4	2	1	10

Solution:

Daily Wage (X)	No. of Workers (f)	fX
4	2	8
6	1	6
10	4	40
11	2	22
14	1	14
Total	**Σf =10**	**ΣfX = 90**

∴ Arithmetic Mean (Average Wage) $=\frac{\sum fX}{\sum f}=\frac{90}{10}=$ ₹9.00

2) **Short-Cut Method:** For calculating the arithmetic mean by short-cut method in a discrete series the following steps are taken:
   i) Any value may be taken as an assumed mean of the data. This assumed value is also known as working mean or arbitrary average (A = Assumed mean). For making the calculation easy, the assumed mean should be close to the middle of the frequency distribution.
   ii) Subtract assumed mean from each value of the observation ($d_x = X - A$).
   iii) Each value of deviation is multiplied by its respective frequency, denoted by (fd_x).

iv) Following is the formula which is used for the calculation of arithmetic mean:

$$\bar{X} = A + \frac{\sum fd_x}{\sum f} \quad \text{or } A + \frac{\sum fd_x}{\sum N}$$

where,

$\bar{X}$ = Arithmetic Mean

A = Assumed Mean

Σfd_x = Total of deviations multiplied with the respective frequencies

Σf = Total of frequencies (N)

Example 12: From the following frequency distributions find out the mean weight of the 100 persons:

Weight (in kg.)	64	65	66	67	68	69	70	71	72	73
No. of Persons	15	13	18	5	20	11	7	6	3	2

Solution: Let assumed mean (A) = 68;

Short-cut Method

Weight in Kg. (X)	No. of Persons (f)	Deviation (d_x) = (X – A)	fd_x
64	15	– 4	– 60
65	13	– 3	– 39
66	18	– 2	– 36
67	5	– 1	– 5
68 (A)	20	0	0
69	11	1	11
70	7	2	14
71	6	3	18
72	3	4	12
73	2	5	10
	$\Sigma f = 100$		$\Sigma fd_x = -75$

$$\bar{X} = A + \frac{\sum fd_x}{\sum f} = 68 + \frac{(-75)}{100} = 68 - 0.75 = 67.25 \text{ Kg.}$$

4.5.6.3. Calculation of Arithmetic Mean - Continuous Series (Grouped Data)

The methods used are as follows:

1) **Direct Method:** For calculating the arithmetic mean in a continuous series the following steps are taken:

   i) First mid value of each class-interval is determined by adding the lower and upper limit of each class and dividing the total by two. **For example,** in a class interval say 0 – 10, the mid value is 5.

   $\left(\frac{0+10}{2} = 10/2 = 5\right)$ (This is denoted by X).

   ii) Multiply these mid values of each class with the respective frequency of each class. In other words X will be multiplied by f.

   iii) Add-up all the products and obtain ΣfX.

iv) ΣfX is divided by the sum of the frequencies i.e., Σf.

v) Apply the formula: $\bar{X}=\frac{\sum fX}{\Sigma f}$

Example 13: From the following find out the mean profits:

Profits per Share (₹)	100-200	200-300	300-400	400-500	500-600	600-700	700-800
Number of Shares	12	20	18	30	32	26	22

Solution:

Calculation of Mean

Profits	Mid-Point (X)	No. of Shares (f)	fX
100-200	150	12	1800
200-300	250	20	5000
300-400	350	18	6300
400-500	450	30	13500
500-600	550	32	17600
600-700	650	26	16900
700-800	750	22	16500
		Σf = 160	**ΣfX = 77600**

$$\bar{X}=\frac{\sum fX}{\Sigma f}=\frac{77600}{160}=485$$

The average profit is ₹485.

2) **Step-Deviation Method:** For calculating the arithmetic mean by step-deviation method in case of grouped series the following steps are taken:

i) Find the mid-point of each group or class, denoted by X.

ii) Any value may be taken as an assumed mean of the data (A = Assumed mean).

iii) Subtract assumed mean from the mid-point of each class, denoted by d_x = (X – A).

iv) Deviations (d_x) are divided by their common factor (i) and step deviation is determined for each class-interval.

$$d'=\frac{d_x}{i}.$$

Thus, $$d' =\frac{X-A}{i}$$

v) The step deviation of each class is multiplied by respective frequency of that class to find the total value Σfd′.

vi) Find the total frequency, N =Σf.

Use the formula: $\bar{X}=A+\frac{\sum fd'}{\sum f}\times i$

where, $\bar{X}$ = Arithmetic mean

A = Assumed mean

Σfd′ = Total of product of step-deviations and frequencies

Σf = Total number of frequencies

i = Common factor in x or in d_x

Example 14: Calculate the mean from the following table:

Weights of Children (in kg.)	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90
Number of Children	4	12	8	21	32	28	10	3	2

Solution: Let assumed mean (A) = 55

C.I. (Weight in kg.)	Mid Value (X)	Frequency (f)	$d_x = X - A$	$d' = d_x/10$	fd'
0–10	5	4	–50	–5	–20
10–20	15	12	–40	–4	–48
20–30	25	8	–30	–3	–24
30–40	35	21	–20	–2	–42
40–50	45	32	–10	–1	–32
50–60	55	28	0	0	0
60–70	65	10	10	1	10
70–80	75	3	20	2	6
80–90	85	2	30	3	6
Total		**Σf =120**			**Σfd' =–144**

$$\text{A.M.} = A + \frac{\sum fd'}{\sum f} \times i = 55 + \frac{(-144)}{120} \times 10$$

$$= 55 - 12 \text{ or } = 43 \text{ Kg.}$$

4.5.7. Weighted Arithmetic Mean

In the economic studies, weighted arithmetic mean plays a very important role. In the calculation of weighted arithmetic mean, items are assigned weights according to their relative importance in the group. The relative importance of various items in a distribution may be different; some items may be relatively more important than others. **For example,** to calculate mean-expenditure of a family, it would be wrong to give equal importance to different items of family expenditure. The family may give different importance to the various items depending upon how much monthly expenditure is incurred on those items. They may give more importance to food and less importance to entertainment or clothes. Hence, the arithmetic mean should be calculated according to their relative importance.

Uses of Weighted Arithmetic Mean

Arithmetic mean cannot present the real picture of any situation because it gives equal importance to all the items. Whereas weighted mean is an important measure because all items of a group do not have equal importance in the calculation. Following are some specific cases where calculation of weighted mean will be useful:

1) When index numbers are constructed.
2) When the results of two or more universities are compared and the number of students differs.
3) When standardised death and birth rates are calculated.

Methods of Calculation of Weighted Arithmetic Mean

Following are the methods of weighted arithmetic mean:

1) **Direct Method:** The following steps are taken in the calculation of weighted arithmetic mean by direct method:
   i) Multiply size of the variable (X) and their respective weights and add-up the products.
   ii) Divide the total by sum of the weights.
   iii) Following formula is used for the calculation of weighted arithmetic mean:

$$\bar{X}_w = \frac{\sum WX}{\sum W}$$

where, $\bar{X}_w$ = Weighted arithmetic mean
W = Weights
X = The variable

2) **Short-Cut Method:** The following steps are taken in the calculation of weighted arithmetic mean by short-cut method:
   i) Any value may be taken as an assumed weighted mean of the data (A_w = Assumed mean).
   ii) Subtract assumed mean from each value of the observation ($d_x = X - A_w$)
   iii) Each value of deviation is multiplied with its respective weight, denoted by Wd_x and then added up, $\sum(Wd_x)$.
   iv) Following is the formula which is used in the calculation of weighted arithmetic mean:

$$\bar{X}_w = A_w + \frac{\sum Wd_x}{\sum W}$$

Where,
$\bar{X}_w$ = Weighted arithmetic mean
A_w = Assumed weighted mean
ΣWd_x = Total of deviations multiplied with the respective weights
ΣW = Total of weights

Example 15: An examination was held to decide the award of a scholarship. The weights given to the various subjects were different. Only three applicants for the scholarship obtained over 50% marks in each subject. The marks were as follows:

Subject	Weight	Marks of A	Marks of B	Marks of C
Statistics	4	65	58	66
Accountancy	3	64	65	72
Economics	2	58	57	58
Mercantile Law	1	72	79	54

Of the candidates the one getting the highest marks is to be awarded the scholarship, who should get it?

Solution:

Subject	Weight W	Marks of A		Marks of B		Marks of C	
		X_1	WX_1	X_2	WX_2	X_3	WX_3
Statistics	4	65	260	58	232	66	264
Accountancy	3	64	192	65	195	72	216
Economics	2	58	116	57	114	58	116
Mercantile Law	1	72	72	79	79	54	54
Total	**$\Sigma W = 10$**		**$\Sigma WX_1 = 640$**		**$\Sigma WX_2 = 620$**		**$\Sigma WX_3 = 650$**

Weighted Mean of A, $XW_1 = \frac{\sum WX_1}{\sum W} = \frac{640}{10} = 64$ Marks

Weighted Mean of B, $XW_2 = \frac{\sum WX_2}{\sum W} = \frac{620}{10} = 62$ Marks

Weighted Mean of C, $XW_3 = \frac{\sum WX_3}{\sum W} = \frac{650}{10} = 65$ Marks

The Weighted Mean of 'C is the highest; hence he is entitled for scholarship.

4.5.8. Combined Mean/Grouped Mean

If the means of two or more than two sub-groups or different samples from the same universe alongwith their numbers are given, then a combined mean can be calculated with the help of following formula:

$$\text{Combined Mean}(\overline{X}) = \frac{N_1\overline{X}_1 + N_2\overline{X}_2 + N_3\overline{X}_3 ..... + N_n\ \overline{X}_n}{N_1 + N_2 + N_3 ..... + N_n}$$

$N_1, N_2, N_3, ...$ are the frequencies of different groups and $\overline{X}_1, \overline{X}_2, \overline{X}_3 .....$ are the arithmetic means of these groups.

Example 16: An analysis of the average speed of the buses in two transport companies A and B, gives the following results:

	Transport Company A	Transport Company B
Number of Buses	595	645
Average Speed (Km/h)	52.5	47.5

Find the combined average speed.

Solution: Combined Average Speed in the two transport companies would be,

$$\overline{X}_{12} = \frac{N_1\overline{X}_1 + N_2\overline{X}_2}{N_1 + N_2}$$

Where, N_1 and N_2 = the number of items in the two series

$\overline{X}_1$ and $\overline{X}_2$ = the mean of the two series respectively

$\overline{X}_{12}$ = The combined mean of the two series.

Given, $N_1 = 595$ and $N_2 = 645$; $\overline{X}_1 = 52.5$ and $\overline{X}_2 = 47.5$

Substituting the values,

$$\text{Combined Average Speed} = \frac{(595 \times 52.5) + (645 \times 47.5)}{595 + 645} = \frac{61875}{1240} = ₹49.9$$

4.5.9. Various Cases in the Calculation of Arithmetic Mean

The following are some typical examples on the calculation of arithmetic mean:

1) **Calculation of Arithmetic Mean of Inclusive Series:** A series in which the upper limit of class interval does not repeat itself as a lower limit of the next class interval then it is called an inclusive series. **For example,** 0-9, 10-19, 20-19, etc., shows an inclusive series. One can calculate arithmetic mean in the case of inclusive series without converting it into exclusive series.

Example 17: Find average profit per shop from the following data:

Profit per Shop (In thousand)	10-12	13-15	16-18	19-21	22-24	25-27	28-30
No. of Shops	35	51	85	65	27	19	8

Solution:

C.I.	Mid Value (X)	f	fX
10-12	11	35	385
13-15	14	51	714
16-18	17	85	1445
19-21	20	65	1300
22-24	23	27	621
25-27	26	19	494
28-30	29	8	232
		Σf = 290	**ΣfX = 5191**

Here, C.I. = Class interval
f = Frequency
$\Sigma f = 290; \Sigma fX = 5191$

$$\text{Mean } (\bar{X}) = \frac{\Sigma fX}{\Sigma f} = \frac{5191}{290} = 17.9$$

2) **Calculation of Arithmetic Mean in a Cumulative Frequency Distribution:** For the calculation of arithmetic mean in the case of cumulative frequency distribution, given frequencies are converted into simple frequency distribution. Cumulative frequency distribution may be classified into the following two types:

i) **Less than or Below Cumulative Frequency Distribution:** In the case of less than or below cumulative frequency distribution, we first convert it into simple frequency distribution. Now, one can calculate arithmetic mean by using any method.

Example 18: Find the mean from the following frequency distribution:

Marks Less than	10	20	30	40	50	60
No. of Students	10	15	35	70	90	100

Solution:

Calculation of Mean by Step-Deviation Method

Marks	No. of Students (f)	Mid-Values (X)	Deviations $d_X = (X - A)$ $A = 25$	Step-Deviations $d' = \frac{dx}{C}$, when C=10	fd′
0-10	10	5	–20	–2	–20
10-20	5(15 – 10)	15	–10	–1	–5
20-30	20(35 – 15)	25	0	0	0
30-40	35(70 – 35)	35	10	1	35
40-50	20(90 – 70)	45	20	2	40
50-60	10(100 – 90)	55	30	3	30
	Σf = 100				**Σfd′ = 80**

$$\overline{X}=A+\frac{\Sigma fd'}{\Sigma f}\times C=25+\frac{80}{100}\times 10=33 \text{ Marks}$$

ii) **More than or Above Cumulative Frequency Distribution:** In this case, we obtain frequencies of each class by subtracting the second class frequency from first class frequency and third from second and so on as shown in the example given below:

Example 19: Find the arithmetic mean from the following data:

Age (In Years)	No. of Persons	Age	No. of Persons
Above 0	134	Above 60	36
Above 10	128	Above 70	22
Above 20	123	Above 80	17
Above 30	90	Above 90	13
Above 40	87		
Above 50	66		

Solution:

Age	No. of Persons (f)	Mid-Values (X)	(fX)
0-10	6(134 – 128)	5	30
10-20	5(128 – 123)	15	75
20-30	33(123 – 90)	25	825
30-40	13(90 – 87)	35	455
40-50	21(87 – 66)	45	945
50-60	30(66 – 36)	55	1650
60-70	14(36 – 22)	65	910
70-80	5(22 – 17)	75	375
80-90	4(17 – 13)	85	340
90-100	13	95	1235
	Σf = 144		**ΣfX = 6840**

$$\overline{X}=\frac{\Sigma fX}{\Sigma f}=\frac{6840}{144}=47.5 \text{ Years}$$

3) **Calculation of Arithmetic Mean in Unequal Classes:** In the case of continuous series which have unequal class interval, there is no need of any adjustment in the classes and arithmetic mean can be calculated in its original form.

Example 20: Calculate the mean of the following series:

Weekly Income (₹)	No. of Families
0-20	18
20-50	25
50-90	40
90-140	16
140-200	32

Solution: Let the assumed mean (A) be 70.

Weekly Income (₹)	No. of Families (f)	Mid-Values (X)	$d_x = (X - A)$	$d' = \frac{d_x}{5}$	fd'
0-20	18	10	–60	–12	– 216
20-50	25	35	–35	–7	– 175
50-90	40	70	0	0	0
90-140	16	115	+45	+9	144
140-200	32	170	+100	+20	640
	$\sum f = 131$				$\sum fd' = + 393$

$$\overline{X} = A + \left(\frac{\Sigma fd_x}{N} \times i\right) = 70 + \left(\frac{393}{131} \times 5\right) = 70 + 15 = ₹85$$

4) **Calculation of Arithmetic Mean in Open-Ended Classes:** A series in which the lower class limit of the first class interval or the upper limit of the last class interval is missing and 'less than' or 'below' and 'more than' or 'above' are specified in lower class limit of first class or upper limit of last class, following two situations are considered in this case:

i) **When Class Intervals are Equal:** In such situation, let us take the following example:

Classes	Below 20	20-40	40-60	60-80	80 and above
Frequencies	5	8	9	11	6

Here the class sizes are same and it is 20. For calculating the lower limit of first class, the class size, i.e., (20) is subtracted from the upper limit of first class, i.e., (20 – 20 = 0). For determining the upper limit of first class, the class size, i.e., (20) is added to the lower limit of the first class, i.e., (0 + 20 = 20). For determining the upper limit of last class, the class size, i.e., (20) is added to the upper limit of the previous class, i.e., (80 + 20 = 100). The first class will be (0 – 20) and the last (80 – 100). Then one can calculate mean by using any method.

ii) **When Class-Intervals are Unequal:**

Weights	Below 20	20-25	25-35	35-50	50-70	70 and above
No. of Persons	7	11	14	19	6	2

Here, the class magnitude is unequal. The size of second, third, fourth, fifth class is 5, 10, 15, 20 respectively, i.e., it is increasing by 5. For calculating the lower limit of first class, the value 5 is subtracted from the upper limit of second class, i.e., (20 – 5 = 15). For determining the upper limit of last class, the value 30 is added to the upper limit of the previous class, i.e., (70 + 30 = 100). The first class will be (15 – 20) and the last class will be (70 – 100). Then one can calculate mean by using any method.

5) **Calculation of Arithmetic Mean in Mid-Value Series:** A series in which only mid-values of the class intervals & the corresponding frequencies are given then it is called mid-value series. In the calculation of arithmetic mean for the continuous series one requires mid-values of the classes. But in this case mid-values are already given so there is no need to adjust the frequencies & construct classes.

Example 21: Calculate the mean of the following series:

Mid-Values (X)	No. of Families (f)
10	17
20	21
30	13
40	11
50	18

Solution: Let the assumed mean (A) is 30.

Mid-Values (X)	No. of Families (f)	$d_x = (X - A)$	$d' = \frac{d_x}{10}$	fd'
10	17	–20	–2	–34
20	21	–10	–1	–21
30	13	0	0	0
40	11	+10	+1	+11
50	18	+20	+2	+36
	80			$\Sigma fd' = -8$

$$\bar{X} = A + \left(\frac{\Sigma fd'}{N} \times i\right) = 30 + \left(\frac{-8}{80} \times 10\right) = 30 - 1 = 29$$

6) **Determination of Missing Value:** Let us assume that the missing values of variables or frequencies are α, β, γ, etc. Now, calculate the value of mean by using general formula. With the available information required equation can be made. Missing values can be determined by solving these linear equations.

Example 22: Find out the missing size from the following:

Marks	10	15	20	α	30	40
No. of Students	3	6	8	10	7	6

Given: $\bar{X} = 24.5$

Solution:

Marks (X)	No. of Student (f)	Total Marks (fX)
10	3	30
15	6	90
20	8	160
α	10	10α
30	7	210
40	6	240
	$\Sigma f = 40$	$\Sigma fX = 730 + 10\alpha$

$$\bar{X} = \frac{\Sigma fX}{\Sigma f}$$

$$\therefore \quad 24.5 = \frac{730 + 10\alpha}{40}$$

$$\Rightarrow 24.5 \times 40 = 730 + 10\alpha \quad \Rightarrow \quad 980 = 730 + 10\alpha$$

$$\Rightarrow 980 - 730 = 10\alpha \quad \Rightarrow \quad \alpha = \frac{250}{10} = 25 \text{ marks}$$

4.6. MEDIAN

4.6.1. Introduction

When N observations are grouped and arranged in the sorting order (ascending or descending order) according to their values, then the central value of the observation is known as median. It is denoted by M or Me.

So, $M = \left(\frac{N+1}{2}\right)^{th}$ observation.

According to Prof. L R. Conner, "The median is that value of the variable which divides the group into two equal parts, one part comprising of all values greater and the other all values less than the median".

According to Croxton and Cowden, "The median is that value which divides a series so that one half or more of the items are equal to or less than it and one half or more of the items are equal to or greater than it."

4.6.2. Characteristics of Median

Following are the main characteristics of the median:

1) The median can be calculated from open-ended distributions while arithmetic mean cannot be calculated.
2) Median can be calculated graphically while arithmetic mean cannot be calculated.
3) Median is preferred in case when the distribution has extreme values, because median is not affected by extreme values.
4) It is the most appropriate measure of location when it is not possible to count the items, yet they are scored or ranked.

4.6.3. Advantages of Median

The advantages of the median are as follows:

1) It is unaffected by the extreme values.
2) In case of individual observation and discrete series, it is easy to understand and calculate.
3) It can be used in other algebraic calculations and also useful during calculation of mean deviation.
4) After sorting the values of variable, it can be located by inspection.
5) It can also be measured by using 'graphical representation'.
6) Median of open-end classes can be measured.
7) Median is clearly definite in nature i.e., it is always clearly defined.

4.6.4. Disadvantages of Median

The disadvantages of the median are as follows:

1) Sorting (ascending and descending order) is necessary for the calculation.
2) It cannot be used to measure the combined mean of two or more groups.
3) When sampling is fluctuated then median also gets fluctuated (affected more than mean).
4) It is not based on all the data samples. It is a positional average.

4.6.5. Methods of Calculation of Median

Following are the main methods of calculating median:

1) Calculation of Median – Individual Series
2) Calculation of Median – Discrete Series (Ungrouped Data)
3) Calculation of Median – Continuous Series (Grouped Data)

4.6.5.1. Calculation of Median – Individual Series

In case of individual series, the following steps are taken for calculating the median:

1) If the given observations are not arranged in ascending or descending order of magnitude then it has to be arranged for calculation.

2) Locate the middle value:
   i) There will be a single value in the middle which is selected as median when the number of observation N is odd. Mathematically,

$$\text{Median} = \text{Value of } \left(\frac{N+1}{2}\right)^{th} \text{ items}$$

Example 23: Find out the median of the following items:

X : 10, 15, 9, 25, 18

Solution:

Computation of Median

S. No.	Size of Item Ascending Order (X)	Size of Item Descending Order (X)
1)	9	25
2)	10	18
3)	15 ← [Median] →	15
4)	18	10
5)	25	9

$$\text{Median} = \text{Size of } \left(\frac{N+1}{2}\right)^{th} \text{ item}$$

$$= \text{Size of } \left(\frac{5+1}{2}\right)^{th} \text{ item}$$

$$= 3^{rd} \text{ item} = 15$$

In the above example the number of items was odd so there was no difficulty in locating the middle item and its value.

ii) If N is even, there will be two middle values, $\left(\frac{N}{2}\right)^{th}$ and $\left(\frac{N}{2}+1\right)^{th}$. The arithmetic mean of these two middle values is taken as median. That is,

$$\text{Median} = \frac{\left(\frac{N}{2}\right)^{th} \text{ value} + \left(\frac{N}{2}+1\right)^{th} \text{ value}}{2}$$

Example 24: Find out the median of the following items

X : 12, 18, 9, 25.

Solution:

Computation of Median

S. No.	Size of Item Ascending Order (X)
1)	9
2)	12
3)	18
4)	25

Here, N = 4 which is even, so

$$\text{Median} = \frac{\left(\frac{N}{2}\right)^{th} \text{ value} + \left(\frac{N}{2}+1\right)^{th} \text{ value}}{2} = \frac{\left(\frac{4}{2}\right)^{th} \text{ value} + \left(\frac{4}{2}+1\right)^{th} \text{ value}}{2}$$

$$= \frac{2^{nd} \text{ value} + 3^{rd} \text{ value}}{2} = \frac{12+18}{2} = \frac{30}{2} = 15$$

4.6.5.2. Calculation of Median – Discrete Series (Ungrouped Data)

In case of discrete series, the following steps are taken for calculating the median:

1) If the given observations are not arranged in ascending or descending order of magnitude then it has to be arranged for calculation.
2) Calculate the total frequency, i.e., $\sum f = N$.
3) Calculate the cumulative frequency (in general, less than type, data arranged in ascending order).
4) Locate the median by using the following formula:

$$\text{Median}(M) = \left(\frac{N+1}{2}\right)^{th} \text{ value}, \qquad (\text{where, } N = \sum f)$$

The value, for which the cumulative frequency includes $\left(\frac{N+1}{2}\right)^{th}$ value, is selected as median.

Example 25: To find the median of the following distribution:

X	1	2	3	4	5	6
f	8	12	16	19	20	25

Solution:

Calculation of Median

X	f	Cumulative frequency
1	8	8
2	12	20
3	16	36
4 ← Median	19	55 ← Cumulative frequency of median
5	20	75
6	25	100
	N = 100	

Now median = Value of $\left(\frac{N+1}{2}\right)^{th}$ item = Value of $\left(\frac{100+1}{2}\right)^{th}$ item or, Value of 50.5^{th} item. This value lies in cumulative frequency (55) for the value 4.

So, Median = 4.

4.6.5.3. Calculation of Median – Continuous Series (Grouped Data)

In case of continuous series, the following steps are taken for calculating the median:

1) If the given series is in inclusive form then it has to be converted in exclusive form.
2) Calculate the total frequency,

$N = \sum f$ and median number $\left(\frac{N}{2}\right)^{th}$ value.

3) If the data is arranged in ascending order, then calculate 'less than' type cumulative frequencies.
4) Calculate median class with the use of $m = \frac{N}{2}$. The class in which median falls is called the median class.
5) Median can be calculated with the use of following formula:

$$\text{Median}(M) = L_1 + \frac{m-c}{f} \times i \quad \text{or} \quad M = L_1 + \frac{m-c}{f} \times (L_2 - L_1)$$

where,

M = Median

m = Median number $= \frac{N}{2}$

L_1 = Lower limit of the median class
L_2 = Upper limit of the median class
f = Frequency of the median class
$i = L_2 - L_1$ = width of the median class (Class size)
c = Cumulative frequency (less than type) of the class preceding to the median class

Example 26: Find the median and median class of the data.

Class-Interval	15-25	25-35	35-45	45-55	55-65	65-75
Frequency	5	10	18	15	0	3

Solution:

Calculation of Median

Class interval	Frequency	Cumulative Frequency
15 – 25	5	5
25 – 35	10	15 ← 'c' cumulative frequency of the class preceding the median class
35 – 45 ← M. Class	18 ← f	34 ← Cumulative frequency of median class
45 – 55	15	49
55 – 65	0	49
65 – 75	3	52
	N = 52	

Median number, $m=\frac{N}{2}=\frac{52}{2}=26^{th}$ element, and this value lie in cumulative frequency (34) and class interval is (35 – 45). So the median class is (35– 45).

Here, m = 26, c = 15, f = 18 and $L_2 - L_1 = 10$.

Hence,

$$M = L_1 + \frac{m-c}{f} \times (L_2 - L_1) = 35 + \frac{26-15}{18} \times 10$$

$$= 35 + \frac{11}{18} \times 10 = 35 + \frac{110}{18} = 35 + 6.11 = 41.11$$

Required median is 41.11 and median class is (35 – 45).

4.6.6. Various Cases in the Calculation of Median

The following are some typical examples on the calculation of Median:

1) **Median in Case of Inclusive Series**

Example 27: Calculate median from the following data:

Value	Frequency	Value	Frequency
0-4	328	30-39	599
5-9	350	40-49	525
10-19	720	50-59	378
20-29	664	60-69	246

Solution:

Computation of Median

Class-Interval	Frequency	Cumulative Frequency
0-4	328	328
5-9	350	678
10-19	720	1,398
20-29	664	2,062
30-39	599	2,661
40-49	525	3,186
50-59	378	3,564
60-69	246	3,810

Median is the value of $\left(\frac{3810}{2}\right)^{th}$ or 1905^{th} item which lies in 20-29 group.

This is a case of inclusive class-intervals. Which should be made exclusive and hence the median group should be deemed to be in 19.5-29.5 group. Thus the value of L_1 would be 19.5 and not 20.

$$\text{Median}(M) = L_1 + \frac{m-c}{f} \times (L_2 - L_1)$$

$$= 19.5 + \frac{1905-1398}{664}(29.5-19.5)$$

$$= 19.5 + \left(\frac{507}{664} \times 10\right) = 27.1$$

2) Median in Case of Exclusive Series

Example 28: Find the median of the following distribution:

Class Intervals (₹)	Frequencies	Class-Intervals (₹)	Frequencies
1-3	6	11-13	16
3-5	54	13-15	4
5-7	85	15-17	5
7-9	56		
9-11	22		
			248

Solution:

Calculation of Median

Class-Intervals	Frequency	Cumulative Frequency
1-3	6	6
3-5	54	60
5-7	85	145
7-9	56	201
9-11	22	223
11-13	16	239
13-15	4	243
15-17	5	248

Median = $\left(\frac{N}{2}\right)^{th}$ item, i.e., 124^{th} item, which lies in 5-7 group.

$$M = L_1 + \frac{m-c}{f} \times (L_2 - L_1) = 5 + \frac{124-60}{85}(7-5) = 6.5$$

3) **Median in Case of Cumulative Frequency Distribution:** If the data is available in the form of cumulative series then for obtaining the frequency of the median class it is required to convert the series into simple series. Once that is done, the rest of the procedure is the same as in any other continuous series.

The following example would illustrate the point:

Example 29: Calculate the median from the following data:

Value	Frequency	Value	Frequency
Less than 10	4	Less than 50	98
Less than 20	15	Less than 60	114
Less than 30	40	Less than 70	123
Less than 40	77	Less than 80	128

Solution:

Computation of Median

Value	Frequency	Cumulative Frequency
0-10	4	4
10-20	11	15
20-30	25	40
30-40	37	77
40-50	21	98
50-60	16	114
60-70	9	123
70-80	5	128

Middle item is $\left(\frac{128}{2}\right)^{th}$ item or 64^{th} item which lies in 30-40 group.

$$M = L_1 + \frac{m-c}{f} \times (L_2 - L_1) = 30 + \frac{64-40}{37}(40-30) = 30 + \left(\frac{24}{37} \times 10\right) = 30 + 6.5 =$$

36.5

4) **Determination of Missing Value**

Example 30: Find out the missing frequencies if N = 100 median = ₹ 50:

Expenditure (₹)	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100
No. of Families	14	?	26	?	16

Solution: Let the frequency of the class 20 – 40 be 'α' and the frequency of the class 60 – 80 be 'β'

Then, $14 + \alpha + 26 + \beta + 16 = 100$, Total frequency

$\Rightarrow \quad \alpha + \beta + 56 = 100$ or $\alpha + \beta = 44$ ..... (1)

Computation of Median

Expenditure (₹)	Frequency (f)	Cumulative frequency (c.f.)
0 – 20	14	14
20 – 40	α	14 + α
40 – 60	26	40 + α
60 – 80	β	40 + α + β
80 – 100	16	56 + α + β
Total	**56 + α + β**	

Median = ₹ 50, N = 100

Since, the median is 50, so median class would be (40 – 60)

Median number

$$m = \frac{N}{2} = \frac{100}{2}, \quad c = 14 + \alpha, \quad L_1 = 40, \quad L_2 = 60, \quad f = 26$$

Hence Median, $M = L_1 + \frac{m-c}{f} \times (L_2 - L_1)$

$$\Rightarrow \quad 50 = 40 + \frac{\frac{100}{2} - (14+\alpha)}{26} \times (60-40)$$

$$\Rightarrow \quad 50 - 40 = \frac{36-\alpha}{26} \times 20$$

$$\Rightarrow \quad 10 \times 26 = (36 - \alpha) \times 20$$

$$\Rightarrow \quad 260 = 720 - 20\alpha$$

$$\Rightarrow \quad 20\alpha = 720 - 260 = 460$$

$$\therefore \quad \alpha = \frac{460}{20} = 23$$

Substituting this value of α in equation (1), we get $\beta = 44 - 23 = 21$

Thus the missing frequencies are 23 and 21.

4.7. MODE

4.7.1. Introduction

Mode is the value of the variable for which the frequency is maximum and it is denoted by Z or Mo.

According to Zizek, "Mode is the value occurring most frequently in a series (or group) of items and around which other items are distributed most densely".

According to Croxton and Cowden, "The mode of a distribution is the value at the point around which the items tend to be most heavily concentrated. It may be regarded as the most typical of a series of values".

4.7.2. Characteristics of Mode

Following are the main characteristics of mode:

1) The value which represents the whole distribution is termed as mode.
2) Mode can be used to describe the qualitative phenomenon of the distribution.
3) The value of mode can be calculated by using graphic method.
4) Mode is generally determined in the case when the given distribution is highly skewed or there is an asymmetrical distribution.

4.7.3. Advantages of Mode

The advantages of mode are as follows:

1) Easy to understand and calculate.
2) Can be easily found out by using inspection method.
3) It is an actual value, which most frequently occurs in the series.
4) Not affected by extreme values.
5) It is simple and accurate and can be measured in an open end class-interval without determining the class limits.

4.7.4. Disadvantages of Mode

The disadvantages of mode are as follows:

1) It is ill defined and in few cases it is not possible to find a definite value.
2) Not a good representative because it is not based on all observations.
3) In further algebraic calculation it is of no use.
4) It may be possible that there is no mode or more than one mode present in the sample.
5) Fluctuation in sampling effects is made to a higher degree than mean or median.
6) Before calculating the mode, data sorting (ascending or descending order) is necessary.

4.7.5. Methods of Calculation of Mode

Following are the main methods for calculating mode:

1) Calculation of Mode – Individual Series
2) Calculation of Mode – Discrete Series (Ungrouped Data)
3) Calculation of Mode – Continuous Series (Grouped Data)

4.7.5.1. Calculation of Mode – Individual Series

If the data is not arranged then it has to be arranged in increasing order. Now find the value occurring the maximum number of times. This value is called the 'mode' of the given data.

Example 31: Calculate mode from the following data of income earned by 10 employees:

S. No.	Income (in ₹)	S. No.	Income (in ₹)
1	10	6	27
2	27	7	20
3	24	8	18
4	18	9	15
5	27	10	32

Solution:

Calculation of Mode

Income (in ₹)	Number of Employees
10	1
15	1
18	2
20	1
24	1
27	3
32	1
Total	**10**

Since the item 27 occurs the maximum number of times, i.e. 3, hence the modal income is 27.

Note: The process of determining mode in case of individual observations essentially involves grouping of data.

When there are two or more values having the same maximum frequency, one cannot say which the modal value is and hence mode is said to be **ill-defined**. Such a series is also known as **bi-modal or multi-modal**.

4.7.5.2. Calculation of Mode – Discrete Series (Ungrouped Data)

In the discrete series the mode is the value which has highest frequency. If two or more values have the same frequency or distribution of frequency is irregular, then mode cannot be determined by the method of inspection. In this situation, a grouping table and an analysis table is to be prepared to find out the value of mode. First we prepare grouping table and then an analysis table. The following steps are taken for calculating the mode:

1) A grouping table is prepared with 6 columns.
2) The size of the item is written in the margin.
3) Frequencies of the respective items are written in column 1 and highest frequency is marked.
4) In column 2, the frequencies are grouped in twos by adding 1^{st} and 2^{nd}, 3^{rd} and 4^{th}, 5^{th} and 6^{th} and so on and highest total is marked.

5) In column 3, leaving the first frequency in column 1and the rest frequencies are grouped in twos by adding 2nd and 3rd, 4th and 5th, 6th and 7th and so on and highest total is marked.

6) In column 4, starting from the first frequency of column 1, the frequencies are grouped in threes by adding 1st, 2nd and 3, 4th, 5th and 6th, 7th, 8th, and 9th, and so on and highest total is marked.

7) In column 5, starting from the second frequency (leaving the first frequency) of column 1, frequencies are grouped in threes by adding 2nd, 3rd and 4th, 5th, 6th and 7th, 8th, 9th and 10th and so on and highest total is marked.

8) In column 6, starting from the second frequency (leaving the first two frequencies) of column 1, frequencies are grouped in threes by adding 3rd, 4th and 5th, 6th, 7th and 8th so on and highest total is marked.

9) After completing the grouping of frequencies table, an analysis table is prepared to find out the item (group) which appears as the highest frequency. The same steps are applied in the case of continuous series.

Example 32: Compute the mode from the following data:

Size	2	3	4	5	6	7	8	9	10	11	12	13
Frequency	3	8	10	12	16	14	10	8	17	5	4	1

Solution: Due to irregular distribution of frequencies, we use the method of grouping to decide which one may be considered as maximum frequency.

Grouping Table

Value of the Items (m)	Frequency or Sum of Frequencies					
	1	2	3	4	5	6
2	3	11	18	21		
3	8				30	38
4	10	22				
5	12		28	42	40	32
6	16	30				
7	14		24	35		
8	10	18			30	26
9	8		25			
10	17	22		10		
11	5		9			
12	4	5				
13	1					

Analysis table is as follows:

Analysis Table

Column No.	Size of Items Containing Maximum Frequency											
	2	3	4	5	6	7	8	9	10	11	12	13
1									1			
2					1	1						
3				1	1							
4				1	1	1						
5					1	1	1					
6			1	1	1							
No. of Items	0	0	1	3	5	3	1	0	0	0	0	0

Since 6 occurs maximum number of times, hence the value 6 is the mode.

4.7.5.3. Calculation of Mode – Continuous Series (Grouped Data)

In a continuous series, determination of mode requires one step more than that used for discrete series. Firstly, one has to find the modal class by observation, or in case of 'irregular distribution' the modal class is determined by preparing grouping table and analysis tables. Finally, mode is obtained by following formula:

$$\text{Mode or } Z = L_1 + \frac{f_m - f_1}{2f_m - f_1 - f_2} \times i$$

Where, L_1 = Lower limit of the modal class
f_m = Frequency of the modal class
f_1 = Frequency of the class preceding the modal class
f_2 = Frequency of the class succeeding the modal class
$i = (L_2 - L_1)$ = Width of modal class (class size)

Example 33: Following is the frequency distribution of yearly expenditure of 60 families:

Yearly Expenditure (in thousand)	50-55	55-60	60-65	65-70	70-75	75-80
No. of Families	3	8	14	20	16	2

Find the modal value.

Solution: Here the class-interval (65 – 70) has the maximum frequency, i.e., 20, therefore, modal class is (65 – 70).

Now we can calculate the modal value of using the formula,

$$\text{Mode} = L_1 + \frac{f_m - f_1}{2f_m - f_1 - f_2} \times i$$

Here, $L_1 = 65$, $f_m = 20$, $f_1 = 14$, $f_2 = 16$ and $i = 5$;

$$\therefore \quad \text{Mode} = 65 + \frac{20-14}{2\times20-14-16} \times 5 = 65 + \frac{30}{10}$$

or Modal value = 65 + 3 = ₹68 thousand

Note: Generally, modes are used for nominal scores, medians for ordinal scores, and means for interval scores.

4.7.6. Relationship between Mean, Median and Mode

The empirical relation between Mean, Median and Mode is,

Mode = 3 Median – 2 Mean

Karl Pearson has expressed this relationship as follows:

Mode = Mean – 3[Mean- Median]

Mode = 3 Median – 2 Mean

Or, Median = Mode + 2/3[Mean - Mode]

Example 34: Calculate the Median when Mean and Mode of Distribution are 38.6 and 32.6 respectively.

Solution: Given, Mean = 38.6 and Mode = 32.6.

$$\text{Median} = \text{Mode} + \frac{2}{3}[\text{Mean} - \text{Mode}]$$

$$= 32.6 + \frac{2}{3}[38.6 - 32.6] = 32.6 + \frac{2}{3}[6] = 32.6 + 4$$

Median = 36.6

Example 35: For a given set of values of a variable, the mean and mode are 28.16 and 24 respectively, calculate the median.

Solution: Mean = 28.16

Mode = 24

$$\text{Median} = \text{Mode} + \frac{2}{3}[\text{Mean} - \text{Mode}] = 24 + \frac{2}{3}[28.16 - 24] = 24 + \frac{2}{3}[4.16]$$

$$= 24 + 2.77$$

Median = 26.77

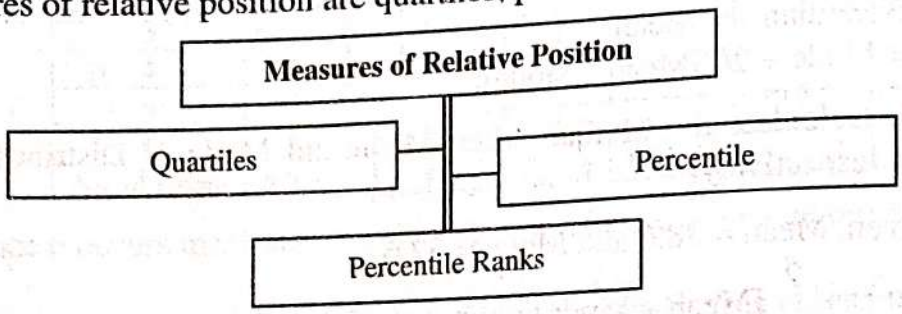
4.7.7. Comparison between Mean, Median and Mode

The comparison between mean, median and mode are given under the following table:

Mean	Median	Mode
It is highly affected by extreme values.	It is not affected by extreme values as in case of mean.	It is also not affected by extreme values as in case of mean.
It is based on all the observations.	It is not based on all observations.	It is also not based on all observations.
It is not necessary to arrange the observations in ascending or descending order.	It is necessary to arrange the data in ascending or descending order of magnitude.	It is also necessary to arrange the data in ascending or descending order of magnitude.
It is capable of further algebraic treatments.	It is also capable of further algebraic treatment.	It is not capable of further algebraic treatment.
It is rigidly defined and determined.	It is also rigidly defined and determined.	It is ill defined.
It can hardly be located by inspection.	It can be located by inspection, after arranging the data in order of magnitude.	It can also be found out by inspection.

4.8. MEASURES OF RELATIVE POSITION

This section introduces measures of relative position that divide the data into percentages to help locate any data value in the whole data set. Commonly used measures of relative position are quartiles, percentile and percentile ranks:



4.9. QUARTILES

4.9.1. Introduction

The measure of central tendency which divides a group of data into four subgroups or parts then it is called quartiles. The three quartiles are denoted as Q_1, Q_2, and Q_3.

The first quartile, Q_1, divides a frequency distribution in such a way that one-fourth (25%) of the distribution has a value less than Q_1 and three-fourth (75%) have a value more than Q_1. The second quartile, Q_2 divides a frequency distribution in such a way that it has equal number of observations above and below it. Hence, it is equal to the median of the data.

The third quartile, Q_3 divides a frequency distribution in such a way that three-fourth (75%) of the observations have a value less than Q_3 and one-fourth (25%) have a value more than Q_3.

4.9.2. Calculation of Quartiles

Following are the main methods for calculating quartiles:

1) Calculation of Quartiles - Individual Series
2) Calculation of Quartiles - Discrete Series (Ungrouped Data)
3) Calculation of Quartile - Grouped Series (Grouped Data)

4.9.2.1. Calculation of Quartiles - Individual Series

Let the series be in ascending order. Let N be the number of observations. Then

$$\text{First quartile } (Q_1) = \left(\frac{N+1}{4}\right)^{th} \text{ item}$$

$$\text{Second quartile } (Q_2) = \left[\frac{2(N+1)}{4}\right]^{th} \text{ item or } \left(\frac{N+1}{2}\right)^{th} \text{ item}$$

$$\text{Third quartile } (Q_3) = \left[\frac{3(N+1)}{4}\right]^{th} \text{ item}$$

Example 36: Calculate quartiles from the following data:
Marks obtained: 06, 30, 37, 18, 14, 42, 34, 11, 09, 26, 22, 03, 28, 52, 48

Solution: Arranging the series in ascending order, we get

Serial No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Marks Obtained	03	06	09	11	14	18	22	26	28	30	34	37	42	48	52

Number of observations, N = 15

$$Q_1 = \left(\frac{N+1}{4}\right)^{th} \text{item} = \left(\frac{15+1}{4}\right)^{th} \text{item} = 4^{th} \text{item} = 11$$

$$Q_2 = \left[\frac{2(N+1)}{4}\right]^{th} \text{item} = \left[\frac{2(15+1)}{4}\right]^{th} \text{item} = 8^{th} \text{item} = 26$$

$$Q_3 = \left[\frac{3(N+1)}{4}\right]^{th} \text{item} = \left[\frac{3(15+1)}{4}\right]^{th} \text{item} = 12^{th} \text{item} = 37$$

4.9.2.2. Calculation of Quartiles - Discrete Series

The computation of quartiles from discrete series involves the following steps:

1) Arrange the data in ascending order of magnitude (if not arranged).
2) Find the less than type cumulative frequencies.
3) Calculate quartiles using the formulae:

$$Q_1 = \left(\frac{N+1}{4}\right)^{th} \text{item}$$

$$Q_2 = \left[\frac{2(N+1)}{4}\right]^{th} \text{item}$$

$$Q_3 = \left[\frac{3(N+1)}{4}\right]^{th} \text{item}$$

Example 37: Calculate quartile from the following

X	3	5	8	12	18	21	26
f	6	11	24	21	16	13	9

Solution:

Variable (X)	Frequency (f)	Cumulative frequency (c.f.)
3	6	6
5	11	17
8	24	41
12	21	62
18	16	78
21	13	91
26	9	100
Total	**N = 100**	–

$$Q_1 = \left(\frac{N+1}{4}\right)^{th} \text{ item} = \left(\frac{100+1}{4}\right)^{th} \text{ item}$$

$= 25.25^{th}$ item $= 25^{th}$ item $+ 0.25(26^{th}$ item $- 25^{th}$ item$)$

$= 8 + 0.25(8 - 8) = 8$

$$Q_2 = \left[\frac{2(N+1)}{4}\right]^{th} \text{ item} = 50.50^{th} \text{ item}$$

$= 50^{th}$ item $+ 0.5\ (51^{st}$ item $- 50^{th}$ item$) = 12 + 0.5(12 - 12) = 12$

$$Q_3 = \left[\frac{3(N+1)}{4}\right]^{th} \text{ item} = 75.75^{th} \text{ item}$$

$= 75^{th}$ item $+ 0.75(76^{th}$ item $- 75^{th}$ item$) = 18 + 0.75(18 - 18) = 18$

4.9.2.3. Calculation of Quartile - Grouped Series

The process of computing quartiles in case of a grouped frequency distribution involves the following steps:

1) Arrange the data in ascending order.
2) Obtain less than type cumulative frequencies.
3) Convert the classes into exclusive form if given otherwise.
4) Use the following formula to locate quartiles:

Formula: $Q_k = L_1 + \dfrac{\frac{kN}{4} - c}{f}(L_2 - L_1)$

where,

$k = 1, 2, 3$; $i = (L_2 - L_1) = k^{th}$ quartile class,

N = Total Frequency

f = Frequency of k^{th} quartile class

c = Frequency of the class preceding the k^{th} quartile class.

Obviously:

$$Q_1 = L_1 + \frac{\frac{N}{4} - c}{f} \times i$$

$$Q_2 = L_1 + \frac{\frac{2N}{4} - c}{f} \times i$$

$$Q_3 = L_1 + \frac{\frac{3N}{4} - c}{f} \times i$$

The values of L_1, L_2, c, i, f, are taken according to respective quartiles

Example 38: Calculate quartile from the following data:

Age (Years)	20 – 25	25 – 30	30 – 35	35 – 40	40 – 45	45 - 50	50 - 55	55 - 60
Number of Persons	14	12	31	26	21	19	10	7

Solution:

Age	Number of Persons (f)	Cumulative frequency
20 – 25	14	14
25 – 30	12	26
30 – 35	31	57
35 – 40	26	83
40 – 45	21	104
45– 50	19	123
50 – 55	10	133
55– 60	7	140
Total	**N = 140**	–

$Q_1 = \left(\frac{N}{4}\right)^{th} = \left(\frac{140}{4}\right)^{th} = 35^{th}$ item which is lies in the class-interval (30 – 35).

Hence, $L_1 = 30$, $L_2 = 35$, $f = 31$, $c = 26$, $i = 5$

$$Q_1 = L_1 + \frac{\frac{N}{4} - c}{f} \times i = 30 + \frac{35-26}{31} \times 5 = 30 + \frac{9 \times 5}{31} = 30 + \frac{45}{31} = 30 + 1.45 = 31.45$$

$$Q_2 = \left(\frac{2N}{4}\right)^{th} \text{item} = \left(\frac{2 \times 140}{4}\right)^{th} \text{item}$$

$= 70^{th}$ item which is lies in the class-interval (35 – 40).

Hence, $L_1 = 35$, $L_2 = 40$, $f = 26$, $c = 57$, $i = 5$

$$Q_2 = L_1 + \frac{\frac{2N}{4} - c}{f} \times i = 35 + \frac{70-57}{26} \times 5 = 35 + \frac{13 \times 5}{26} = 35 + \frac{65}{26}$$

$$= 35 + 2.5 = 37.5$$

$$Q_3 = \left(\frac{3N}{4}\right)^{th} \text{item} = \left(\frac{3 \times 140}{4}\right)^{th} \text{item}$$

$= 105^{th}$ item which is lies in the class-interval (45 – 50).

Hence, $L_1 = 45$, $L_2 = 50$, $f = 19$, $c = 104$, $i = 5$

$$Q_3 = L_1 + \frac{\frac{3N}{4} - c}{f} \times i = 45 + \frac{105-104}{19} \times 5 = 45 + \frac{5}{19}$$

$$= 45 + 0.3 = 45.3$$

4.9.3. Advantages of Quartiles

Salient advantages of quartiles are as follows:

1) It is simple to understand and easy to calculate.
2) It is less affected by the extreme values.
3) It can be calculated exactly in case of open-end classes.

4.9.4. Disadvantages of Quartiles

Quartiles have some disadvantages too, which are as follows:

1) It is not based on all observations. So it may not be a good representative. In fact, 50% of the items in any series are ignored. In other words, it does not cover the first 25% and the last 25% items of a series.
2) It is not capable of further algebraic treatment.
3) It is affected to a greater extent by fluctuations of sampling.

4.10. PERCENTILE

4.10.1. Introduction

Percentiles divide the data into one hundred parts, such that each part contains at the most 1% of the data, and quartiles divide the data into four parts, such that each part contains at the most 25% of the data.

Then from quartiles we can derive another measure, which is called the interquartile range, to give the range of the middle 50% of the data values. This is obtained by first organising the data into ascending order and then trimming 25% of the data values from the lower and the upper ends.

If the values of the observation in a data set are arranged in ascending or descending order and divided it into hundred equal parts by using ninety-nine points on the scale of observations then it is called **percentile**. If the data is arranged in ascending order, the first point is known as 'first percentile', denoted by P_1, the second point is called 'second percentile', denoted by P_2, and so on, the last point is called 'ninety-ninth percentile' and is denoted by P_{99}.

According to Klugh, "A percentile is point on the scale of measurement below which a specified percentage of N to located, where N is the total number of measurement."

According to Guilford, "A percentile is a value on the scoring scale below which is any given percentage of the cases."

4.10.2. Calculation of Percentiles

1) Calculation of percentile – Individual and Discrete Series
2) Calculation of percentile – Grouped Series

4.10.2.1. Calculation of Percentiles – Individual and Discrete Series

Formula:

$$P_1 = \left(\frac{N+1}{100}\right)^{th} \text{item}$$

$$P_2 = \left[\frac{2(N+1)}{100}\right]^{th} \text{item}$$

.....

$$P_{99} = \left[\frac{99(N+1)}{100}\right]^{th} \text{item}$$

} For Individual and Discrete Series

Example 39: Find P_{60} and P_{70} from the following data:

80	48	26	42	65	16	58	75	98

Solution: Arranging the data in ascending order, we get:

16	26	42	48	58	65	75	80	98

$$P_{60} = \text{Size of } \left[\frac{60(N+1)}{100}\right]^{th} \text{item} = \left[\frac{60(9+1)}{100}\right]^{th} \text{item} = 6^{th} \text{ item} = 65$$

$$P_{70} = \text{Size of } \left[\frac{70(N+1)}{100}\right]^{th} \text{item} = \left[\frac{70(9+1)}{100}\right]^{th} \text{item} = 7^{th} \text{ item} = 75$$

4.10.2.2. Calculation of Percentile – Grouped Series

Formula: $$P_k = L_1 + \frac{\frac{kN}{100} - c}{f} \times (L_2 - L_1)$$

where, $k = 1, 2, 3, 4, 5, \ldots\ldots\ldots\ldots, 100$;
$i = (L_2 - L_1) = k^{th}$ quartile class
N = Total frequency f = Frequency of k^{th} quartile class
c = Frequency of the class preceding the k^{th} quartile class

Obviously:

$$P_1 = L_1 + \frac{\frac{N}{100} - c}{f} \times i$$

$$P_2 = L_1 + \frac{\frac{2N}{100} - c}{f} \times i$$

.....

$$P_{99} = L_1 + \frac{\frac{99N}{100} - c}{f} \times i$$

} **(For Grouped Series)**

Example 40: Find the values of P_{40} and P_{90} from the following data:

Class Interval	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	5	12	25	30	26	18	9

Solution:

Class Interval	f	cf
0-10	5	5
10-20	12	17
20-30	25	42
30-40	30	72
40-50	26	98
50-60	18	116
60-70	9	125
	N = 125	

$$P_{40} = \text{Size of } \left(\frac{40N}{100}\right)^{th} \text{ item} = \left(\frac{40\times125}{100}\right)^{th} \text{ item}$$

$= 50^{th}$ item which is lies in the class interval (30 – 40).

Here, $L_1 = 30$, $f = 30$, $c = 42$, $i = 10$

$$P_{40} = L_1 + \frac{\left(\frac{40N}{100}\right) - c}{f} \times i = 30 + \frac{50-42}{30} \times 10 = 30 + \frac{80}{30} = 32.66$$

$$P_{90} = \text{Size of } \left(\frac{90N}{100}\right)^{th} \text{ item} = \left(\frac{90\times125}{100}\right)^{th} \text{ item} = 112.5^{th} \text{ item which is lies in the}$$

class interval (50 – 60).

Here, $L_1 = 50$, $f = 18$, $c = 98$, $i = 10$

$$P_{90} = L_1 + \frac{\left(\frac{90N}{100}\right) - c}{f} \times i = 50 + \frac{112.5-98}{18} \times 10 = 50 + \frac{145}{18} = 58.05$$

4.10.3. Advantages of Percentile

Percentile has the following advantages:

1) It is simple to understand and easy to calculate.
2) Decile is less affected by the extreme values.
3) It can be calculated exactly in case of open-end classes.

4.10.4. Disadvantages of Percentile

Disadvantages of percentile are as follows:

1) Percentiles are not based on all observations. So it may not be a good representative.
2) It is not capable of further algebraic treatment.
3) Its value is affected to a greater extent by fluctuations of sampling.

4.10.5. Percentile Ranks

The percentile rank of a given score in a distribution is the per cent of the total scores which fall below the given score. A percentile rank then indicates the position of a score in a distribution in percentile terms. If, e.g., a student had a score which was higher than 70 per cent of the scores in the distribution, but not higher than 70 per cent, his percentile rank would be 70.

Computation of Percentile Ranks

To compute the percentile rank for a score from the grouped data, we will need to determine the number of cases below the score in order to determine what per cent of the total cases would fall below that score. The formula for computing percentile rank is,

$$PR = \frac{100}{N}\left(\frac{\text{Raw Score} - 1}{i} \times f + cf\right)$$

Where, the symbols have the same meaning as in the case of percentiles.

Let us explain this in the following example.

Example 41: Find the percentile rank for the following frequency distribution.

Class Interval	50-54	45-49	40-44	35-39	30-34	25-29
f	3	5	3	5	1	2

Solution: Let us consider the values that will be substituted into the formula; raw score = 63 (given in the problem).

L – 59.5 (since the score 63 falls in the class 60-64 for which the real lower limit is 59.5)
l = 5, f = 6,
Cf = 24, N = 40.

The computation is as follows:

$$PR = \frac{100}{N}\left(\frac{\text{Raw Score} - 1}{1} \times f + Cf\right)$$

$$= \frac{100}{40}\left(\frac{63 - 59.5}{5} \times 6 + 24\right) = \frac{100}{40}\left(\frac{3.5 \times 6 + 24}{5}\right)$$

$$= \frac{100}{40}(4.2 + 24) = \frac{100}{40}(28.2) = \frac{2820}{40}$$

$$= 70.5, \text{ i.e., } 71$$

Percentile rank = 71

4.11. MEASURES OF VARIABILITY/ DISPERSION

4.11.1. Meaning and Definitions of Variability/ Dispersion

Measures of average such as the median and mean represents the typical value for a data set. Within the data set the actual values usually differ from one another and from the average value itself.

The extent to which the median and mean are good representatives of the values in the original data set depends upon the variability or dispersion in the original data.

Variability refers to how spread apart the scores of the distribution are or how much the scores vary from each other. Variability, generally, is used as dispersion.

Variability refers to how "spread out" a group of scores is. The terms variability, spread, and dispersion are synonyms, and refer to how spread out a distribution is.

Distribution cannot be clearly depicted by measuring the averages or central tendency. Averages provide the observations of only the central part of the distribution. So, study of scatteredness of observations is very important and this study is known as **measure of dispersion**.

The word 'Dispersion' literally means 'fluctuation', 'scatter', 'variation', 'deviation', or 'spread'. So, measure of dispersion shows the variation of an individual item from its average.

It is also known as **measure of variation** as it explains the extent of scatterness in an observation and it measures the mean deviation about some central value.

Dispersion is based on values from first order (the average or mean). So, it is known as **second order**.

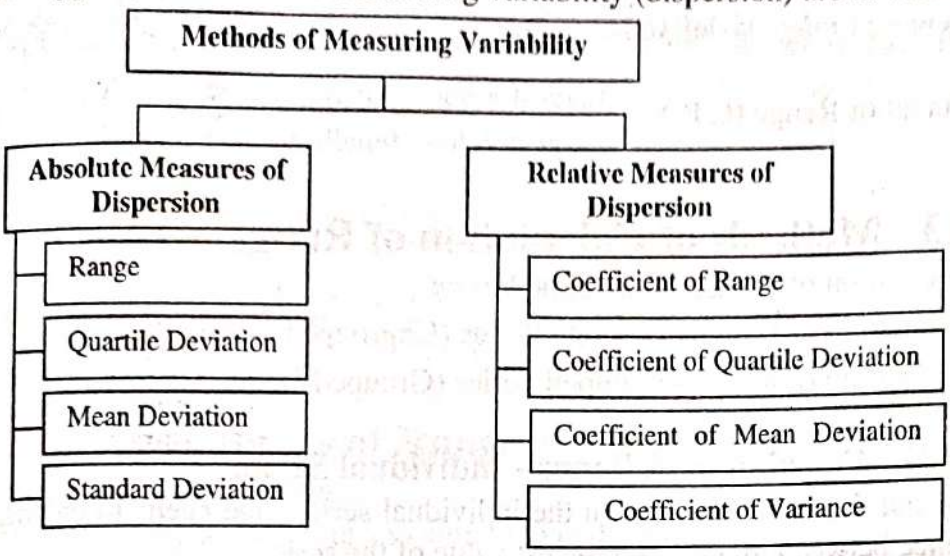
According to A.L. Bowley, "Dispersion is the measure of the variation of the items."

According to Connor, "Dispersion is a measure of the extent to which the individual vary."

According to Kafka, "The measurement of a scatteredness of the mass of figures in a series about an average is called measure of dispersion or measure of variation".

4.11.2. Methods of Measuring Variability/Dispersion

The two types of methods for measuring variability (dispersion) are as follows:



4.11.2.1. Absolute Measures of Dispersion

The measure of dispersion which is expressed in terms of the units of the observations (e.g., Rupees, Meter, Years, etc.) is called absolute measure of dispersion.

1) Range
2) Quartile Deviation
3) Mean Deviation
4) Standard Deviation

4.11.2.2. Relative Measures of Dispersion

The measure of dispersion which is independent of unit or may involve the point about which the deviations are taken, is known as relative measure of dispersion or coefficient of dispersion. There is only one relative measure corresponding to an absolute measure of dispersion.

1) Coefficient of Range
2) Coefficient of Quartile Deviation
3) Coefficient of Mean Deviation
4) Coefficient of Variance

4.12. RANGE

4.12.1. Meaning of Range

Range is the simplest absolute measure of dispersion which shows the difference between the highest and the lowest value in a series.

Mathematically: $R = L - S$

Where,

R = Range
L = Maximum (largest) value
S = Minimum (smallest) value

4.12.2. Coefficient of Range

Relative measure of variation (coefficient of range) is used to compare the series. Coefficient of range is defined as:

$$\text{Coefficient of Range (C.R.)} = \frac{\text{Largest Value} - \text{Smallest Value}}{\text{Largest Value} + \text{Smallest Value}} = \frac{L-S}{L+S}$$

4.12.3. Methods of Calculation of Range

1) Calculation of Range - Individual Series
2) Calculation of Range - Discrete Series (Ungrouped Data)
3) Calculation of Range - Grouped Series (Grouped Data)

4.12.3.1. Calculation of Range - Individual Series

To find out the value of range in the individual series, one needs to calculate the difference between highest and lowest value of the series.

Example 42: Calculate Range and its Coefficient from the following data:
54, 45, 16, 15, 75, 85, 28

Solution: Here, Largest value (L) = 85, Smallest value (S) = 15
Range = L – S = 85 – 15 = 70

$$\text{Coefficient of Range} = \frac{L-S}{L+S} = \frac{85-15}{85+15} = \frac{70}{100} = 0.7 \text{ or } 70\%$$

4.12.3.2. Calculation of Range - Discrete Series (Ungrouped Data)

In case of individual series, it can also be calculated by taking the difference of highest and lowest value. In this case frequency of the series is not taken into consideration for the calculation.

Example 43: Find range and coefficient of range from the following data:

X	5	15	25	35	45	55
f	7	14	18	10	4	1

Solution: Here, Largest value (L) = 55, Smallest value (S) = 5

$\therefore$ Range = L – S = 55 – 5 = 50

$$\text{Coefficient of Range} = \frac{L-S}{L+S} = \frac{55-5}{55+5} = \frac{50}{60} = 0.83 \text{ or } 83\%$$

4.12.3.3. Calculation of Range - Grouped Series (Grouped Data)

In case of grouped series it can be calculated by taking the difference of lower limit of the lowest class interval and upper limit of the highest class interval. It can also be measured by taking the difference of mid value of the lowest class interval and mid value of the highest class interval.

Example 44: Calculate Range and the Coefficient of range from the following details:

X	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80	80 – 90	90 – 100
f	6	4	15	24	11	3	10	16	20

Solution: Largest value (L) = 100; Smallest value (S) = 10

$\therefore$ Range (L – S) = 100 – 10 = 90

$$\text{Coefficient of Range} = \frac{L-S}{L+S} = \frac{(100-10)}{(100+10)} = \frac{90}{110} = 0.82 \text{ or } 82\%$$

4.12.4. Advantages of Range

Range has various advantages:

1) It is very easy to calculate and simple to understand.
2) It is rigidly defined.
3) It provides the limit (which is measured from set of data) within which all the data items occur.

4.12.5. Disadvantages of Range

Range has some disadvantages also:

1) This method is highly affected by the extreme items as it gives importance to the two extreme values.
2) This method does not provide any information about the structure of the series.
3) It is affected by the sampling fluctuations.
4) Range is not a reliable method to measure the dispersion.

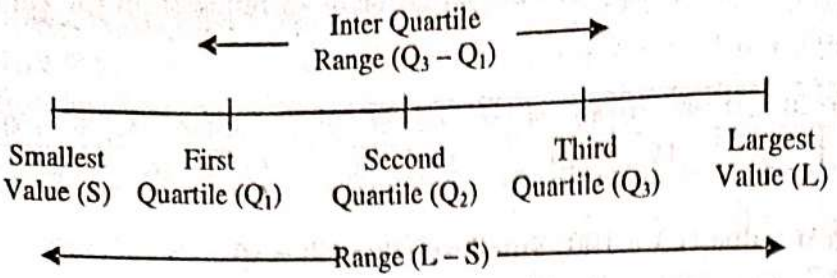
4.13. QUARTILE DEVIATION

4.13.1. Meaning and Definition of Quartile Deviation

Quartile deviation is another measure of variation which gives the solution to overcome the limitation of range. In a data set, it calculates the spread over the middle half of the values. This measure of variation minimises the effect of extreme values (also known as outliers).

According to Garrett (1999), "The quartile deviation or Q is one-half the scale distance between the 75^{th} and 25^{th} percentiles in a frequency distribution."

In this method, the study of **Interquartile range** is necessary because a large amount of values in the data set lie in the central part of the frequency distribution. To calculate this value, all the data set is divided into four parts. Every part of the data set contains 25% of the observed value. In these values the highest one is known as quartile.



In a data set 'Interquartile range' is the spread of values between third quartile (Q_3) and first quartile (Q_1). In other words, it can be defined by the range of middle 50% of the data. Figure above shows the concept of Interquartile range:

Interquartile Range = $Q_3 - Q_1$

Quartiles are the points which divide the data in four equal parts (Q_1, Q_2, Q_3, and Q_4).

where,

$$Q_1 = \text{Value of the item } \left(\frac{1}{4}\right)^{th}$$

$$Q_3 = \text{Value of the item } \left(\frac{3}{4}\right)^{th}$$

Half the total numbers of items are included between Q_1 and Q_3.
The difference between third quartile and first quartile ($Q_3 - Q_1$) only includes the central items and excludes the extreme values. The interquartile range is a good and convenient indicator of the absolute variability. If the interquartile range is large, then the variability in the data set will also be large. The half of the difference between third quartile and first quartile ($Q_3 - Q_1$) is known as 'semi-interquartile or quartile deviation'.

Mathematically,

$$\text{Quartile Deviation, Q.D.} = \frac{Q_3 - Q_1}{2}$$

where, ($Q_3 - Q_1$) = Interquartile range

4.13.2. Coefficient of Quartile Deviation

If the difference of the third and first quartiles is divided by the sum of the third and first quartiles then it is known as the 'coefficient of quartile deviation'. In case of open-ended distribution (when the frequency distribution has the extreme class limits and no specific class limits), it is a very useful measure.

Mathematically, coefficient of quartile deviation is defined as follows:

$$\text{Coefficient of Quartile Deviation (CQD)} = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

where,

CQD = Coefficient of Quartile Deviation
Q_3 = Third quartile
Q_1 = First quartile

4.13.3. Methods of Calculation of Quartile Deviation

1) Computation of Quartile Deviation - Individual Series
2) Computation of Quartile Deviation - Discrete Series
3) Computation of Quartile Deviation - Continuous Series

4.13.3.1. Computation of Quartile Deviation - Individual Series

Following are the formula for calculating Q_1 and Q_3 in individual series.

$$Q_1 = \text{Size of } \left(\frac{N+1}{4}\right)^{th} \text{ item} \quad Q_3 = \text{Size of } \left[\frac{3(N+1)}{4}\right]^{th} \text{ item}$$

where, N = Number of observation.

Example 45: Compute Quartile Deviation and Coefficient of Quartile Deviation for the following data:

24, 14, 21, 100, 104, 68, 34, 106, 100, 72, 16, 21, 14, 21, 72, 100, 106, 34, 100

Solution: First we arrange the following data in ascending order:

X	14	16	21	24	34	68	72	100	104	106
f	2	1	3	1	2	1	2	4	1	2
c.f	2	3	6	7	9	10	12	16	17	19

Q_1 = Size of or item = 5^{th} item = 21

Q_3 = Size of or item = 15^{th} item = 100

$$\text{Quartile Deviation} = \frac{Q_3 - Q_1}{2} = \frac{100-21}{2} = 39.5$$

$$\text{Coefficient of Quartile Deviation} = \frac{Q_3 - Q_1}{Q_3 + Q_1} = \frac{100-21}{100+21} = \frac{79}{121} = 0.653$$

4.13.3.2. Computation of Quartile Deviation- Discrete Series

Following are the formula for calculating the Q_1 and Q_3 in discrete series:

$$Q_1 = \text{Size of } \left(\frac{N+1}{4}\right)^{th} \text{ item} \quad \text{and} \quad Q_3 = \text{Size of } \left[\frac{3(N+1)}{4}\right]^{th} \text{ item}$$

where, N = number of observation.

Example 46: Find the quartile deviation and coefficient of quartile deviation from the given data:

No. of Persons in a Family	1	2	3	4	5	6	7	8	9	10
No. of Families	2	4	16	12	28	31	8	22	9	7

Solution: **Computation of Quartile Deviation**

No. of Persons in a Family	No. of Families (f)	Cumulative Frequency
1	2	2
2	4	6
3	16	22

4	12	34
5	28	62
6	31	93
7	8	101
8	22	123
9	9	132
10	7	139
	N = 139	

$$Q_1 = \text{Size of } \left(\frac{N+1}{4}\right)^{th} \text{ item } = \left(\frac{139+1}{4}\right)^{th} \text{ item } = 35^{th} \text{ item } = 5$$

$$Q_3 = \text{Size of } \left[\frac{3(N+1)}{4}\right]^{th} \text{ item } = \left[\frac{3(139+1)}{4}\right]^{th} \text{ item } = 105^{th} \text{ item } = 8$$

$$\text{Quartile Deviation } = \frac{(Q_3 - Q_1)}{2} = \frac{8-5}{2} = 1.5$$

$$\text{Coefficient of Quartile Deviation (CQD)} = \frac{(Q_3 - Q_1)}{(Q_3 + Q_1)} = \frac{8-5}{8+5} = \frac{3}{13} = 0.23$$

4.13.3.3. Computation of Quartile Deviation - Continuous Series (Exclusive)

Following are the formulae for calculating the Q_1 and Q_3 in continuous series:

$$Q_1 = L_1 + \frac{\frac{N}{4} - c}{f} \times i \text{ and } Q_3 = L_1 + \frac{\frac{3N}{4} - c}{f} \times i$$

where, L_1 = Lower limit; N = Number of observation,
c = Cumulative frequency of class preceding to quartile class;
i = Class interval

Following example explains the calculation of quartile deviation in Continuous series.

Example 47: Calculate Quartile Deviation from the following data:

Population (in thousand)	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No. of Localities	4	7	15	12	3	9	6

Solution:

Computation of Quartile Deviation

Population	No. of Localities (f)	Cumulative Frequency
10-20	4	4
20-30	7	11
30-40	15	26
40-50	12	38
50-60	3	41
60-70	9	50
70-80	6	56

Q_1 = Size of $\left(\frac{N}{4}\right)^{th}$ item $= \left(\frac{56}{4}\right)^{th}$ item = 14^{th} item which lies in class interval 30-40.

Here, $L_1 = 30$, $c = 11$, $f = 15$ and $i = 10$.

So, $Q_1 = L_1 + \frac{\frac{N}{4} - c}{f} \times i = 30 + \frac{14-11}{15} \times 10 = 30 + \frac{30}{15} = 32$

Q_3 = Size of $\left(\frac{3N}{4}\right)^{th}$ item $= \left(\frac{3 \times 56}{4}\right)^{th}$ item

= 42^{th} item which lies in class interval 60-70.

Here, $L_1 = 60$, $c = 41$, $f = 9$ and $i = 10$.

So, $Q_3 = L_1 + \frac{\frac{3N}{4} - c}{f} \times i = 60 + \frac{42-41}{9} \times 10$

$= 60 + 1.1 = 61.1$

Quartile Deviation $= \frac{Q_3 - Q_1}{2} = \frac{61.1 - 32}{2} = \frac{29.1}{2} = 14.55$

4.14. MEAN DEVIATION (M.D.)

4.14.1. Meaning of Mean Deviation

The arithmetic average of the absolute deviation of a series is known as the mean deviation. This deviation is calculated from any one of the measures of averages such as mean, mode and median.

The mean deviation also called the mean absolute deviation is the mean of the absolute deviations of a set of data about the data's mean.

Mathematically,

$$\text{Mean Deviation (MD)} = \frac{\sum |d|}{N}$$

where, $\sum |d|$ = Sum of all deviations (taken either from mean or median, ignoring ± signs.)

In a series, it can be defined as the arithmetic average of the deviation of various items from mean or median of that series. For calculating the mean deviation, median is preferred because the addition of the deviation from the mean is greater than that from the median. So, the value of mean deviation measured from the mean is greater than the value measured from the median.

Mean deviation is also known as **First Moment of Dispersion.**

Note: It is generally measured either from median or mean.

4.14.2. Coefficient of Mean Deviation

$$\text{Coefficient of mean deviation from mean} = \frac{\text{Mean Deviation (M.D.)}}{\text{Arithemtic mean}}$$

$$\text{Coefficient of mean deviation from median} = \frac{\text{Mean Deviation (M.D.)}}{\text{Median}}$$

$$\text{Coefficient of mean deviation from mode} = \frac{\text{Mean Deviation (M.D.)}}{\text{Mode}}$$

4.14.3. Methods of Calculation of Mean Deviation

Following are the methods for calculating mean deviation:

1) Computation of Mean Deviation - Individual Series
2) Computation of Mean Deviation - Discrete Series
3) Computation of Mean Deviation - Continuous Series

4.14.3.1. Computation of Mean Deviation - Individual Series

Following steps are involved in the calculation of the mean deviation:

1) First, measure the average mean, median or mode of the series.
2) Find the deviation of the items from the average, while ignoring the positive (+) and negative (-) signs. The resultant deviation is denoted by $|dx|$.
3) Next, measure the total sum of these deviations. It is represented by $\Sigma|dx|$.
4) In the last step, divide the sum obtained by the number of items.

Symbolically,

$$\text{Mean Deviation} = \frac{\sum|d_x|}{N}$$

where, $|d_x|$ = Deviation from mean (or median) ignoring ± signs

N = Number of items

Example 48: The following are the monthly expenditure of six families. Calculate mean deviation from mean and mean deviation from median.

Expenditure (₹)	4,260	4,980	8,460	5,240	4,780	6,480

Solution: First we arrange the given data in ascending order:

Expenditure (₹)	4,260	4,780	4,980	5,240	6,480	8,460

Here, N = 6 which is even, so

$$\text{Median} = \frac{\left(\frac{N}{2}\right)^{th}\text{ value} + \left(\frac{N}{2}+1\right)^{th}\text{ value}}{2} = \frac{\left(\frac{6}{2}\right)^{th}\text{ value} + \left(\frac{6}{2}+1\right)^{th}\text{ value}}{2}$$

$$= \frac{3^{rd}\text{ value} + 3.5^{th}\text{ value}}{2} = \frac{4980+5240}{2} = \frac{10220}{2} = 5110$$

$$A.M. = \frac{\sum X}{N} = \frac{1}{6} \times 34200 = 5700.$$

About Mean

Serial No.	X (₹)	Deviation from A.M. ignoring ± sign $\lvert d_x \rvert$
1	4260	1440
2	4780	920
3	4980	720
4	5240	460
5	6480	780
6	8460	2760
Total	**ΣX = 34200**	**$\Sigma \lvert d_x \rvert$ = 7080**

About Median

Serial No.	X (₹)	Deviation from Median ignoring ± sign $\lvert d_x \rvert$
1	4260	850
2	4780	330
3	4980	130
4	5240	130
5	6480	1370
6	8460	3350
Total	**ΣX = 34200**	**$\Sigma \lvert d_x \rvert$ = 6160**

$$\text{Mean deviation (about mean)} = \frac{\sum |d_x|}{N} = \frac{7080}{6} = 1180$$

$$\text{Mean deviation (about median)} = \frac{\sum |d_x|}{N} = \frac{6160}{6} = 1026.6$$

4.14.3.2. Computation of Mean Deviation - Discrete Series

In case of discrete series following steps are involved:

1) First, calculate the averages such as mean, mode or median.
2) From the central tendency calculate the deviation of the size, ignore the positive and negative signs. The result is represented by $\lvert d_x \rvert$.
3) In this step, deviation of every size ($\lvert d_x \rvert$) is multiplied by their respective frequency (f) and summated ($\Sigma f \lvert d_x \rvert$).
4) In the last step, total sum is divided by the total frequency.

Symbolically, $M.D. = \frac{\sum f|d_x|}{\sum f}$

where,

$\lvert d_x \rvert$ = Deviation from mean (or median) ignoring ± signs.

N = Total frequency

Example 49: Calculate the Mean-deviation from the following data:

Quantity Demanded (Units)	10	20	30	40	50	60	70	80	90	100
frequency	7	13	16	6	14	19	28	17	21	9

Solution:

Quantity Demanded (X)	frequency (f)	fX	$\lvert d_x \rvert = (X - \bar{X})$ ignoring ± sign	$f\lvert d_x \rvert$
10	7	70	50	350
20	13	260	40	520
30	16	480	30	480
40	6	240	20	120
50	14	700	10	140

60	19	1140	0	0
70	28	1960	10	280
80	17	1360	20	340
90	21	1890	30	630
100	9	900	40	360
Total	**Σf = 150**	**ΣfX= 9000**		**3220**

$$\text{Arithmetic Mean } (\bar{X}) = \frac{\sum fX}{\sum f} = \frac{9000}{150} = 60$$

$$\text{Mean Deviation} = \frac{\sum f|d_x|}{\sum f} = \frac{3220}{150} = 21.5$$

4.14.3.3. Computation of Mean Deviation - Continuous Series

In case of continuous series, following steps are involved:

1) First, calculate the mid value of the class intervals.
2) Measure the median or arithmetic mean.
3) Find $|d_x|$ and $f|d_x|$.
4) Divide the total sum $\sum f|d_x|$ by the total frequency $\sum f$.

Example 50: Calculate Mean deviation from the mean for the following data:

Sales (₹ in thousand)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No. of days	5	6	8	15	17	7	9	3

Solution: **Calculation of Mean Deviation**

Sales	**Mid Value (X)**	**No. of days (f)**	**fX**	$\|d_X\| = \|X - \bar{X}\|$	$f\|d_X\|$
0 – 10	5	5	25	35	175
10 – 20	15	6	90	25	150
20 – 30	25	8	200	15	120
30 – 40	35	15	525	5	75
40 – 50	45	17	765	5	85
50 – 60	55	7	385	15	105
60 – 70	65	9	585	25	225
70 – 80	75	3	225	35	105
		Σf = 70	**ΣfX = 2800**		**$\Sigma f\|d_x\|$ = 1040**

$$\text{Mean}(\bar{X}) = \frac{\sum fX}{\sum f} = \frac{2800}{70} = 40$$

$$\text{Mean Deviation (M.D.)} = \frac{\sum f|d_x|}{\sum f} = \frac{1040}{70} = 14.86$$

4.14.4. Advantages of Mean Deviation

Mean deviation has various advantages such as:

1) It is easy to understand and defined rigidly.
2) It is a better measure of dispersion in comparison to range and quartile deviation because it includes all the observations in the calculation.
3) It gives a good measure for the comparison of the formation of different distributions because it is based on the deviation about average.
4) Compared to standard deviation, it is less affected by the extreme values.

4.14.5. Disadvantages of Mean Deviation

Mean deviation has some disadvantages:

1) For open ended classes, it is not possible to calculate mean deviation.
2) Mean deviation tends to increase with the size of the sample, though not proportionately and not as rapidly as range.
3) In sociological studies, it is rarely used.
4) The ignorance of sign is mathematically unsound and illogical.

4.15. STANDARD DEVIATION (S.D.)

4.15.1. Meaning of Standard Deviation

Standard deviation is used to measure the spread of items in a set of observation. If all the observation values are identical or distribution of items of a set is uniform, then deviation of every value from mean is zero. When elements of the set are more dispersed, then standard deviation becomes larger.

It is denoted by the small Greek letter σ (Sigma). If $\bar{X}$ is the mean of $X_1, X_2, \ldots, X_N$, then,

$$\sigma=\sqrt{\left[\frac{1}{N}\left\{(X_1-\bar{X})^2+\ldots\ldots\ldots+(X_N-\bar{X})^2\right\}\right]}=\sqrt{\sum_{i=1}^{N}\frac{(X_i-\bar{X})^2}{N}}$$

According to Yule and Kenndall, "The standard deviation is the square-root of the arithmetic mean of the square of all the deviations, deviations being measured from the arithmetic mean of the observation."

4.15.2. Properties of Standard Deviation

1) Standard deviation is always positive.
2) Standard deviation will not change if all the variables are summated with the same number.
3) If researcher multiplies the variable with the same number, then the output received will be multiplied by the square of that same number.

4) In case of multiple distribution (with same mean and known standard deviation), SD can be calculated as:

i) If samples size are same

$$\sigma = \sqrt{\frac{\sigma_1^2 + \sigma_2^2 + ... + \sigma_n^2}{N}}$$

ii) If samples size are different

$$\sigma = \sqrt{\frac{k_1.\sigma_1^2 + k_2.\sigma_2^2 + ... + k_N.\sigma_N^2}{k_1 + k_1 + ... + k_N}}$$

4.15.3. Methods of Calculation of Standard Deviation

1) Calculation of Standard Deviation – Individual Series
2) Calculation of Standard Deviation – Discrete series
3) Calculation of Standard Deviation – Continuous Series

4.15.3.1. Calculation of Standard Deviation – Individual Series

There are two methods of calculating standard deviation in an individual observation or series:

1) **Deviation Taken from Actual Mean:** This method is adopted when the mean is a whole number. The following are the steps:
   i) Find out the actual mean of the series.
   ii) Find out the deviation of each value from the mean (d_x or $x = X - \overline{X}$).
   iii) Square the deviations and take the total of squared deviations Σx^2.
   iv) Divide the total (Σx^2) by the number of observations. The square root of the quotient is standard deviation. Thus apply the following formula:

$$\sigma = \sqrt{\frac{\Sigma x^2}{N}} \text{ or } \sqrt{\frac{\Sigma (X - \overline{X})^2}{N}}$$

2) **Deviation Taken from Assumed Mean (Short-Cut Method):** This method is adopted when the arithmetic average is a fractional value. Taking deviations from fractional value would be a very difficult and tedious task. To save time and labour, we apply short-cut method; deviations are taken from an assumed mean. The following are the steps:
   i) Assume any one of the item in the series as an average (A).
   ii) Find out the deviations from the assumed mean; i.e., (X – A) denoted by d_x.
   iii) Find out the total of the deviations; i.e., Σd_x.
   iv) Square the deviations; i.e., d_x^2 and add up the squares of deviations, i.e., Σd_x^2.
   v) Then substitute the values in the following formula:

$$\sigma = \sqrt{\frac{\Sigma d_x^{\,2}}{N} - \left(\frac{\Sigma d_x}{N}\right)^2}$$

where, d_x stands for the deviation from assumed mean = (X – A).

Example 51: Find S.D of (₹) 8, 10, 15, 24, 28.

Solution: Let the assumed mean (A) = 16.

Calculation from Arithmetic Mean

X	$x = (X - \bar{X})$	x^2
8	–9	81
10	–7	49
15	–2	4
24	7	49
28	11	121
$\Sigma X = 85$		$\Sigma x^2 = 304$

Calculation from Assumed Mean

X	$d_x = (X - A)$	d_x^2
8	–8	64
10	–6	36
15	–1	1
24	8	64
28	12	144
	5	$\Sigma d_x^2 = 309$

From Arithmetic Mean

$$\bar{X} = \frac{\sum X}{N} = \frac{85}{5} = 17$$

$$\sigma = \sqrt{\frac{\sum x^2}{N}} \text{ or } \frac{\sum (X - \bar{X})^2}{N} = \sqrt{\frac{1}{5} \times 304} = \sqrt{60.8} = 7.8$$

From Assumed Mean

Let A (assumed mean) = 16

$$\sigma = \sqrt{\frac{\Sigma d_x^2}{N} - \left(\frac{\Sigma d_x}{N}\right)^2} = \sqrt{\frac{309}{5} - \left(\frac{5}{5}\right)^2}$$

$$= \sqrt{61.8 - (1)^2} = \sqrt{60.8} = 7.8$$

Note: If the actual mean is in fraction, then it is better to take deviations from an assumed mean for avoiding too much calculation.

4.15.3.2. Calculation of Standard Deviation – Discrete Series (Ungrouped Data)

There are three methods for calculating standard deviation in discrete series:

1) **Actual Mean Method:** It includes the following steps:
   i) Calculate the mean of the series.
   ii) Find deviations for various items from the mean i.e., $(X - \bar{X}) = d_x$.
   iii) Square the deviations d_x^2 and multiply by the respective frequencies (f). We get fd_x^2.
   iv) Total the product (Σfd_x^2). Then apply the formula.

$$\sigma = \sqrt{\frac{\Sigma f d_x^2}{\Sigma f}}$$

Example 52: Calculate standard deviation from the following series:

Age (in years)	15	25	35	45	55	65
No. of Persons	7	25	20	16	11	6

Solution:

Calculation of Standard Deviations

Age (X)	No. of Persons (f)	fX	$d_x = (X - \bar{X})$	fd_x^2
15	7	105	– 22	3388
25	25	625	– 12	3600
35	20	700	– 2	80
45	16	720	8	1024
55	11	605	18	3564
65	6	390	28	4704
	$\Sigma f = 85$	$\Sigma fX = 3145$		$\Sigma fd_x^2 = 16360$

$$\bar{X} = \frac{\sum fX}{\sum f} = \frac{3145}{85} = 37$$

$$\text{Standard Deviation } (\sigma) = \sqrt{\frac{\sum f(d_x)^2}{\sum f}} = \sqrt{\frac{16360}{85}} = \sqrt{192.5} = 13.87$$

2) **Assumed Mean Method:** We applied short-cut method in individual observation. Similarly we can apply it in discrete series also. Here deviations are taken, not from the actual mean, but from an assumed mean. It involves the following steps:

i) Assume any one of the items in the series as an average and this is called assumed average and denoted by A.

ii) Find out the deviations from assumed mean, i.e., (X – A), and denote it by d_x.

iii) Multiply these deviations by the respective frequencies and get the Σfd_x.

iv) Square the deviations (d_x^2).

v) Multiply the squared deviations (d_x^2) by the respective frequencies (f) and get Σfd_x^2.

vi) Substitute the values in the following formula:

$$\sigma = \sqrt{\frac{\sum f d_x^2}{\sum f} - \left(\frac{\sum f d_x}{\sum f}\right)^2} \quad \text{where } d_x = X - A$$

Example 53: Find the Standard Deviation of the following series:

X	10	11	12	13	14	Total
f	4	16	22	14	6	62

Solution: Let the assumed mean (A) = 12.

Calculation of Standard Deviations

X	f	$d_x = (X - A)$	d_x^2	fd_x	fd_x^2
10	4	–2	4	– 8	16
11	16	–1	1	– 16	16
12	22	0	0	0	0
13	14	1	1	14	14
14	6	2	4	12	24
Total	$\Sigma f = 62$			$\Sigma fd_x = 2$	$\Sigma fd_x^2 = 70$

$$\sigma=\sqrt{\frac{\sum f(d_x)^2}{\sum f}-\left(\frac{\sum fd_x}{\sum f}\right)^2}=\sqrt{\frac{70}{62}-\left(\frac{2}{62}\right)^2}=\sqrt{1.13-0.001}=1.06$$

3) **Step Deviation Method:** Here we take a common factor for all the items of the series. In this method the calculation becomes easy and simple. The formula for this is:

$$\sigma=\sqrt{\frac{\sum fd_x'^2}{\sum f}-\left(\frac{\sum fd_x'}{\sum f}\right)^2}\times i$$

where, $d_x'=\frac{X-A}{i}$, i = Common Factor.

Example 54: Find the Standard Deviation for the following distribution

X	4.5	14.5	24.5	34.5	44.5	54.5	64.5
f	5	3	7	18	14	9	4

Solution: Let the assumed mean (A) = 34.5

Calculation of Standard Deviation

X	f	$d_x=(X-A)$	$d_x'=\left(\frac{d_x}{10}\right)$	fd_x'	$f(d_x')^2$
4.5	5	− 30	− 3	− 15	45
14.5	3	− 20	− 2	− 6	12
24.5	7	− 10	− 1	− 7	7
34.5	18	0	0	0	0
44.5	14	10	1	14	14
54.5	9	20	2	18	36
64.5	4	30	3	12	36
	$\Sigma f = 60$			$\Sigma fd_x' = 16$	$\Sigma f(d_x')^2 = 150$

$$\sigma=\sqrt{\left\{\frac{\sum f(d_x')^2}{\sum f}-\left(\frac{\sum fd_x'}{\sum f}\right)^2\right\}}\times i=\sqrt{\frac{150}{60}-\left(\frac{16}{60}\right)^2}\times 10=\sqrt{2.5-0.071}\times 10$$

$= 1.56 \times 10 = 15.6$

4.15.3.3. Calculation of Standard Deviation – Continuous Series (Grouped Data)

In the continuous series the method of calculating standard deviation is almost the same as in a discrete frequency distribution. But in a continuous series, mid-values of the class intervals are to be found out. The step deviation method is widely used. It involves the following steps:

1) Find out the mid-value of each group or class.
2) Assume one of the mid-values as an average and denote it by A.
3) Find out deviation of each mid-value from the assumed average A and denote these deviations by d_x.
4) If the class-intervals are equal, then take a common factor. Divide each deviation by the common factor and denote this column by d_x'.
5) Multiply these deviations d_x' by the respective frequencies and get $\Sigma fd_x'$.

6) Square the deviations and get d_x^2.
7) Multiply the squared deviation (d_x^2) by the respective frequencies (f). Then obtain the total: $\Sigma f d_x^2$.
8) Substitute the values in the following formula to get the standard deviation.

$$\sigma = \sqrt{\frac{\Sigma f d_x'^2}{\Sigma f} - \left(\frac{\Sigma f d_x'}{\Sigma f}\right)^2} \times i$$

where, $d_x' = \frac{X - A}{i}$, i = Common factor

Example 55: Find the S.D. from the following figures:

Height (Inches)	44-46	46-48	48-50	50-52	52-54	Total
No. of Children	5	25	28	22	5	85

Solution: Let A (assumed mean) = 49

Height (Inches)	Mid-point (X)	No. of Children (f)	$d_x = X - 49$	$d_x' = d/2$	fd'_x	fd'^2_x
44-46	45	5	– 4	– 2	– 10	20
46-48	47	25	– 2	– 1	– 25	25
48-50	49	28	0	0	0	0
50-52	51	22	2	1	22	22
52-54	53	5	4	2	10	20
Total		$\Sigma f = 85$			$\Sigma fd_x' = -3$	$\Sigma fd_x'^2 = 87$

$$\sigma = \sqrt{\left\{\frac{\Sigma f(d_x')^2}{\Sigma f} - \left(\frac{\Sigma d_x'}{\Sigma f}\right)^2\right\}} \times i = \sqrt{\frac{87}{85} - \left(\frac{-3}{85}\right)^2} \times 2$$

$$= \sqrt{\left(\frac{7395 - 9}{7225}\right)} \times 2 = \sqrt{\frac{7386}{7225}} \times 2 = 1.01 \times 2 = 2.02$$

4.15.4. Advantages of Standard Deviation

1) S.D. is rigidly defined and considers all the observations for calculation.
2) It contains various mathematical properties and is used in algberic calculation.
3) Combined S.D. can be calculated for two or more groups.
4) Compared to other measures of dispersion, standard deviation is less affected by sampling fluctuation.
5) It is used to calculate coefficient of variation.

4.15.5. Disadvantages of Standard Deviation

1) More complex to calculate and understand, compared to other measures of dispersion.
2) Distance from the mean decides the weightage of the element. If distance (from the mean) is more, then it is given more weight and if distance is less (from mean), then that element is given less weight.

4.16. COEFFICIENT OF VARIANCE (CV)

4.16.1. Introduction

It is an absolute measure of dispersion. Coefficient of variation is expressed in terms of units in which actual data is collected and stated. The standard deviation of the weights of people cannot be compared with the standard deviation of heights of the people because both are given in two different units i.e., weights are given in kilogram and heights are given in meters. For the purpose of comparison, standard deviation is definitely converted into relative measure (known as coefficient of variation) of dispersion.

The ratio of the standard deviation to the mean in percentage is known as 'coefficient of variation'.

Mathematically, Coefficient of variation (C.V.) $= \frac{\sigma}{\overline{X}} \times 100$

According to Karl Pearson, "Coefficient of variation is the percentage variation in mean, standard deviation being considered as the total variation in the mean." That is, it shows the relationship between the standard deviation and the arithmetic mean expressed in terms of percentage.

4.16.2. Methods of Calculation of Coefficient of Variation

1) Calculation of Coefficient of Variation – Individual Series

Example 56: Calculate Coefficient of Variation (C.V.) for the following data: 56, 66, 61, 68, 54, 70, 55.

Solution: Let the assumed mean is (A) = 60.

Calculation of Coefficient of Variation

X	dX = (X – A)	dX^2
56	–4	16
66	6	36
61	1	1
68	8	64
54	–6	36
70	10	100
55	–5	25
	$\Sigma dX = 10$	$\Sigma dX^2 = 278$

$$\overline{X} = A + \frac{\sum dX}{N} = 60 + \frac{(10)}{7} = 60 + 1.43 = 61.43$$

$$\text{S.D. } (\sigma) = \sqrt{\frac{\sum (dX)^2}{N} - \left(\frac{\sum dX}{N}\right)^2} = \sqrt{\frac{278}{7} - \left(\frac{10}{7}\right)^2} = \sqrt{\frac{278}{7} - \frac{100}{49}}$$

$$= \sqrt{\frac{278 \times 7 - 100}{49}} = \sqrt{\frac{1846}{49}} = \sqrt{37.67} = 6.14$$

$$\text{Coefficient of Variation} = \frac{\sigma}{\overline{X}} \times 100 = \frac{6.14}{61.43} \times 100 = \frac{614}{61.43} = 9.99$$

2) Calculation of Coefficient of Variation – Discrete Series (Ungrouped Data)

Example 57: Calculate coefficient of variation of the following data:

Weekly Rent (₹)	400	700	800	950	1000	1200	1450
No. of Persons Paying the Rent	11	13	34	39	18	8	2

Solution: Calculation of Coefficient of Variation

Weekly Rent (X)	No. of Persons (f)	fX	$d_x = (X - \bar{X})$	$f(d_x)$
400	11	4400	–466	2388716
700	13	9100	–166	358228
800	34	27200	– 66	148104
950	39	37050	84	275184
1000	18	18000	134	323208
1200	8	9600	334	892448
1450	2	2900	584	682112
	$\Sigma f = 125$	$\Sigma fX = 108250$		$\Sigma fd_x^2 = 5068000$

$$\bar{X} = \frac{\sum fX}{\sum f} = \frac{108250}{125} = 866$$

$$\text{Standard Deviation } (\sigma) = \sqrt{\frac{\sum f(d_x)^2}{\sum f}} = \sqrt{\frac{5068000}{125}} = \sqrt{40544} = 201.3$$

$$\text{Coefficient of Variation} = \frac{\sigma}{\bar{X}} \times 100 = \frac{201.3}{866} \times 100 = 23.24$$

Thus, CV = 23.24%

3) Calculation of Coefficient of Variation – Continuous Series (Grouped Data)

Example 58: Following data represents daily wages paid to workers in two factories A and B:

Daily Wages	No. of Workers	
	Factory A	Factory B
50-100	7	6
100-150	31	21
150-200	23	29
200-250	14	15
250-300	9	13
300-350	11	5
350-400	5	1

i) Find the average wage in both factories.
ii) Which factory has a more consistent wage structure?

Solution:

For Factory A ⇒

Calculation of Coefficient of Variation for Factory A

Daily Wages	Mid Value (X)	f	fX	d_x	$f(d_x)^2$
50-100	75	7	525	-120	100800
100-150	125	31	3875	-70	151900
150-200	175	23	4025	-20	9200
200-250	225	14	3150	30	12600
250-300	275	9	2475	80	57600
300-350	325	11	3575	130	185900
350-400	375	5	1875	180	162000
Total		**$\Sigma f = 100$**	**$\Sigma fX = 19500$**		**$\sum f(d_x)^2 = 680000$**

$$\text{Mean } (\bar{X}) = \frac{\Sigma fX}{\Sigma f} = \frac{19500}{100} = 195$$

$$\sigma_X = \sqrt{\frac{\Sigma f(d_x)^2}{\Sigma f}} = \sqrt{\frac{680000}{100}} = \sqrt{6800} = 82.5$$

$$\text{C.V.} = \frac{\sigma_X}{\bar{X}} \times 100 = \frac{82.5}{195} \times 100 = 42.31$$

For Factory B ⇒

Calculation of Coefficient of Variation for Factory B

Daily Wages	Mid Value (Y)	f	fY	d_Y	$f(d_Y)^2$
50-100	75	6	450	-115	79350
100-150	125	21	2625	-65	88725
150-200	175	29	5075	-15	6525
200-250	225	15	3375	35	18375
250-300	275	13	3575	85	93925
300-350	325	5	1625	135	91125
350-400	375	1	375	185	34225
Total		**$\Sigma f = 90$**	**$\Sigma fY = 17100$**		**$\sum f(d_Y)^2 = 412250$**

$$\text{Mean } (\bar{Y}) = \frac{17100}{90} = 190$$

$$\sigma_Y = \sqrt{\frac{\Sigma f(d_Y)^2}{\Sigma f}} = \sqrt{\frac{412250}{100}} = \sqrt{4122.5} = 64.21$$

$$\text{C.V.} = \frac{\sigma_Y}{\bar{Y}} \times 100 = \frac{64.21}{190} \times 100 = 33.8$$

Average wage in Factory A = 195

Average wage in Factory B = 190

Factory B has more consistent wage structure in comparison to factory A because the coefficient of variation is lower of factory B.

4.16.3. Advantages of Coefficient of Variation

The advantages of coefficient of variation are as follows:

1) Since, standard deviation of data is always understood in the context of the mean of the data, hence coefficient of variation is very useful.
2) Instead of standard deviation, coefficient of variation is used to compare the data sets with different units or widely different means.

4.16.4. Disadvantages of Coefficient of Variation

The disadvantages of coefficient of variation are as follows:

1) It gives infinity when the mean value is close to zero and due to this it is very sensitive to small changes in the mean.
2) It cannot be directly used to measure the confidence interval for the mean.

4.17. CORRELATION

4.17.1. Concept of Correlation

Study of the linear relationship between two variables is known as correlation. If there are two variables and changes in the value of one variable will affect the value of the other variable then both the variables are correlated. Correlation is the statistical method whereby relationship is expressed on a quantitative scale. The degree of correlation is expressed in figures ranging from 0 to 1 and 0 to -1.

Correlation is a statistical tool used to measure the relationship between two sets of variables and express each in a precise manner.

According to Croxton and Cowden, "The appropriate statistical tool for discovering and measuring the relationship of quantitative nature and expressing it in brief formula is known as correlation".

According to A. M. Tuttle, "An analysis of the covariance of two or more variables is usually called correlation".

According to English and English, "Correlation is a relationship or dependence. It is the fact that two things or variables are so related that change in one is accompanied by a corresponding or parallel change in the other".

According to Ferguson, "Correlation is concerned with describing the degree of relation between two variables".

According to Lathrap, "Correlation is a joint relationship between two variables".

Correlation is a statistical measure that determines a relation between any two entities. It can have a positive, negative or zero value.

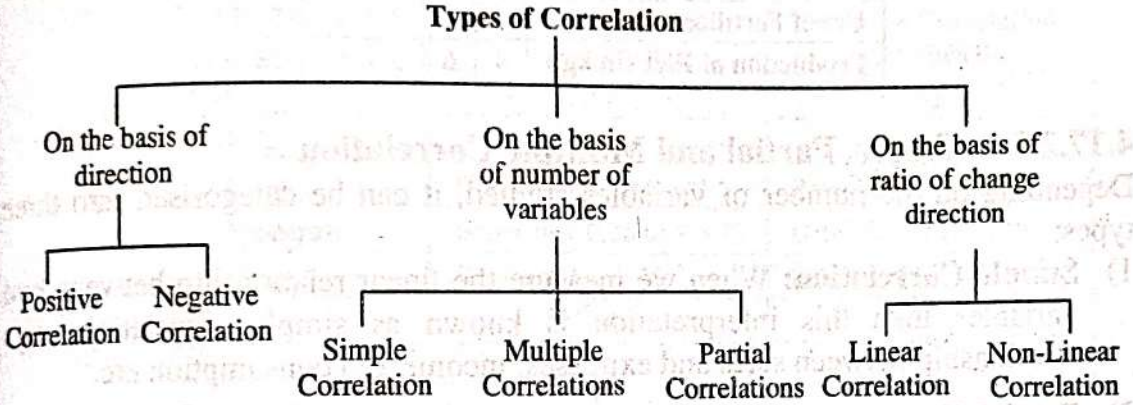
Negative value says that when one increases other decreases, i.e., they are indirectly proportional to each other. **For example,** if price of a product increases, it is highly likely that sales for the product will decrease if there is no improvement in the product for the higher price. Thus product price and product sales are negatively correlated. When price increases, sales decreases, and *vice versa*.

Positive value says that when one increases other also increases and *vice versa*, i.e., they are directly proportional to each other. **For example,** if price of a petrol increases, it is highly likely that sales for the diesel car will increase as it will be available for lesser price as compared to petrol cars. Thus product price and product sales are positively correlated. When price of one product increases, sales of other product is also increasing, and *vice versa*.

In case of **zero value**, there is no relation between the 2 entities. **For example,** whether it will rain or not and whether you will eat or not, are definitely not related. This situation is obvious but in certain cases it is difficult to determine whether they positively or negatively correlated or not related at all.

4.17.2. Types of Correlation

Categorisation of correlation is done on various bases such as on the direction of change of the variable, constancy of the ratio of change between the variable, etc.



4.17.2.1. Positive Correlation and Negative Correlation

Depending on the direction of change of the variables, correlation may be positive or negative.

1) **Positive Correlation:** Correlation is positive when two variables vary in the same direction. **For example,** consider the correlation between sales and expenses of a firm (**table below**).

Firms	1	2	3	4	5	6
Sales (in ₹)	50	60	70	80	90	100
Expenses (in ₹)	11	15	19	23	27	31

2) **Negative Correlation:** Two variables are said to be negatively correlated when both the variables vary in the opposite direction. When one variable increases then other variable decreases and *vice versa* is also a negative correlation. **For example,** consider the correlation between production and price of crop.

Production (in kg)	100	200	300	400	500	600	700	800
Price (₹ Per kg)	10	9	8	7	6	5	4	3

4.17.2.2. Linear Correlation & Non-linear (Curvilinear) Correlation

On the basis of constancy of the ratio of change between the variable, correlation may be linear or non-linear.

1) **Linear Correlation:** In a linear correlation, change in the values of one variable has a fixed ratio to the variation in the values of other variable. When these variables are plotted on a graph, then plotted points would fall on a straight line. **For example,** consider the following relationship shown in the table.

Mustard (kg)	10	20	30	40	50	60	70	80
Oil (Kg)	3	6	9	12	15	18	21	24

2) **Non-Linear (Curvilinear) Correlation:** In a non-linear correlation, change in values of one variable does not have a fixed ratio to the variation in the value of other variable. When these variables are plotted on a graph, then plotted points would fall on a curve. **For example,** consider the following relationship shown in the table.

Use of Fertilizer (in kg.)	1	2	3	4	5
Production of Rice (in kg.)	4	6	9	17	28

4.17.2.3. Simple, Partial and Multiple Correlation

Depending on the number of variables studied, it can be categorised into three types:

1) **Simple Correlation:** When we measure the linear relationship between two variables then this interpretation is known as simple correlation, e.g., relationship between sales and expenses, income and consumption etc.

2) **Partial Correlation:** If we have various related variables and try to find out the relationship between two variables then it is known as partial correlation. **For example,** consider the two variables height and weight, which are partially correlated because of the effect of third variable 'age' on height and weight. In this condition, if we neglect the effect of age, and study the relationship between height and weight, then this correlation is known as partial correlation.

3) **Multiple Correlation:** It is defined as the measurement of the effect of multiple variables on one variable. **For example,** if we try out to find the relationship of rainfall and temperature on the yield of wheat, then this is known as multiple correlation.

4.17.3. Degree of Correlation

On the basis of coefficient of correlation, the degree of correlation is determined as follows:

1) **Perfect Correlation:** If two variables change in the same direction and in the same proportion, the correlation between the two variables is called **perfect positive correlation. According to Karl Pearson** the coefficient of correlation in this case is +1. If two variables change in the opposite direction and in the same proportion, the correlation between the two variables is called **perfect negative correlation.** In this case the coefficient of correlation is – 1.

2) **Absence of Correlation:** If two series of two variables show no relation between them or change in one variable does not lead to a change in the other variable, then it means that there is no relationship between variables. In this case, the coefficient of correlation is zero.

3) **Limited Degree of Correlation:** If two variables are not perfectly correlated or there is an absence of perfect correlation, then it is referred as limited correlation. It may be positive, negative or zero but lies with the limits ± 1. High degree, moderate degree and low degree are the three categories of this kind of correlation. If the value of coefficient of correlation (represented by 'r') is lies between ±0.75 to ±1, it is known as **High degree** of correlation and when the value of r lies between ±0.25 to ±0.75 then it is known as **Moderate degree** of correlation. When the correlation lies between 0 and ± 0.25, **Low degree** of correlation is said to exist **(table 4.2)**.

Table 4.2: Degree of Correlation

Degree	Positive Correlation Co-efficient	Negative Correlation Co-efficient
1) Perfect	+1	–1
2) Limited		
i) High	Between + 0.75 to + 1	Between – 0.75 to –1
ii) Moderate	Between + 0.25 to + 0.75	Between – 0.25 to – 0.25
iii) Low	Between 0 to 0.25	Between 0 to – 0.25
3) Absence	Zero	Zero

4.17.4. Coefficient of Correlation

In simple linear regression analysis, the coefficient of correlation (or correlation coefficient) is a statistic which indicates the relationship between the independent variable and the dependent variable. The correlation coefficient is a measure that determines the degree to which two variables' movements are associated.

Correlation coefficients are expressed as values between +1 and -1. A coefficient of +1 indicates a perfect positive correlation. A change in the value of one variable will change in the same direction in the second variable. A coefficient of -1 indicates a perfect negative correlation. A change in the value of one variable will change in the opposite direction in the second variable.

According to Chaplin (1975), "Correlation coefficient is a numerical index of the degree of relationship between two variables."

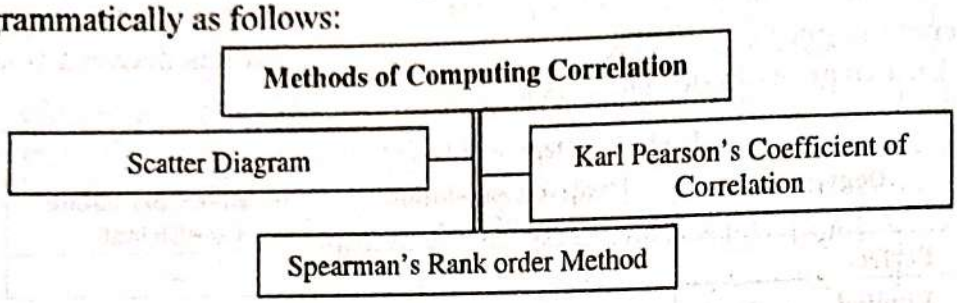
According to Guilford, "A coefficient of correlation is a single number that tells us what extent two things are related, to what extent variation in the one go with the variation in the other."

The extent of measurement as to how much one number can expect to be influenced by changes in another number is known as correlation coefficient. **For example,** measuring the value that how much the share price of a company is

expected to get influenced, when there are fluctuations in the index. If the two numbers are perfectly correlated then it means that value of correlation coefficient is +1. If one grows the other also grows, and the change in one is a multiple of the change in the other. If the numbers are perfectly inversely correlated then it means that value of correlation coefficient is –1. If one grows the other falls. The growth in one variable is a negative multiple of the growth in the other variable. If the two variables are not related then the correlation coefficient is zero.

4.17.5. Methods of Computing Correlation

The various method of computing linear correlation can be shown diagrammatically as follows:



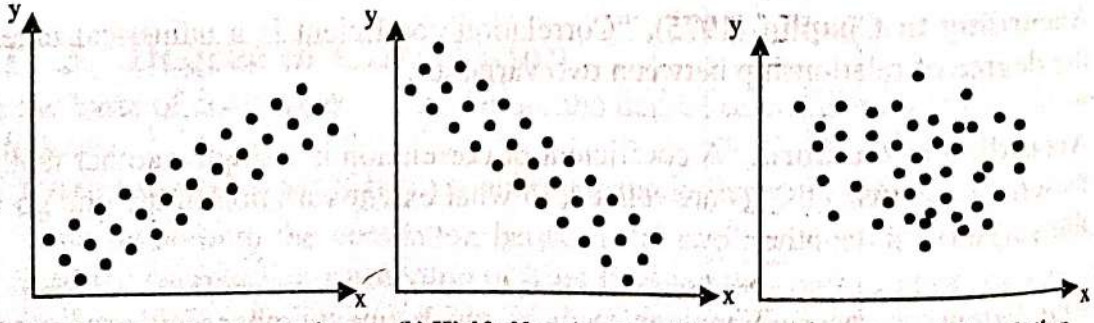
4.17.6. Scatter Diagram

Graphical presentation of the relationship between two variables calculated on the same set of individual is known as **scatter diagram.**

Note: Scatter diagram is a dot chart specially used to show the correlation.

For example, if we plot a dot chart for some predefined value of two variables and get some trends (either upwards or downwards) in the chart, then the trend shows a correlation between both the variables. The idea will be clear from the **figure 4.3:**

- In **figure 4.3(a),** the values of the two variables move in the upward direction, hence the correlation is positive.
- In **figure 4.3(b),** we find negative correlation as the values move in reverse direction.
- In **figure 4.3(c),** we do not get any trend lying and hence it shows the absence of correlation and r = 0.



(a) Highly Positive Correlation **(b) Highly Negative Correlation** **(c) Absence of Correlation**

Figure 4.3

➢ In **figure 4.4**, the value of the two variables moves in the same direction and when r = +1 then its shows perfect positive correlation and when r = −1 then its shows perfect negative correlation.

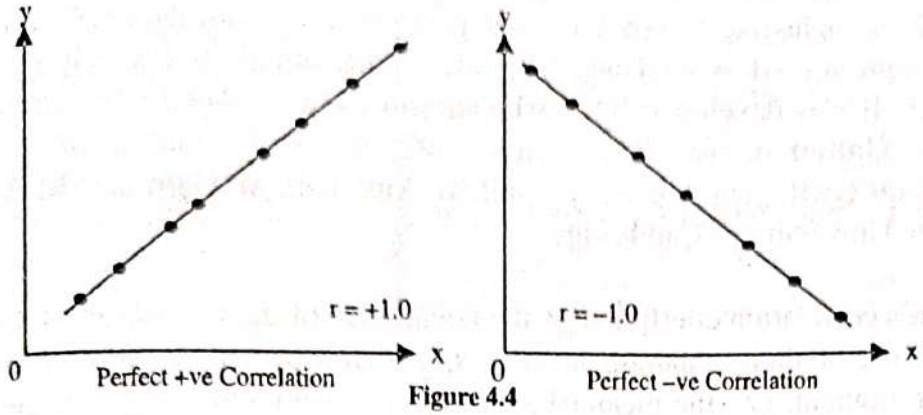


Figure 4.4

4.17.6.1. Advantages of Scatter Diagram

1) It is a very simple and non-mathematical technique.
2) It is not influenced by the size of extreme items.
3) It is the very basic step to find out the relationship between two variables.

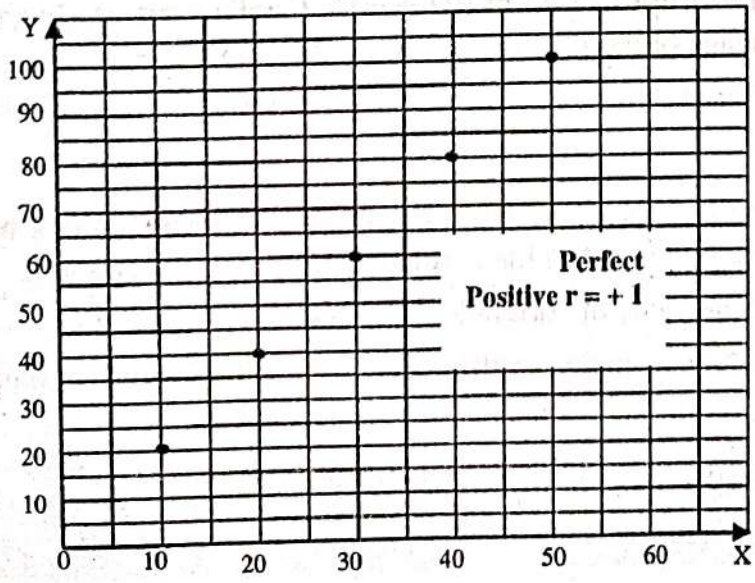
4.17.6.2. Disadvantages of Scatter Diagram

The main disadvantage of this technique is that it cannot find out an exact degree of correlation between two variables. We can only view the visual form of correlation and direction (positive or negative) on the chart.

Example 59: Draw a scatter diagram for the following and indicate whether the correlation is positive or negative.

X	10	20	30	40	50
Y	20	40	60	80	100

Solution:



4.17.7. Karl Pearson's Coefficient of Correlation

In statistics, the **Pearson** product-moment correlation coefficient (sometimes referred to as the PPMCC or PCC or Pearson's r) is a measure of the linear dependence (correlation) between two variables X and Y. It has a value between +1 and −1 inclusive, where 1 is total positive linear correlation, 0 is no linear correlation, and −1 is total negative linear correlation. It is widely used in the sciences. It was developed by **Karl Pearson** from a related idea introduced by **Francis Galton** in the 1880s. Early work on the distribution of the sample correlation coefficient was carried out by **Anil Kumar Gain** and **R. A. Fisher** from the University of Cambridge.

Pearson's correlation coefficient is the covariance of the two variables divided by the product of their standard deviations. The form of the definition involves a product moment, i.e., the mean (the first moment about the origin) of the product of the mean-adjusted random variables; hence the modifier product-moment in the name.

To calculate the magnitude of linear relationship between two variables **Karl Pearson** (biometrician and statistician) gave a quantitative technique. This technique is known as **Pearsonian Coefficient of Correlation (r)** and is extensively used in practice.

4.17.7.1. Properties of Karl Pearson's Coefficient of Correlation

1) Ideal measure of correlation and is independent of the units of the variables.
2) Free from change of origin and scale.
3) Based on all observations.
4) Lies between −1 and +1 and when:
   i) $r = -1$, shows a perfect negative correlation between variables.
   ii) $r = 0$, then there is no correlation between variables.
   iii) $r = +1$, shows a perfect positive correlation between variables.

4.17.7.2. Advantages of Karl Pearson's Coefficient of Correlation

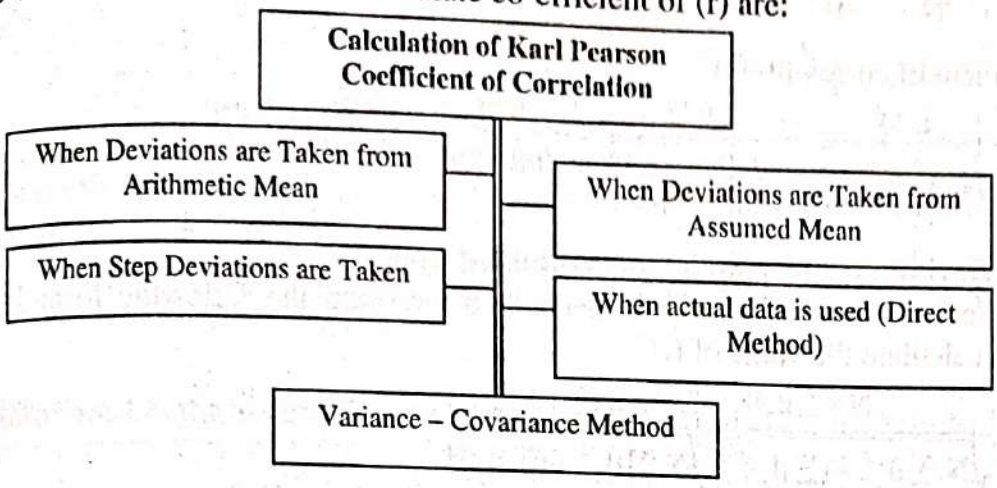
The main advantage of the Karl Pearson's coefficient of correlation is that it gives the result in one value and also summarises the degree of correlation and direction.

4.17.7.3. Disadvantages of Karl Pearson's Coefficient of Correlation

1) Every time assumes only a linear relationship between variables.
2) Interpreting the value of correlation coefficient (r) is difficult.
3) Significance of correlation coefficient (r) is affected by the extreme values.
4) It is a time consuming method.
5) Does not convey the cause and effect relationship.

4.17.7.4. Calculation of Karl Pearson Coefficient of Correlation

The various formulae used to calculate co-efficient of (r) are:



When Deviations are Taken from Arithmetic Mean

When deviation is taken from arithmetic mean, then r is calculated as:

$$r=\frac{\sum xy}{\sqrt{\sum x^2}\sqrt{\sum y^2}} \text{ or } \frac{\sum xy}{\sqrt{\sum x^2.\sum y^2}}$$

$$\text{or } \frac{\sum xy}{N\sigma_x.\sigma_y}$$

$$\text{or } r=\frac{\sum(X-\bar{X})(Y-\bar{Y})}{\sqrt{\sum(X-\bar{X})^2\sum(Y-\bar{Y})^2}}$$

where, $x = X - \bar{X}$, (deviation from Arithmetic Mean (A.M.) of X series)

$y = Y - \bar{Y}$, (deviation from Arithmetic Mean (A.M.) of Y series)

σ_x = Standard Deviation (S.D.) of X series

σ_y = Standard Deviation (S.D.) of Y series

And, N = Number of observation

Example 60: Calculate Karl Pearson Coefficient of Correlation.

X	42	52	55	60	66	68	65	60	58	34
Y	11	13	18	22	26	40	31	27	24	18

Solution:

X	Y	$x = (X-\bar{X})$	x^2	$y = (Y-\bar{Y})$	y^2	xy
42	11	– 14	196	– 12	144	168
52	13	– 4	16	– 10	100	40
55	18	– 1	1	– 5	25	5
60	22	4	16	– 1	1	– 4
66	26	10	100	3	9	30
68	40	12	144	17	289	204
65	31	9	81	8	64	72
60	27	4	16	4	16	16
58	24	2	4	1	1	2
34	18	– 22	484	– 5	25	110
$\Sigma X = 560$	$\Sigma Y = 230$		$\Sigma x^2 = 1058$		$\Sigma y^2 = 674$	$\Sigma xy = 643$

$$\bar{X} = \frac{\Sigma X}{N} = \frac{560}{10} = 56;\ \bar{Y} = \frac{\Sigma Y}{N} = \frac{230}{10} = 23$$

Coefficient of correlation (r)

$$= \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}} = \frac{643}{\sqrt{1058 \times 643}} = \frac{643}{\sqrt{680294}} = \frac{643}{824.8} = 0.779$$

When Deviations are Taken from Assumed Mean

When deviations are taken from assumed mean, then the following formula is used to calculate the value of r.

$$r = \frac{N \times \Sigma d_x d_y - \Sigma d_x . \Sigma d_y}{\sqrt{N.\Sigma d_x^2 - (\Sigma d_x)^2}\ \sqrt{N.\Sigma d_y^2 - (\Sigma d_y)^2}}$$

where $d_x = X - A_x$ and $d_y = Y - A_y$

A = Assumed Mean

Example 61: Find the coefficient of correlation from the following data

X	1	2	3	4	5	6	7	8	9	10
Y	62	56	48	41	36	28	21	16	12	8

Solution: Let the assumed mean for X is 5, Assumed mean for Y is 40.

X	Y	$d_x = (X - 5)$	$d_y = (Y - 40)$	d_x^2	d_y^2	$d_x d_y$
1	62	−4	22	16	484	−88
2	56	−3	16	9	256	−48
3	48	−2	8	4	64	−16
4	41	−1	1	1	1	−1
5	36	0	−4	0	16	0
6	28	1	−12	1	144	−12
7	21	2	−19	4	361	−38
8	16	3	−24	9	576	−72
9	12	4	−28	16	784	−112
10	8	5	−32	25	1024	−160
Total		$d_x = 5$	$d_y = -72$	$\Sigma d_x^2 = 85$	$\Sigma d_y^2 = 3710$	$\Sigma d_x d_y = -547$

$$r = \frac{N\Sigma d_x d_y - \Sigma d_x \Sigma d_y}{\sqrt{\left\{N\Sigma d_x^2 - (\Sigma d_x)^2\right\} \times \left\{N\Sigma d_y^2 - (\Sigma d_y)^2\right\}}}$$

$$= \frac{10(-547) - 5(-72)}{\sqrt{10 \times 85 - (5)^2} \times \sqrt{10 \times 3710 - (-72)^2}}$$

$$= \frac{-5470 + 360}{\sqrt{850 - 25} \times \sqrt{37100 - 5184}} = \frac{-5110}{\sqrt{825} \times \sqrt{31916}}$$

$$= \frac{-5110}{\sqrt{26330700}} = \frac{-5110}{5131.34}$$

$$r = -0.996$$

The variable X and Y are perfectly negatively correlated.

When Step Deviations are Taken

To calculate the r following formula is used when step deviation is taken.

$$r=\frac{N\times\Sigma d'_x d'_y-\Sigma d'_x.\Sigma d'_y}{\sqrt{N.\Sigma {d'_x}^2-(\Sigma d'_x)^2}\sqrt{N.\Sigma {d_y}^2-(\Sigma d'_y)^2}};\ \text{Where } d'_x=\frac{d_x}{i_x}, d'_y=\frac{d_y}{i_y}$$

Example 62: Calculate Coefficient of Correlation between the expenses and saving of any family.

Expenses (₹)	10	18	27	39	46
Saving (₹)	70	55	47	28	20

Solution: Let the assumed mean for X is 25, Assumed mean for Y is 40.

X	$d_x=(X-15)$	$d'_x=\frac{dx}{5}$	$(d'_x)^2$	Y	$d_y=(Y-30)$	$d_y'=\frac{dy}{5}$	$(d'_y)^2$	$d_x'd_y'$
10	– 25	– 5	25	70	25	5	25	– 25
18	– 10	– 2	4	55	10	2	4	– 4
27	0	0	0	47	– 10	– 2	4	0
39	10	2	4	28	– 20	– 4	16	– 8
46	30	6	36	20	– 30	– 6	36	– 36
N = 5		$\Sigma d_x'=1$	$\Sigma d_x'^2=69$	N = 5		$\Sigma d_y'=-5$	$\Sigma d_y'^2=85$	$\Sigma d_x'd_y'=-73$

$$r=\frac{\Sigma d'_x d'_y-\frac{\Sigma d'_x d'_y}{N}}{\sqrt{\Sigma {d'_x}^2-\frac{(\Sigma d'_x)^2}{N}}\sqrt{\Sigma (d'_y)^2-\frac{(\Sigma d'_y)^2}{N}}}=\frac{-73-\left(-\frac{73}{5}\right)}{\sqrt{69-\frac{1}{5}}\sqrt{85-\frac{(-5)^2}{5}}}$$

$$=\frac{-58.4}{\sqrt{68.8}\times\sqrt{80}}=\frac{-58.4}{\sqrt{5504}}=\frac{-58.4}{74.2}=-0.787$$

When Actual Data is Used (Direct Method)

In case of actual data following formula is used to calculate the coefficient r.

$$r=\frac{N\times\Sigma XY-\Sigma X.\Sigma Y}{\sqrt{N.\Sigma X^2-(\Sigma X)^2}\sqrt{N.\Sigma Y^2-(\Sigma Y)^2}}$$

Example 63: Calculate the Karl Pearson coefficient of correlation for the following data:

X	4	7	11	14	19	15
Y	18	16	17	19	19	21

Solution:

X	Y	X^2	Y^2	XY
4	18	16	324	72
7	16	49	256	112
11	17	121	289	187

14	19	196	361	266
19	19	361	361	361
15	21	225	441	315
$\Sigma X = 70$	$\Sigma Y = 110$	$\Sigma X^2 = 968$	$\Sigma Y^2 = 2032$	$\Sigma XY = 1313$

Coefficient of Correlation, r

$$= \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{N\sum X^2 - (\sum X)^2}\sqrt{N\sum Y^2 - (\sum Y)^2}}$$

$$= \frac{6\times 1313 - 70\times 110}{\sqrt{6\times 968 - (70)^2}\sqrt{6\times 2032 - (110)^2}}$$

$$= \frac{7878 - 7700}{\sqrt{5808 - 4900}\sqrt{12192 - 12100}} = \frac{178}{\sqrt{908}\times\sqrt{92}} = \frac{178}{\sqrt{83536}} = \frac{178}{289} = 0.616$$

Variance – Covariance Method

Following formula is used to calculate the value of **r** when variance and covariance are given:

$$r = \frac{Cov.(X, Y)}{\sqrt{Var.(X)}\sqrt{Var.(Y)}}$$

where, $r = \frac{\Sigma(X-\overline{X})(Y-\overline{Y})}{\sqrt{\Sigma(X-\overline{X})^2\,\Sigma(Y-\overline{Y})^2}}$

Divide numerator and denominator by N we have,

$$r = \frac{\Sigma(X-\overline{X})(Y-\overline{Y})/N}{\sqrt{\frac{\Sigma(X-\overline{X})^2\,\Sigma(Y-\overline{Y})^2}{N}}} = \frac{\Sigma(X-\overline{X})(Y-\overline{Y})/N}{\sqrt{\frac{\Sigma(X-\overline{X})^2}{N}\times\frac{\Sigma(Y-\overline{Y})^2}{N}}}$$

$$= \frac{Cov.(X, Y)}{\sqrt{Var.(X)}\sqrt{Var.(Y)}}$$

Example 64: If covariance between X and Y variables is 12.5 and the variance of X and Y are respectively 16.4 and 13.8, find the coefficient of correlation between them.

Solution: Covariance of XY = 12.5
Variance of X = 16.4
Variance of Y = 13.8

$$r = \frac{Cov.(X, Y)}{\sqrt{Var.(X)}\sqrt{Var.(Y)}} = \frac{12.5}{\sqrt{16.4}\sqrt{13.8}} = \frac{12.5}{\sqrt{226.32}} = \frac{12.5}{15.04} = 0.83$$

r = 0.83

4.17.8. Spearman's Rank Order Method

Spearman's Rank Correlation coefficient named after **Charles Edward Spearman** and denoted by **R,** which is a technique to find the correlation between the ranks of two series. This technique is used when value of variable

cannot be calculated quantitatively. To apply the Spearman's rank correlation technique we need to first arrange the value of variable in serial order. We apply this method when we deal with qualitative characteristics.

For example, when we test the IQ of a person with the number of hours spent in front of TV per week, etc. Spearman's rank correlation coefficient (R) is defined as,

$$R = 1 - \frac{6\sum D^2}{N(N^2 - 1)}$$

Where, R = Rank Coefficient of Correlation
D = Difference between Two Ranks (R_1–R_2)
N = Number of Pair of Observations

Rank Correlation Coefficient (R) always exists between –1 and +1and also used when the measurements are given for both the series.

4.17.8.1. Advantages of Spearman's Rank Method

1) Easy to understand and calculate.
2) When data are qualitative (e.g., intelligence, efficiency) in nature then it is very useful.
3) It also applies when actual data are given.

4.17.8.2. Disadvantages of Spearman's Rank Method

1) Not useful in bivariate distribution.
2) If we take a large sample (n>30) then calculation becomes more difficult and takes too much time.

4.17.8.3. Calculation of Rank Correlation

Various conditions for calculating the Rank Correlation are as follows:

1) When Ranks are Given
2) When Ranks are not Given
3) Repeated Rank

When Ranks are Given

When the actual ranks (say R_1 and R_2) are given, then following steps are used to calculate the rank.

1) Calculate the difference of two ranks ($R_1 - R_2$) and assign it to D, i.e., D = ($R_1 - R_2$).
2) Then calculate the square of D and summate the D as ΣD^2.
3) In the last, put all the calculated values in the formula.

Example 65: Following are the rank obtained by 10 students in two subjects, English and History. To what extent the knowledge of the students in the two subjects is related?

English	1	2	3	4	5	6	7	8	9	10
History	2	4	1	5	3	10	9	6	7	8

Solution: **Calculation of Rank Correlation Coefficient**

Rank of English (R_1)	Rank of History (R_2)	$D = (R_1 - R_2)$	D^2
1	2	−1	1
2	4	−2	4
3	1	+2	4
4	5	−1	1
5	3	+2	4
6	10	−4	16
7	9	−2	4
8	6	+2	4
9	7	+2	4
10	8	+2	4
			$\Sigma D^2 = 46$

Rank correlation coefficient (R)

$$= 1-\frac{6\Sigma D^2}{N(N^2-1)} = 1-\frac{6\times 46}{10(10^2-1)} = 1-\frac{276}{10(100-1)} = 1-\frac{276}{990} = 1 - 0.28 = +0.72.$$

When Ranks are not Given

If no rank is given, then we first calculate the rank of the given data (actual data).

i) To assign the rank we take the lowest number of rank as 1, the next lowest number a rank is 2, and so on.

ii) Calculate the difference of two ranks $(R_1 - R_2)$ and assign it to D, i.e., $D = (R_1 - R_2)$.

iii) Then calculate the square of D and summate the D as ΣD^2.

iv) In the last, put all the calculated values in the formula.

Example 66: Calculate coefficient of correlation by rank method:

X	54	58	85	75	65	90	80	50
Y	120	134	150	115	110	140	142	100

Solution: **Calculation of Rank Correlation Coefficient**

X	Rank (R_1)	Y	Rank (R_2)	$D = (R_1 - R_2)$	D^2
54	7	120	5	2	4
58	6	134	4	2	4
85	2	150	1	1	1
75	4	115	6	−2	4
65	5	110	7	−2	4
90	1	140	3	−2	4
80	3	142	2	1	1
50	8	100	8	0	0
					$\Sigma D^2 = 22$

Coefficient of Rank Correlation

$$R = 1-\frac{6\sum D^2}{N(N^2-1)} = 1-\frac{6\times 22}{8(64-1)} = 1-\frac{132}{504} = \frac{504-132}{504} = \frac{372}{504} = 0.738$$

Tied Ranks/Equal or Repeated Ranks

When values are repeated, then ranks assigned to these values are similar. In this case, calculate the average of rank and assign it to the repeated values. For **example,** if two persons are positioned on the fifth place, they each of them are

given the rank $\frac{5+6}{2}=5.5$, which is common rank to be assigned; and the next rank will be 7. In case if three are ranked equal at the fifth place, they all are given the rank $\frac{5+6+7}{3}=6$, which is the common rank to be assigned to each; and the next rank will be 8, in this case.

In this (Tied Ranks/Equal or Repeated Ranks) case, to perform calculation following formula is used:

$$R=1-6\left\{\frac{\sum D^2+\frac{1}{12}(m_1^3-m_1)+\frac{1}{12}(m_2^3-m_2).....}{N^3-N}\right\}$$

where, m = Number of Items having common Ranks

Example 67: Obtain the rank correlation coefficient for the following data:

X	68	64	74	50	64	80	74	40	55	64
Y	62	58	67	45	81	60	67	48	50	70

Solution: **Calculation of Rank Correlation**

X	Rank (R_1)	Y	Rank (R_2)	D = ($R_1 - R_2$)	D^2
68	7	62	6	1	1
64	5	58	4	1	1
74	8.5	67	7.5	1	1
50	2	45	1	1	1
64	5	81	10	−5	25
80	10	60	5	5	25
74	8.5	67	7.5	1	1
40	1	48	2	−1	1
55	3	50	3	0	0
64	5	70	9	−4	16
					$\Sigma D^2 = 72$

In series X the value 64 occurs thrice ($m_1 = 3$), i.e., at 4^{th}, 5^{th} and 6^{th} rank. Hence all three values are given the average rank, i.e., $\frac{4+5+6}{3}\text{th}=5^{th}$ rank. Also in series X the value 74 occurs twice ($m_2 = 2$), i.e., at 8^{th} and 9^{th} rank. Hence values are given the average rank, i.e., $\frac{8+9}{2}\text{th}=8.5^{th}$ rank. While, in series Y, the value 67 occurs both at the 7^{th} and 8^{th} rank, ($m_3 = 2$). Hence both are given the average rank, this is, $\frac{7+8}{2}\text{th}=7.5^{th}$ rank.

Coefficient of Rank

$$\text{Correlation (R)} = 1 - \frac{6\left[\Sigma D^2 + \frac{m_1^3 - m_1}{12} + \frac{m_2^3 - m_2}{12} + \frac{m_3^3 - m_3}{12}\right]}{N(N^2 - 1)}$$

$$= 1 - \frac{6\left[72 + \frac{3^3 - 3}{12} + \frac{2^3 - 2}{12} + \frac{2^3 - 2}{12}\right]}{10(10^2 - 1)} = 1 - \frac{6[72 + 2 + 0.5 + 0.5]}{10(10^2 - 1)}$$

$$= 1 - \frac{6[75]}{990} = 1 - \frac{450}{990} = 1 - 0.4545$$

R = 0.5455

4.18. NORMAL PROBABILITY CURVE

4.18.1. Probability

Computation of the chance of an occurrence of a certain event is called probability. Hence, probability is the study of random happening of an event and uncertainty, e.g., "Probability of rain tomorrow is only 35%", and "Probability of winning a lottery is 1 out of 40,406,353".

Before conducting an experiment, the absolute certainty of the outcome is unpredictable, therefore it is termed as probability, which actually depends on the idea of a 'random experiment'.

The theory of probability originates from the 'game of chance' associated with gambling, e.g., consider a game like gambling, tossing of a coin, throwing of a die, and random drawing of cards from a pack of cards.

Thus, in statistics, probability (of an event) is defined as the 'proportion of time' in which an event occurs and is observed, even if the experiment is run an infinite number of times.

Probability is the mode of expression of knowledge or belief whether the event has occurred or will occur. Thus, in the theory of probability this concept has been given an exact mathematical significance for being used widely in such areas of study as mathematics, statistics, finance, gambling, science, and philosophy, so that conclusions can be drawn regarding the probability of potential events and the mechanics of complex systems being hidden.

According to American Heritage Dictionary, "Probability is the branch of mathematics that studies the likelihood of occurrence of random events in order to predict the behaviour of a defined system."

4.18.1.1. General Rule for Probability

The probability of an event (say A) is defined as follows:
If an event happens m times and it fails n times, then the probability (p) of event A is defined as:

$$P(A) = \frac{m}{m+n}$$

$$\text{or } P(A) = \frac{\text{Number of cases favorable to the occurrence of the event}}{\text{Total number of mutually exclusive and exhaustive cases}}$$

So the total number of trials favourable to the event (A) divided by the total number of ways in which the event (A) can happen.

Probability in favour of the occurrence of the event

$$\Rightarrow \frac{m}{n} = \frac{\text{Number of cases favorable to the occurrence of the event}}{\text{the number of cases against the occurrence of the event}}$$

Probability against the occurrence of the event

$$\Rightarrow \frac{n}{m} = \frac{\text{The number of cases against the occurrence of the event}}{\text{The number of cases favorable to the occurrence of the event}}$$

4.18.1.2. Applications of Probability

1) It plays a great role in making predictions.
2) It is used to solve scientific investigations as well as day-to-day problems.
3) It is very useful when one wants to predict the uncertainties of betting and chances of success.
4) It is extensively used in business and economics.
5) It is the basis of the law of 'statistical regularity' and 'law of inertia of a large number'.

4.18.2. Concept of Normal Probability Curve

The normal probability distribution is very common in the field of statistics. **The normal distribution** is a continuous distribution of data that has the shape of a symmetrical bell curve. **Laplace** and **Gauss** (1777-1855) created the **Normal probability curve.** It is also called the **Gaussian distribution**, after **Carl Gauss** who created a mathematical formula for the curve. It is also known as the **Bell Curve.** Generally, normal curve is used in measuring things like people's height, weight, salary, opinions or votes.

The continuous random variable X follows a **normal distribution** if its probability density function is defined as:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left\{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right\}$$

where, f(x) = probability function
The **mean** of X is μ and the **variance** of X *is* σ^2. We say $X \sim N(\mu, \sigma^2)$.

The normal distribution graph is based on two factors namely, the mean and standard deviation. The mean of the distribution finds the position of the centre of

the curve, and the standard deviation finds the height and width of the curve. When the value of standard deviation is high then the curve will be short in height and wide in width. When the value of standard deviation is small then the curve will be tall in height and narrow in width. All normal distributions look like a symmetric, bell-shaped curve, as shown in **figure 4.5.**

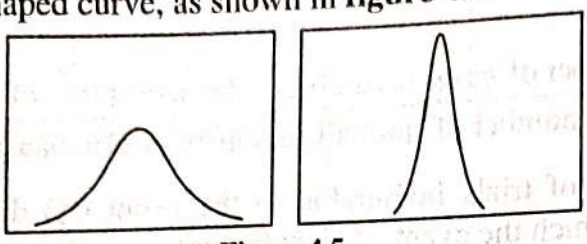


Figure 4.5

The curve on the left is shorter and wider than the curve on the right, because the curve on the left has a bigger standard deviation.

4.18.3. Characteristics of Normal Probability Curve

The characteristics of normal probability curve are as follows:

1) **The Mean, Median and Mode are Equal:** The mean, median and mode fall at the middle point and they are numerically equal.
2) **The Curve is Bilaterally Symmetrical:** NPC is a bell shaped curve. The curve is symmetrical to its ordinate of the central point of the curve. It means the size, shape and slope of the curve on one side of the curve is identical to the other side of the curve. If the curve is bisected then its right hand side completely matches to the left hand side.
3) **It is Unimodal:** The curve is having only one peak point. because the maximum frequency occurs only at one point.
4) **The Mean of NPC is μ and the Standard Deviation is σ:** As the mean of the NPC represent the population mean so it is represented by the μ (Meu). The standard deviation of the curve is represented by the Greek Letter σ.
5) **The Height of the Curve Symmetrically Declines:** The height of the curve decline to both the direction symmetrically from the central point. Means the M + σ and M — σ are equal if the distance from the mean is equal.
6) **The Curve is Asymptotic:** NPC is asymptotic. It approaches but never touches the base line. The normal probability curve approaches the horizontal axis and extends from -∞ to + ∞. It means the extreme end of the curve tends to touch the base line but never touch it. It is depicted in figure given below:

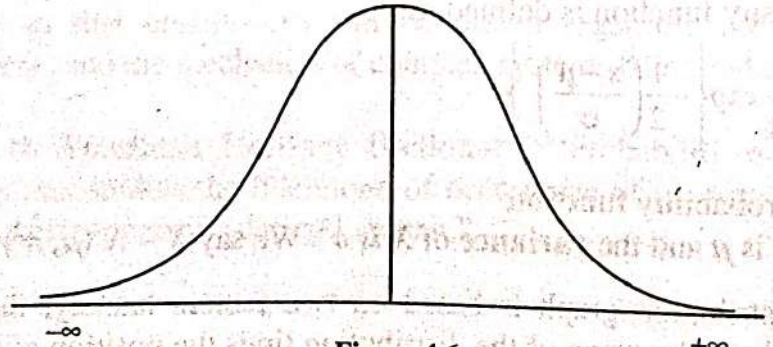


Figure 4.6

7) **The Points of Inflection Occur at ± 1 Standard Deviation Unit:** The points of influx in a NPC occur at ± 1σ to unit above and below the mean. Thus at this point the curve changes from convex to concave in relation to the horizontal axis.

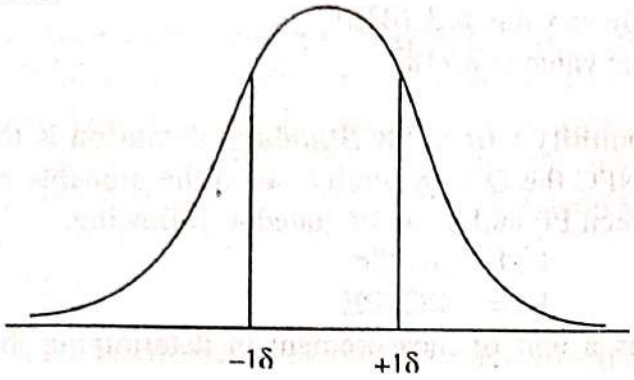


Figure 4.7

8) **The Total Area of NPC is Divided in to ± Standard Deviations:** The total of NPC is divided into six standard deviation units. From the centre it is divided in to three +ve' standard deviation units and three —ve' standard deviation units.

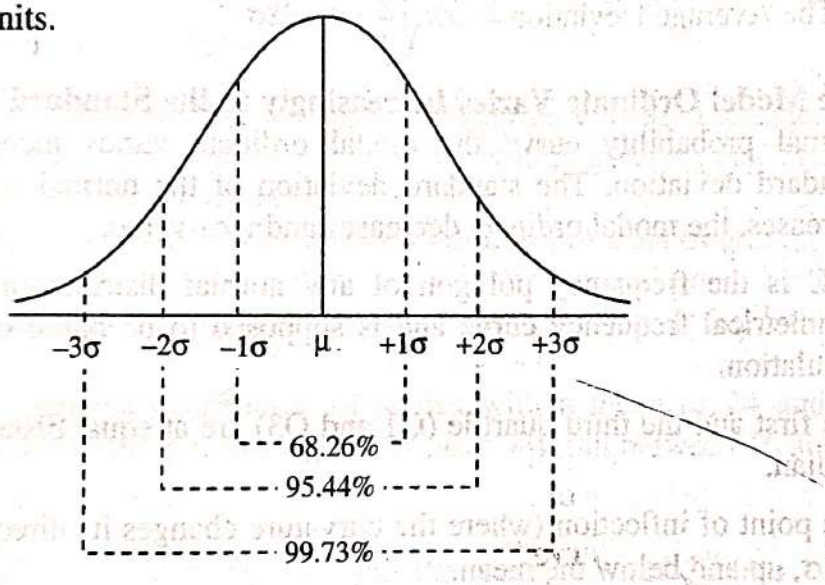


Figure 4.8

Thus ± 3σ of NPC include different number of cases separately. Between ± 1σ lie the middle 2/3rd cases or 68.26%, between ± 2σ lie 95.44% cases and between ± 3σ lie 99.73% cases and beyond + 3σ only 0.37% cases fall.

9) **The Y Ordinate Represents the Height of the Normal Probability Curve:** The curve has its maximum height or ordinate at the starting point, i.e., the mean of the distribution. The Y ordinate of the NPC represents the height of the curve. At the centre the maximum ordinate occurs. The height of the curve at the mean or mid-point is denoted as Y_0. In order to determine the height of the curve at any point we use the following formula:

$$Y = \frac{N}{\sigma\sqrt{2x}} e^{\frac{x^2}{2\sigma^2}}$$

where,
Y = Ordinate, the height of curve above the horizontal axis.
x = Deviation from the mean
σ = Standard deviation
π = A constant whose value is 3.1416
e = A constant, the value is 2.7183

10) **In Normal Probability Curve the Standard deviation is the 50% Larger than the Q:** In NPC the Q is generally called the probable error or PE. The relationship between PE and σ can be stated as following:

$$1\ PE = .6745\sigma$$
$$1\sigma = 1.4826PE$$

Q can be used as a unit of measurement in determining the area within a given part.

11) **The Average Deviation about the Mean of NPC is 0.798σ:** There is a constant relationship between standard deviation and average deviation in a NPC.

$$\text{The Average Deviation} = \sigma \times \sqrt{\frac{2}{\pi}} = 0.798\sigma$$

12) **The Model Ordinate Varies Increasingly to the Standard Deviation:** In a normal probability curve the modal ordinate varies increasingly to the standard deviation. The standard deviation of the normal probability curve increases, the modal ordinate decreases and *vice-versa*.

13) NPC is the frequency polygon of any normal distribution. It is an ideal symmetrical frequency curve and is supposed to be based on the data of a population.

14) The first and the third quartile (Q1 and Q3) are at equal distance from Q2 or median.

15) The point of inflection (where the curvature changes its direction) is at point +–1σ, up and below the mean.

4.18.4. Uses/Applications of Normal Probability Curve

NPC is used in many ways. Its' uses can be mentioned on the basis of following points:

1) **NPC is used as a Model:** Normal curve represents a model distribution. It can be used as a model in:
   i) Comparing various distributions with it, i.e., whether the distribution is normal or not and, if not, in what way it diverges from the normal,
   ii) Comparing two or more distributions in terms of overlapping, and
   iii) Evaluating student's performance from their scores.

2) **It used in Computing Percentile and Percentile Ranks:** Normal probability curve may be conveniently used for computing percentiles and percentile ranks in a given normal distribution.

3) **Used in Grouping:** A group of individuals may be conveniently grouped into certain categoreis as A, B, C, D, E (very good, good, average, poor, very poor) in terms of some trait (assumed to be normally distributed), with the help of a normal curve.

4) **It Converts Raw Score into Comparable Standard Normalised Scores:** With the help of a normal curve, we can convert the raw scores belonging to different tests into a standard normalised scores like sigma a scores. For converting a given raw score into a z score, we subtract the mean of the scores of distribution from the respective raw scores and divide it by the standard deviation of the distribution. That is,

$z = X - M/\sigma.$

In this way a standard z score clearly indicates how many standard deviation units a raw score is above or below the mean and thus provides a standard scale for the purpose of valuable comparison.

5) **It Determines the Relative Difficulty of Test Items:** Normal curve provides the simplest rational methods of scaling test items for difficulty and therefore, may be conveniently employed for determining the relative difficulty of test questions, problems and other test items.

6) **Used to Determine the Percentage of Cases:** NPC is used to determine the percentage of cases in a normal distribution within given limits. The Normal Probability Curve helps us to determine:
   i) What percent of cases fall between two scores of a distribution?
   ii) What percent of scores lie above a particular score of a distribution?
   iii) What percent of scores lie below a particular score of a distribution?

Example 68: Given a distribution of scores with a mean of 24 and σ of 8. Assuming normality what percentage of the cases will fall between 16 and 32.

Solution:
Here, first of all we have to convert both the scores 16 and 32 into a standard score.

$$Z = \frac{x}{\sigma}$$

where z = Standard Score
x = Deviation of the Score (X – M)
σ = Standard deviation

$$\text{Z score for } 16 = \frac{x}{\sigma} = \frac{16-24}{8} = \frac{-8}{8}$$

$$= -1\sigma$$

$$\text{Z score for } 32 = \frac{x}{\sigma} = \frac{32-24}{8} = \frac{8}{8}$$

$$= +1\sigma$$

4.19. EXERCISE

4.19.1. Very Short Answer Type Questions

1) Define statistics.
2) Define median.
3) Define mode.
4) What is correlation?
5) Write the formula of mean deviation.

4.19.2. Short Answer Type Questions

1) What do you mean by measures of central tendency? Write the formulae of mean, median and mode.
2) What do you mean by measures of dispersion?
3) What is correlation? What are its uses?
4) What are the applications of NPC?
5) What are uses of correlation?

4.19.3. Long Answer Type Questions

1) What is the spearman's rank order method of computing coefficient of correlation?
2) Find the arithmetic mean of following series:

X	10	20	30	40	50
f	7	9	5	6	3

[Ans: Mean Salary: 4666.7]

3) Compute for the following data:
105, 29, 19, 109, 26, 40, 111, 21, 105, 77, 73, 108, 66, 95, 25
   i) Range
   ii) Coefficient of Range

[Ans: i) Range = 92 ii) Coefficient of Range = 0.7]

4) What is correlation how can it be computed?
5) What is a measure of dispersion?