

**T.Y.B.A.
GEOGRAPHY PAPER - VI
PRACTICAL GEOGRAPHY**

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I

T.Y.B.A. Geography Paper – 06 PRACTICAL GEOGRAPHY

(Section – A) Topo map and Thematic map Interpretation

Unit-I :

Map-Basic

Concept of Map, basic components of map, types of maps, methods of enlargement and reduction of maps- location, distance, directions - area calculation (graphical and strip method)

Unit-II:

Map Projections

Concept, need, classification and suitability, construction and properties: Graphical methods of drafting selected projections: Zenithal polar equal area, Zenithal equidistant, Conical one standard parallel, Conical two standard parallel, Cylindrical equal area, Cylindrical equidistant

Unit-III:

Interpretation of Topographical Maps

Definition of Topographical maps, methods of showing relief and landforms, topographical map index, colour scheme used in topographical maps, conventional signs and symbols- interpretation of map : a) S.O.I. Topographical Maps, Utility of topographical maps in geographical analysis

Unit-IV

Interpretation of Thematic Maps

Concept, Distinguishing characteristics; various categories of thematic maps, reading and interpretation, utility of thematic maps, techniques of representation of the theme, interpretation and appreciation

Unit-V :

Interpretation of Weather Maps and Graphs

Line and bar graph, Climograph, Hythergraph and Wind rose, Weather maps: Reading and interpretation

(Section – B) Statistical Techniques, Computer and Surveying

UNIT –VI

Need and Importance of the statistical techniques

Nature of the statistical data, Frequency distribution
Measures of central tendency – Mean Median & Mode

II

UNIT –VII

Measures of dispersion

Range, Quartile Deviation, Mean deviation, Standard deviation Moving average, Area mean

UNIT – VIII

Correlation & Regression

X² test

Introduction to SPSS package

UNIT – IX

COMPUTER

Importance & use of computer, basic terms related to computer Ms word, ms excel Use of internet

Unit - x

Surveying

Plane Table Survey

Prismatic Compass Survey

Abney level or Clinometer

Journal and viva



MAP-BASIC

1.0. After going through this chapter you will be able to understand the following features:

- 1.1 Objectives
- 1.2 Introduction
- 1.3 Subject discussion
- 1.4 Concept of Map
- 1.5 Basic components of map
- 1.6 Types of maps
- 1.7 Methods of enlargement and reduction of maps
- 1.8 Location
 - 1.8.1 Four-figure grid references
 - 1.8.2 Six-figure grid references
- 1.9 Distance
- 1.10 Directions
- 1.11 Area calculation (graphical and strip method)
- 1.12 Summary
- 1.13 Check your Progress/Exercise
- 1.14 Answers to the self learning questions
- 1.15 Technical words and their meaning
- 1.16 Task
- 1.17 References for further study

1.1. OBJECTIVES

By the end of this unit you will be able to:

- Understand the concept of map
- Learn basic components of map
- Discuss types of maps
- Evaluate methods of enlargement and reduction of maps
- Learn location of map
- Learn distance of map
- Learn directions of map
- Learn area calculation (graphical and strip method) of map

1.2. INTRODUCTION

In this unit named Map-Basic, we will study about the concept and the distinguishing characteristics of Maps. There will be a discussion on basic components of map and the types. Methods of enlargement and reduction of maps is very important. We will learn that in this unit. We will also learn location, distance and directions of map. Area calculation of map both graphical and strip method will be discussed in the latter part of this unit.

1.3. SUBJECT-DISCUSSION

Map is a two-dimensional form of the three dimensional earth that represent geography and culture. Since time immemorial people have been making pictures of places that were different than maps today. The earliest maps were carved on rocks. Those illustrations show beliefs and rituals connected with wider cosmologies. Down the ages with the nations' expansion the need for maps became more evident. People need maps now to make a very large area look small and understandable. Hence, maps are the primary tools by which spatial relationships are visualized. So Maps are considered as important documents. There are several key elements that should be included each time a map is created in order to help the reader to understand the communications of that map and to document the source of the geographic information used.

Maps have important parts and the acronym DOGSTAILS makes it easy to remember. These are described below.

- Date or D states When the map was made
- Orientation or O states the Directions (north arrow)
- Grid or G Locates places on the map
- Scale, S, states what the map distance is
- Title or T describes What, where, and when
- Author or A states Who made the map
- Index or I answers Map address of places
- Legend or L describes what the symbols mean
- Sources or S states Basis for map information

1.4. CONCEPT OF MAP

A Map is the representation of the earth's pattern as a whole or a part of it, or the heaven on a plane surface with conventional signs, drawn to a scale and projection so that each and every point on its corresponds to the actual terrestrial or celestial position. The

work of a map is to illustrate specific and detailed feature of a particular area, there are many kinds of map; static, two-dimensional, three- dimensional, dynamic and even interactive. Maps attempt to represent various things like political boundaries, physical features, roads, topography, population, climates, natural resources and economic activities.

1.5. BASIC COMPONENTS OF MAP

Maps may contain a variety of elements or components they are as follows

- 1) Base Map
- 2) Projection
- 3) Title
- 4) Scale
- 5) Compass rose - Direction
- 6) Conventional signs & symbols
- 7) Lettering in the map
- 8) Legend (or key)
- 9) Date

Without these five components, the map would not be a productive map for use.

1) Base Map - Base map is the map drawn accurately & is obtained from the authentic source. e.g. Govt. publication etc.

2) Projection - There are many different types of projections. Each projection has specific characteristics & hence we select base map drawn on suitable projection as per our requirement. e.g. equal area projection is used to show distribution of geographical features.

3) Title – The title of a map tells the reader what they are looking at. It could be a simple name of a country. The title should clearly explain what the cartographer is trying to show.

4) Scale – the scale on the map allows the reader to see the size and the distance of the features on the map.

5) Compass rose-Direction – the compass rose on the map orients the reader with the cardinal directions of the map. North direction is marked on the map.

Cardinal directions are East, West, North, South.

6) Conventional signs & symbols - Map is a generalized picture of the earth's surface. Signs & symbols are used to represent distribution in symbolic form e.g. church or CG means camping ground etc. signs & symbols help us to understand geographical features.

7) Lettering in the map - Lettering helps us in reading details given in the map. Large size old letters are used to represent title or large areas like continents or oceans.

Small size letters are used for small villages.

Upright letters are used for land features and slant letters are used for water bodies like rivers, sea or oceans.

8) Legend – a map legend, or key, helps the reader interpret what is on the map. The key should explain every feature or symbol on the map.

9) Date – every map must have a date. This tells the reader when the map was created. Without a date the reader would not know the relevance of the map.

There are various ways by which the earth is mapped.

- 1) By actual survey with the help of the instruments like chain, prismatic compass, plane table, theodolite etc.
- 2) By photographs.
- 3) By freehand sketches and diagrams.
- 4) By computer.
- 5) By satellite and remote sensing methods.

1.6. TYPES OF MAPS

A map is the representation of the earth surface or a part of it or some other celestial body such as sun, moon, stars or planets on a flat surface i.e. a plane surface. The representation is drawn to a specific scale and map projection and shows distinctive aspects of the surface such as relief features, routes, settlements etc.

❖ Maps may be classified with respect to:

- 1) Scale
- 2) Purpose or content

1.6.1. Classification of Maps based on scale

- a) **Cadastral Maps** – Cadastral maps are drawn to register the ownership of landed property by demarcating the boundaries of fields and buildings etc. they are prepared specially by government to realize revenue and tax.
- b) **Topographical Maps** – Topographical maps are prepared on a large scale. They show general surface features detail comprising both natural landscape and cultural landscape. They do not show plot or boundaries of the building but topographic forms like relief and drainage, swamp and forests, villages and towns and means of communication on them. In India 1: 50,000 scale maps are generally prepared.
- c) **Wall maps** – They are used in classrooms. In these maps, the world as a whole or in hemisphere is distinctly represented. They may also be prepared for a continent or country, large or small, according to need.
- d) **Chorographical or atlas maps** – These maps are drawn on a very small scale and give more or less highly generalized picture regarding the physical, climate and economic conditions of different regions of the earth. These maps show only important peaks, important rivers, chief towns, railway lines, etc.

1.6.2. Maps based on purpose or contents

- a) **Astronomical Maps** – These maps shows heavenly body or heavenly feature.
- b) **Geological Maps** – They show the rocks that from the crust of the earth and their mode of occurrence and their deposition. A correlation of these maps with the corresponding relief maps reveals the causes and evolution of landforms.
- c) **Orographic or Relief Maps** – Maps showing the surface forms is termed as ore-graphic or relief maps. They show the bulges and depressions found over the surface. The level of land, its slope and drainage are well marked on it.
- d) **Weather and climate Maps** – They show the average condition of temperature, pressure, wind and precipitation over a short period, which range from a day to a season. Map showing daily weather conditions are termed as daily weather maps while those showing the average of weather conditions over 10 years or more are called climatic maps.
- e) **Political Maps** – Show boundaries between different states or boundaries between different political units within a country.

- f) **Historical Maps** – Maps showing historical events are called historical maps.
- g) **Social Maps** – Social organism tribes and races their languages, religions, etc. are depicted on social maps.
- h) **Population Maps** – It denotes distribution of man over an area.
- i) **Economic Maps** – Maps displaying the distribution of important centers of agricultural, minerals and industrial products and its linkages with various means of communication may be termed as economic map.
- j) **Military Maps** – These maps records strategic point, routes, battle plans, etc.
- k) **Land utilization Maps** – They exhibit the nature and character of land use.

1.7. METHODS OF ENLARGEMENT AND REDUCTION OF MAP

The significance of the scale of any map is immediately recognized when particular map is to be enlarged or reduce. A small-scale map cannot possibly show and roads can only be shown in a much generalized way which means that these features cannot be measured to scale. A small-scale map can be enlarged to show more details and conversely a large scale map can be reduced.

Nowadays maps can be, enlarged or reduce in a number of ways, be its graphical or instrumental one common method of enlarging and reducing map is the square method.

1.7.1. **Enlarging map**

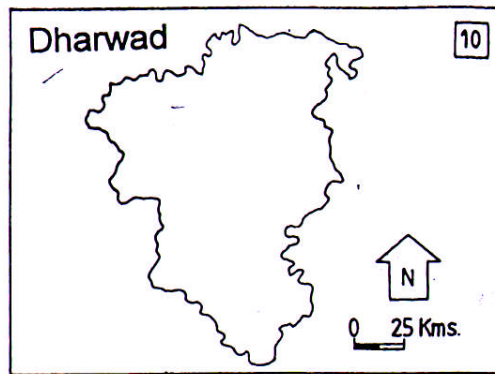
While enlarging any map to a given size, the following steps should be followed.

- Measure the length and width of the map.
- Multiply the length and width by 2 or 4 respectively if intend to enlarge the map to twice or thrice its original size.

For e.g.:- If the length and width of a map are 5cm and 3cm respectively such a map would measure 10cm by 6cm if enlarge to twice its size and 20cm by 12cm if enlarged 4 times its size and so on.

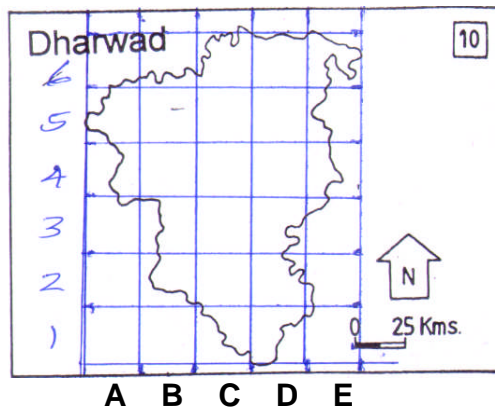
- Having enlarged the original map it is equally obvious that the scale would change therefore if a map has a scale of 1:60000 the scale of the map changes to 1:30000 if the size of the map has been enlarged to four times its original size.
- The feature to be shown on the enlarged map should also be proportional to the required size of the map.
- Once it is finished drawing the enlarged map write its title and the new horizontal scale.

Q.1 Enlarge the given map of Dharwad in the proportion of 1:2



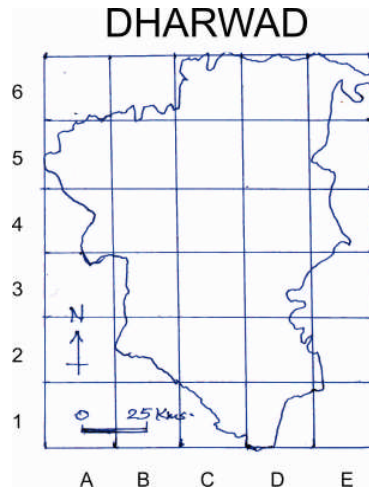
Answer -

1) Draw grid of 1cm × 1 cm on the map.



- 2) Give number to rows & alphabets to columns.
- 3) Our enlargement ratio is 1:2 & so draw a grid of 2cm × 2cm on the plain paper give numbers & alphabets as per the original diagram.
- 4) Now carefully transfer details on the new enlarged grid as per the original grid on the map of Dharwad carefully transfer details of each square - one by one.

- 5) Measure length of the graphical scale. It is 1cm to 25km our enlargement ratio is 1:2 SD draw a line of 2cm on the enlarged map & write some numbers i.e. zero (0) and 25 kms.



- 6) Give title draw north to the enlarged map.

1.7.2. Reducing map

In reducing any map to given size the following steps to be followed.

- Measure the length and width of the map.
- Divide the length and width by 2 or 4 if you are asked to reduce the map to half or a fourth of its original size.

For e.g.- If the length and width of a map are 24cm and 20cm respectively such a map should measure 12cm by 10cm if reduce to half of its size and so on.

- Having reduced the original map, it is obvious that the scale would equally change. Therefore if a map has a scale of 1:50000, the scale of the map changes to 1:1,00,000 if the size has been reduced to half and 1:2,00,000 if the size of the map has been reduced to a fourth of its original size.
- The feature to be shown on the reduced map should also be proportional to the required size of the map.
- Once we have finished drawing the reduced map write its title and new horizontal scale

Q.1 Reduction the map of Brazil in the proportion of 2:1.



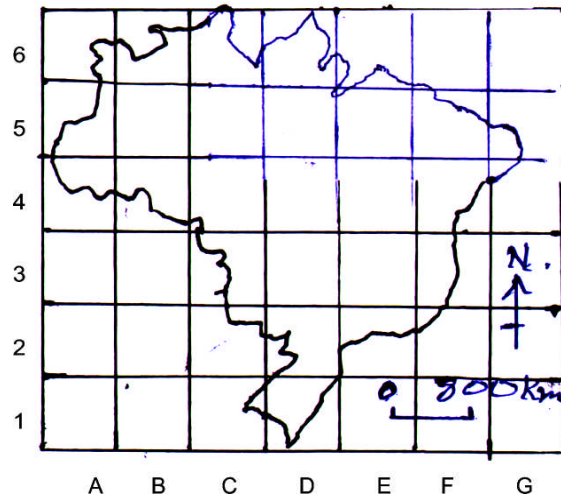
Answer -

- 1) As the map is large we can draw grid of 2cm × 2cm on the map.
(For small maps use grid of 1cm × 1cm).
- 2) Give numbers to rows & alphabets to columns.
- 3) Our reduction ratio is 2:1 & SD we can prepare grid of 1cm × 1cm for drawing reduced map.



- 4) Now concentrate on the single square of the original map & draw carefully similar shape in the reduced grid. It is easy to complete entire map.

5) For drawing scale of the map, measure length of scale on the original map. It is 2.2cm our ratio is 2:1 & hence we will draw line of 1.1cm on the reduced map. The value of 800km remains same.



1.8. Locations on maps

Grid lines on maps define the coordinate system. These are numbered to provide a unique reference to features. Grid references define locations on maps. The grid numbers on the east-west (horizontal) axis are called Eastings, and the grid numbers on the north-south (vertical) axis are called Northings. Numerical grid references consist of an even number of digits. Eastings are written before Northings. So in a 6 digit grid reference 123456, the Easting component is 123 and the Northing component is 456. There are varied Grid systems. But the most common is a square grid with grid lines intersecting each other at right angles and numbered sequentially from the origin at the bottom left of the map.

1.8.1. Four-figure grid references

When giving a four-figure grid reference, you should always give the eastings number first and the northings number second, just like in graph where we give the x coordinate first followed by the y.

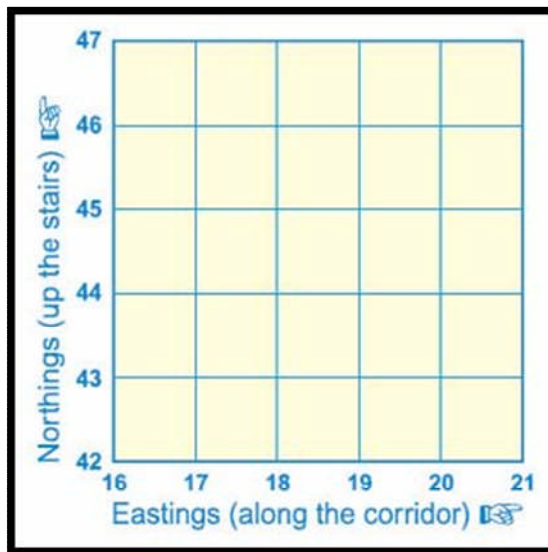
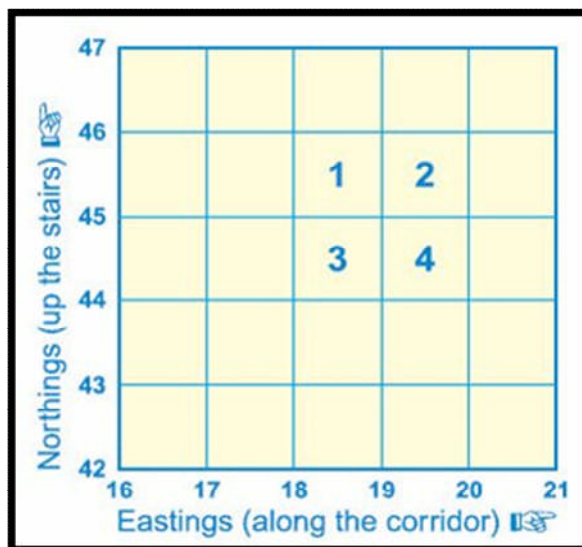


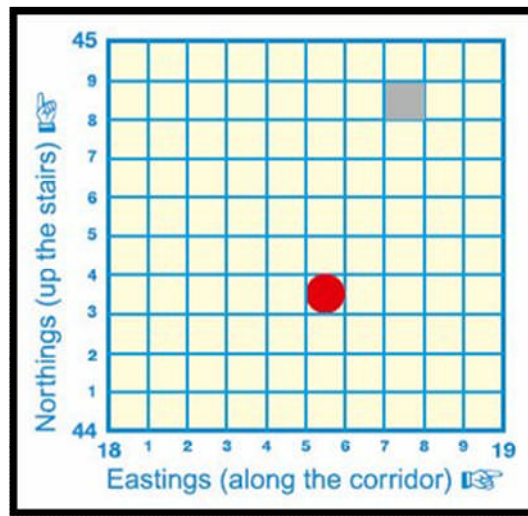
Fig: Four-figure grid references

For example, the number 2 in the diagram below is square 19 across and square 45 up and therefore, the four-figure grid reference is '1945', the number 1 in the diagram is 18 45, the number 3 in the diagram is 18 44 and the number 4 is 19 44.



Six-figure grid references

To get the six-figure grid reference, we have to imagine that the four-figure square is further divided up into tenths. This is explained in the example below. The grey box is in the four-figure grid reference square '18 44', but more accurately it is 7 tenths across and 8 tenths up within that larger grid square, therefore the six-figure map reference is '187 448'.



The shapes on the diagram above have the following six-figure grid references:

Grey square – 187 448 and Red dot – 185 443

There are a few points that we should remember regarding grid reference. Four figure grid references are very useful but it has a major weakness. They are not very accurate because all objects in the same grid square have the same four figure grid reference even though they may be hundreds of meters apart. Hence for greater accuracy a six figure grid reference is used. A six figure grid reference does not only indicate the grid square an object is located in. It also tells us the exact point within the grid square where the object is found. Therefore, objects located in the same grid square will have the same four figure grid reference, but different six figure grid references.

1.9. DISTANCE ON THE MAP

Maps are not only useful for directions, but can also help one determine the distance between two or more places. Thus people use a map scale to measure distance between cities and other places on a map. How we can measure distances on a map is discussed below.

- At first one should find the scale for the map one is going to use. One can use a ruler bar scale or a written scale, in words or numbers. At the bottom of each map there is a scale that indicates the distance on the map. While measuring a distance

on the map, one must compare it to the scale. This will instantly tell him the real world distance.

- A ruler should be used to measure the distance between the two places. A straight line distances may be easily measured on a map with a ruler. However, when using this technique above, a pencil, fingers or a twig may be considered as a tool to get a distance and compare it to the map scale. But if the line is curved, one should use a string to determine the distance and then measure the string.
- If the scale is a representative fraction (and looks like 1/100,000 or 1:100,000), multiply the distance of the ruler by the denominator, giving distance in the ruler units.

Examples:

8.5cm measured on a 1: 25 000 scale

Multiply distance by scale

$$8.5\text{cm} \times 25,000 = 212,500 \text{ cm}$$

Convert to meters

$$212,500 / 100 = 2,125 \text{ m}$$

Convert to km:

$$2,125 / 1,000 = 2.125 \text{ km}$$

- If the scale is a word statement (i.e. "One centimeter equals one kilometer") then determine the distance.
- For a graphic scale, one needs to measure the graphic and divide the scale into the measured units on the ruler.
- One should convert the units of measurement into the most convenient units for him such as conversion of 63,360 inches to one mile.
- A graphic scale will change with the reduction or enlargement but the other scales become wrong. So one should watch out for maps that have been reproduced and have had their scale changed.
- Remember that the grid lines on a 1:25 000 scale map are 1km apart. A quick way of estimating distance is to count each square you cross in a straight line. If going diagonally the distance across the grid square is about 1½km.
- There are other ways to measure map distance using a romer or map measurer. A romer is a ruler that is scaled with a specific map scale. Instead of reading in cm and converting, one can read the distance directly. But the romer must have the same scale as the map is being used. A map measurer is a mechanical or electronic tool with a small wheel that you run

over the map. You can then read off the converted distance. Again, check the manual to make sure you are using the correct scale conversions.

1.10. DIRECTION ON MAPS

Similar to distance, direction is difficult to measure on maps due to the distortion produced by projection systems. Nevertheless this distortion is somewhat small on maps having scales larger than 1:125,000. Direction is usually measured relative to the location of North or South Pole. Directions determined from these locations are said to be relative to True North or True South.

1.10.1. Direction and Bearings

Directions and bearings are terms we use to communicate where one location is relative to another location. Directions uses the four points of the compass i.e. North, South, East and West, and bearings uses a system of 360 degrees and a protractor.

We are able to communicate where one location is relative to another with the help of these two approaches. For example, Mumbai is south of Ahmedabad and Alibag is south of Mumbai.

There are four points of the compass, North, South, East and West. Importantly, North does not mean up in the sky, but means the direction that a compass points to as magnetic north (which is a location near the North Pole). Based on this being north, the opposite is south (hence the South Pole), and east and west are directions that move us around the earth parallel to the poles.

As we know that there are eight major directions that we commonly use. The first four, North, South, East and West are called the cardinal directions. Another four equal divisions such as Northeast, Southeast, Southwest and Northwest, are called Primary Inter Cardinal directions. A direction between two points, for example a direction halfway between North and East, is called North East. Similarly, a direction halfway between West and South would be called South West. Occasionally, sixteen directions are used such as WSW = West-southwest

So we can see there are sixteen divisions. With so many directions, it turns out to be utter confusing. Hence, we use numbers called bearings. There are 360° of bearings. The number would have been more had we used decimals. So commonly we use only 360.

All of these bearings and directions appear on magnetic compasses, which are used to figure out directions and calculate exact bearings. Many people use GPS systems instead of compasses today. But a simple protractor can be used to calculate bearings on a diagram or map.

1.10.2. Bearings

- **Definition:**

Bearing is a horizontal arc or angle measured from a north reference line, in a clockwise direction, to a point of interest some distance away from the point of measurement.

Bearings are a more precise way to indicate direction. We use a protractor to measure it. We know that a circle has 360 degrees, with 180 degrees in each half of the circle. A bearing will be a number, between 0 and 360 degrees, which represents the direction that one location is when viewed from a starting location.

The most important part regarding bearings is that everyone should calculate them the same way. If calculated differently error may occur because one person may think it is 180 degrees, when it may appear as 360 degrees to another or something different entirely.

1.10.3. How to see bearings

Bearings are always calculated based on north being zero degrees, and degrees are then counted moving clockwise around the circle from there. Bearings can be seen using a protractor. The following depicts steps involved in seeing a bearing between two points:

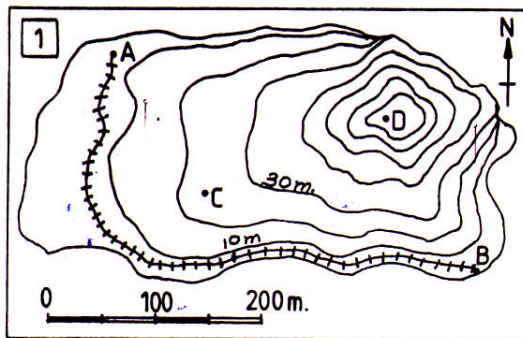
- Draw a line between the two points which will be long enough to see using your protractor.
- Place the protractor on the map, with 0 degrees pointing north, and the centre of the protractor on the starting location.
- Read on the protractor the degrees that the line between the two points follows. If your protractor only has 180 degrees, where the bearing is greater than 180 degrees, you may need to measure the angle from 360 to your line, and then subtract that from 360 degrees in order to calculate the bearing.

1.10.4. Common errors

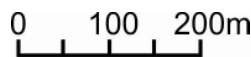
- i. A common error with directions is getting the north, south, east and west labels in the wrong points on the compass.
- ii. Not placing the protractor on the starting point for determining the bearing of the second point.
- iii. Not placing the protractor with zero pointing north as indicated by the orientation on the map.
- iv. Incorrectly calculating a bearing when it is greater than 180 degrees. If the direction is between south and north on the western side, the bearing must be greater than 180 degrees and less than 360 degrees.

Location, Distance & Direction -

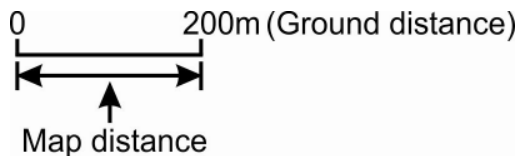
Q.1 Study the following map and answer the following questions.



- 1) Identify the type of scale given in the map.
Ans - Linear or Graphical scale is given in this map.
- 2) Convert the given scale into R.F.
Ans - Let us redraw scale.



This is linear scale. In this scale length of line is 4cm and measurement of distance on the ground is 200m.



Hence 4cm to 200 m or 1cm to 50 m ($200 \div 4 = 50$)

Verbal Scale = 1cm to 50m

Let us prepare simple table to convert 50m into cm

K	H	D	M	D	C	M

K = Kilometer, H = Hectometer, D = Decameter, M = Meter
D = Decimeter, C = Centimeter, M = Milimeter

You can remember all these in the form of simple sentence.

Kind Hearted Daddy Mummy Didi Call Me

OR

Khoi Hui Duniya Me Dusara Kaun Mera

खोई हुयी दुनिया में दुसरा कौन मेरा.

K	H	D	M	D	C	M

Verbal scale - 1cm to 50m.

In order to prepare R.F. or Representative Fraction (R.F) it is necessary that both numbers 1(cm) and 50(m) must be in the same unit. It is necessary to convert 50m into cm.

Consider following number 50, 50., 50.0 all three numbers are same. Complete numbers. So we can give dot (decimal point) after 50.D and this dot represent meters. In our table line to the right side of the words (K, H, D, M, D, C, M) is the decimal line for that word.

Put number 50m in the table.

K	H	D	M	D	C	M
		5	0			

We want to convert 50m into centimeters. Decimal line for centimeters is to the right side of word 'C'.

Put decimal point on the line.

K	H	D	M	D	C	M
		5	0			

Now cancel decimal point of meter and put zero in the 'D' and 'C' columns.

K	H	D	M	D	C	M
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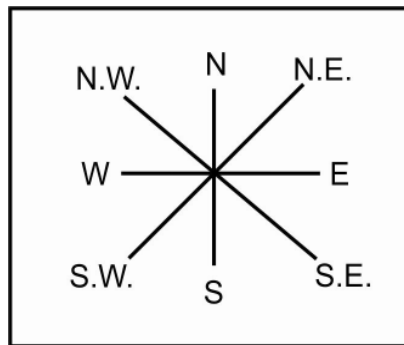
		5	0	×	0	0	
--	--	---	---	---	---	---	--

Hence 50m = 5000cm. Hence our scale is 1cm to 5000cm
so

R.F. is 1 : 5000

3) State the direction of 'B' from 'A' and direction of 'A' from 'B'.

Answer - Direction



'B' is to the South East of 'A'. 'A' is to the North West of 'B'.

4) Measure the straight line distance between 'A' and 'B'.

Answer - Measure distance between 'A' and 'B' points on the map it is 7.5cm.

Our scale is 1cm to 50m.

Hence 7.5cm are equivalent to $7.5 \times 50 = 375.0$ m.

Hence distance between 'A' and 'B' is 375m.

5) Measure distance between 'A' & 'B' along the railway track or find out the length of railway route represented in the map.

Answer - Use thread to measure distance between 'A' & 'B' points along the railway route keep thread attached to railway line & turn it as railway route turns or bend. This distance is 11.0 cm & so as per scale 1cm to 50m. 11.0cm are $11 \times 50 = 550$ m. Hence the length of railway route is 550m.

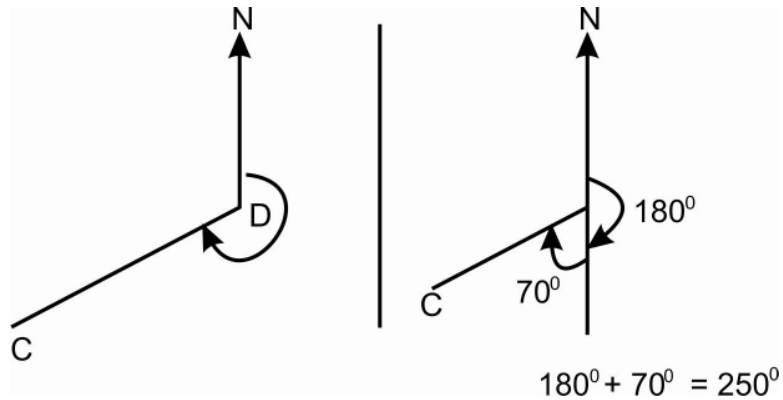
6) What is the height of point 'D'?

Answer - It is about 70m. (To find out height of point 'D' give values to all unnumbered contours.)

7) Find out the bearing of 'C' from 'D'.

Answer - Draw north direction at 'D' by drawing line parallel to north at 'D'.

Now measure angle of 'C' from north direction in the clockwise direction.



8) Find out total area covered by the map.

Ans. Area = Length x Width
 = 9.5cm x 6.0cm
 (Rectangular frame of map)

Scale is 1cm to 50m.

So 9.5cm = 9.5 x 50 = 475.0M &

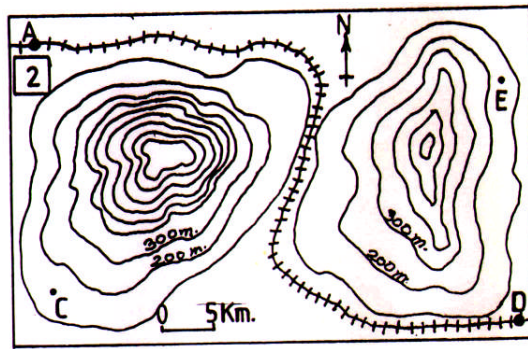
6.0cm = 6.0 x 50 = 300.0m

Hence area is 475 x 300 = 142,500 sq.m

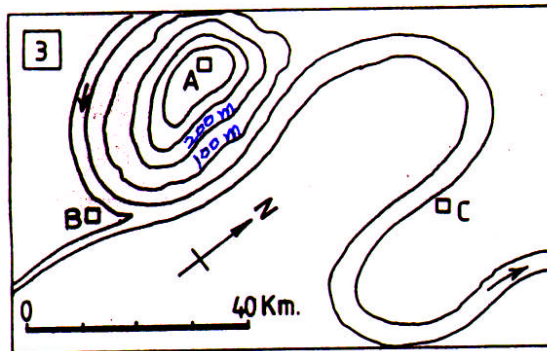
Exercise -

Answer questions related to map no. 2, 3 & 4. With reference to the maps given below.

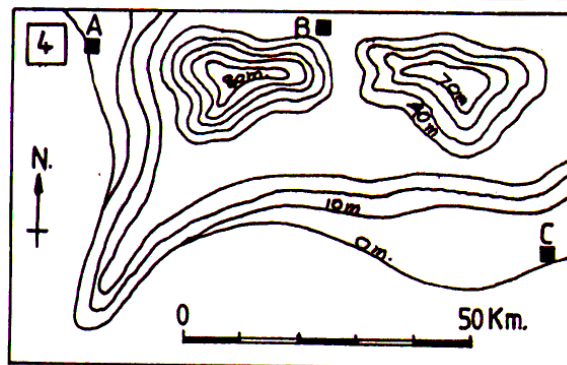
Map 2



Map 3



Map 4



Map 2 Questions -

- 1) Measure the length of railway route.
- 2) State the direction of 'A' from 'C' and 'D'.
- 3) State the bearings of 'A', 'C' and 'D' from 'E'.
- 4) State the maximum height represented in the map.
- 5) State the contour interval (Ans - $300\text{m} - 200\text{m} = 100\text{m}$)
- 6) Find out total area covered by the map.
- 7) Convert scale of the map into R.F. & Verbal scale.

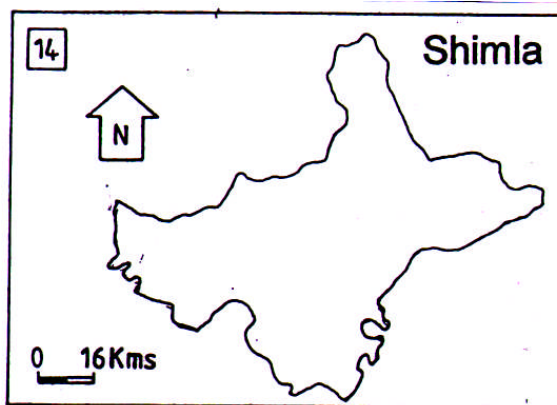
Map 3 Questions -

- 1) Measure the length of main river.
- 2) State the directions of 'A' & 'B' from 'C' (Please note the direction of North)
- 3) State height of point A.
- 4) Find out straight line distance between A-B, A-C and B - C.
- 5) Find out bearing of 'A' & 'B' from 'C'.

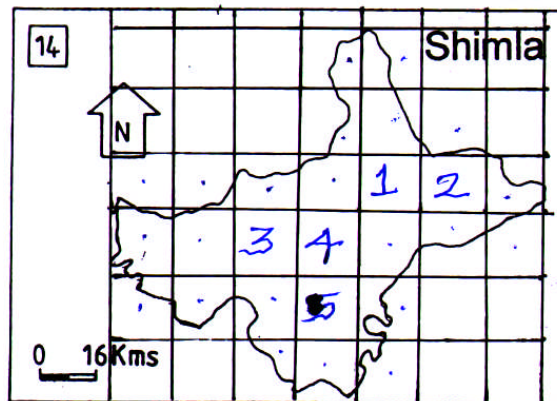
Map 4 Questions -

- 1) Identify major landform represented in the map (Ans. Sea-cliff in S.W. corner of the map. Zero m. contour line means sea level)
- 2) What type of scale is drawn on the map convert it into R.F.
- 3) State the directions & bearing of 'B' & 'C' from 'A'.
- 4) Use blue colour to represent sea (beyond zero meters) green between 0 m to 30 m & yellow from 30 m to 60 m.

Area Calculation (1) Grid Method -



Q.1 Find out area of Shimla. Use grid method.



Answer -

- 1) Draw grid of 1cm x 1cm on the map of Shmla.
- 2) Identify full squares. Total number of full squares are 5 (Five).
- 3) Remaining all squares are half squares. Total number of half squares are 22 (Twenty Two).
- 4) Convert half squares into full squares by dividing by 2. Hence $22 \div 2 = 11$
- 5) Total number of full squares are $5 + 11 = 16$ (sixteen)
- 6) Scale of the map is 1cm to 16 kms.
- 7) Using this scale let us calculate are of one square cm.
 $1\text{cm} \times 1\text{cm}$ to $16\text{km} \times 16\text{ km}$
 1sqcm to 256 sq. kms.
- 8) Total number of squares ($1\text{cm} \times 1\text{cm} = 1\text{ sq. cm.}$) are $16 = 16$ sq. cms.
 $\therefore 1\text{sq cm}$ to 256 sq.kms.
 $\therefore 16\text{ sq.cm}$ to 4096 sq kms.

Hence are of Shimla by grid method is 4096 sq. kms.

1.11. AREA CALCULATION ON MAP

1.11.1. Area calculation on map by square method

To calculate the area on a map we should follow the steps below:

Step 1: Work out the area of one grid square on the map.

For example:

If the Scale of the map is 1:50 000, then each cm represents 0.5km

Length: $2\text{cm} \times 0.5\text{km} = 1.0\text{km}$

Width: $2\text{cm} \times 0.5\text{ km} = 1.0\text{km}$

Therefore area of One Grid Square = $1.0\text{km} \times 1.0\text{km} = 1.0\text{ sq. km}$

Step 2: Determine the number of squares that the object occupies.

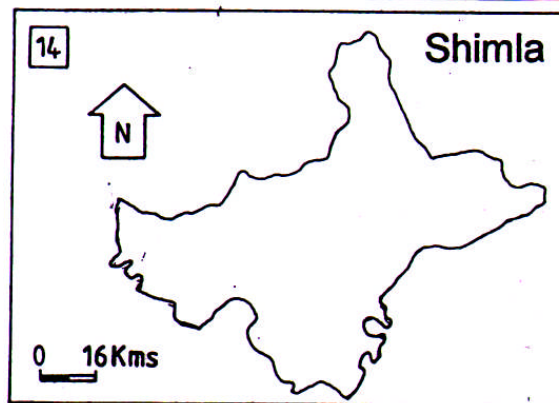
Let us consider the area to be calculated occupies a total of about 0.5 of a grid square.

Step 3: Multiply the number of grid squares that the object occupies by the area of one grid square.

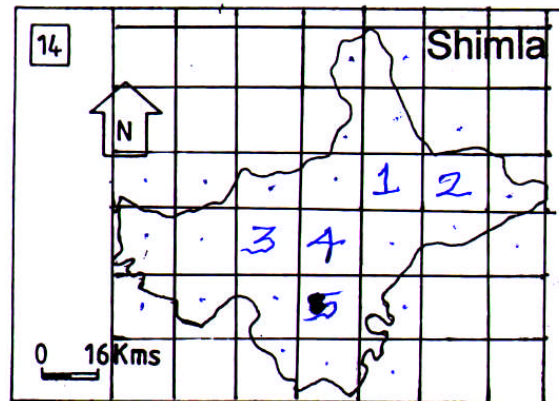
Hence, 0.5 of a square $\times 1.0\text{ sq. km} = 0.5\text{ sq. km}$ is the area

1.11.2. Example of Area calculation square method

Area Calculation (1) Grid Method -



Q.1 Find out area of Shimla. Use grid method.



Answer -

- 1) Draw grid of 1cm x 1cm on the map of Shimla.
- 2) Identify full squares. Total number of full squares are 5 (Five).
- 3) Remaining all squares are half squares. Total number of half squares are 22 (Twenty Two).
- 4) Convert half squares into full squares by dividing by 2. Hence $22 \div 2 = 11$
- 5) Total number of full squares are $5 + 11 = 16$ (sixteen)
- 6) Scale of the map is 1cm to 16 kms.
- 7) Using this scale let us calculate area of one square cm.
 $1\text{cm} \times 1\text{cm}$ to $16\text{km} \times 16\text{km}$
 1sqcm to 256sq. kms .
- 8) Total number of squares ($1\text{cm} \times 1\text{cm} = 1\text{sq. cm.}$) are $16 = 16$ sq. cms.
 $\therefore 1\text{sq cm}$ to 256sq.kms .

∴ 16 sq.cm to 4095 sq kms.

Hence are of Shimla by grid method is 4096 sq. kms.

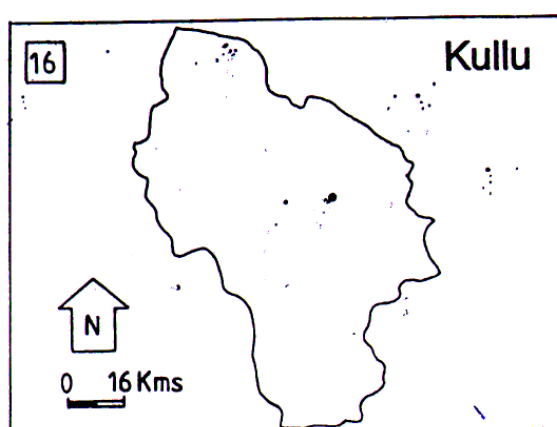
1.11.3. Area calculation on map by strip method

❖ Example

- Calculate the area of the given map in sq. mts with the help of strip method.

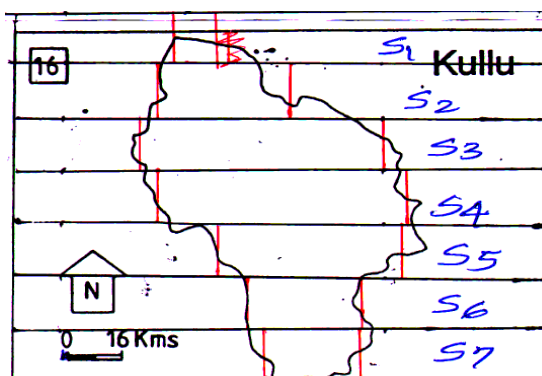
Area calculation (2) Strip Method -

Q.1 Find out area of Kully by strip method.



Answer -

1) Draw grid of 1cm width on the map Kullu.

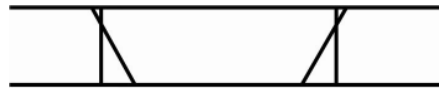


2) Draw Give & take lines for each strip.

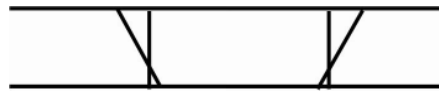
Give & take lines are small vertical lines. These are drawn at the Western & Eastern border of map area for each strip. These lines are used to convert irregular shape of the country / area into regular shape (Rectangle) so the measurement of area becomes easy.

3) Give & take lines are drawn vertically (i.e. Perpendicular to the horizontal lines) These lines are drawn with proper judgement that the portion of map included in the rectangle and excluded from rectangle are almost same. Hence these lines are known as Give & take lines. Consider following examples.

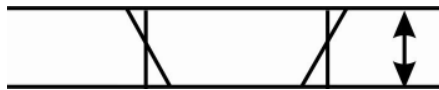
A)



B)



C)



- A) Wrong - Extra area is included.
 B) Wrong - More area is excluded.
 C) Correct Method - Area included & area excluded are same.

4) Give numbers to all strips as S-1, S-2....

5) Measures length of all strips.

$$S_1 = 0.7cm, S_2 = 2.2cm, S_3 = 4.0cm$$

$$S_4 = 4.1cm, S_5 = 3.0cm, S_6 = 1.9cm$$

$$S_7 = 1.6cm$$

7) Find out total length of all strips.

$$\begin{aligned} \text{Total length} &= S_1 + S_2 + S_3 + S_4 + S_5 + S_6 + S_7 \\ &= 0.7 + 2.2 + 4.0 + 4.1 + 3.0 + 1.9 + 1.6 \end{aligned}$$

$$\text{Total length} = 17.5cm$$

8) Width of each strip is 1cm.

9) Total area = Total length x Width (1cm)

$$= 17.5cm \times 1cm$$

$$= 17.5cm$$

10) Scale of the map is 1cm to 16 kms

11) Find out area of 1sq. cms

$$= \text{length} \times \text{width}$$

= 1 cm x 1 cm to 16 kms x 16 kms

1 sq.cm to 256 sq. kms.

12) 1 sq. cm to 256 sq. kms.

∴ 17.5 sq.cm to 4480 sq.kms.

Area of Kullu is 4480 sq.kms.

1.12. SUMMARY:

After going through this unit we may conclude that Map is a diagrammatic representation of an area of land or sea showing physical features, cities, roads, etc. It is a form of human communication that represents geography and culture. Moreover to show distribution of resources and bring out relationship amongst geographic elements map are needed. These are also used as tools for planning urban development along with selection of areas for the construction of dams and highways. There are four parts of a map such as Title, Scale, Compass Rose and Key. Title, usually found on the top or bottom of the map, tells us what the map is. Scale states the relationship between distance on a map and actual distance on the earth. Scale may be represented by words (e.g., "one inch equals one mile"), a ratio or fraction (e.g., 1:63,360). Students use a map scale to measure distance between cities and other places on a map. Compass Rose is an object that appears on maps to identify four main directions: North, South, East and West. Key is found on the bottom of the map. The map key tells us what the symbols on the map stand for. Symbols are small pictures on the map used for representing real things on our Earth like mountains, hills, and valleys etc.

Maps can be classified on the basis of scale and contents. Cadastral Maps, Topographical Maps, Wall maps, Chorographical or atlas maps, Astronomical Maps, Geological Maps, Orographic or Relief Maps, Weather and climate Maps, Political Maps, Historical Maps, Social Maps, Population Maps, Economic Maps, Military Maps and Land utilization Maps are the names of different types of maps. At present maps can be enlarged or reduced in many ways. It may be graphical or instrumental. One common method of enlarging and reducing map is the square method. Locations on maps may be done by Four-figure and six figure grid references. Scale on map is used to measure distance between cities and other places on a map. There are many ways by which distances on a map are measured. Similar to distance, direction is difficult to measure on maps. Bearings are a more precise way to indicate direction. We use a protractor to measure it. Area is calculated on map by square method and strip method.

1.13. CHECK YOUR PROGRESS/ EXERCISE

1. True false

- a. Map is a two-dimensional form of the three dimensional earth that represent geography and culture.
- b. The scale of a map tells the reader what they are looking at.
- c. A map legend, or key, helps the reader interpret what is on the map.
- d. While finding the location of any place on a map at first we should measure the length and width of the map.
- e. To get the six-figure grid reference, we have to imagine that the four-figure square is further divided up into tenths.

2. Fill in the blanks

- a. The _____ on the map orients the reader with the cardinal directions, East, West, North, and South, of the map.
- b. _____ maps are drawn to register the ownership of landed property by demarcating the boundaries of fields and buildings etc.
- c. _____ maps, where the world as a whole or in hemisphere is distinctly represented, are used in classrooms.
- d. Land utilization Maps exhibit the _____ and _____ of land use.
- e. A _____ scale will change with the reduction or enlargement but the other scales become wrong

3. Multiple choice question

- a. Every map must have a date because
 - i. it allows the reader to see the size and the distance of the features on the map.
 - ii. this tells the reader when the map was created and without it the reader would not know the relevance of the map.

- iii. it clearly explains what the map maker (cartographer) is trying to show.
- b. There are various ways by which the earth is mapped such as
- i. by actual survey with the help of the instruments like chain, prismatic compass, plane table, theodolite etc., by photographs, by freehand sketches and diagrams and by computer.
 - ii. by multiplying the length and width of the area to be mapped by 2 or 4 respectively if intend to show the area to twice or thrice its original size.
 - iii. By measuring the Bearings of the area to indicate direction with a protractor.
- c. A Social Map
- i. denotes distribution of man over an area.
 - ii. displays the distribution of important centres of agricultural, minerals and industrial products and its linkages with various means of communication.
 - iii. denotes Social organism tribes and races their languages, religions, etc. on maps.

4. Answers the following Questions

1. What are the Basic components of map?
2. What is a map? Elaborate your answer stating different types of maps.
3. State the methods of enlargement and reduction of maps
4. How will you find the location of a place on map?
5. State how to calculate Area on map.
6. Write short notes on:
 - a. Four-figure grid references
 - b. Six-figure grid references
 - c. Distance on map
 - d. Directions on map

1.14. ANSWERS TO THE SELF LEARNING QUESTIONS

- 1.a. true

- 1.b. false, The title of a map tells the reader what they are looking at.
- 1.c. true
- 1.d. false, While enlarging or reducing any map to a given size at first we should measure the length and width of the map.
- 1.e. true
- 2.a. Compass rose
- 2.b. Cadastral
- 2.c. Wall
- 2.d. nature and character
- 2.e. graphic
- 3.a.ii.
- 3.b.i.
- 3.c.iii.

1.15. TECHNICAL WORDS:

1. **Map** -A map is a visual representation of an entire area or a part of an area, typically represented on a flat surface. There are many kinds of maps; static, two-dimensional, three-dimensional, dynamic and even interactive. Maps attempt to represent various things, like political boundaries, physical features, roads, topography, population, climates, natural resources and economic activities.
2. **Grid reference**-a map reference indicating a location in terms of a series of vertical and horizontal grid lines identified by numbers or letters.
3. **Four figure grid** -A four figure grid reference points you towards a particular square on a map. On all OS maps these squares represent one square kilometre. All maps will have lines numbered around the edge
4. **Six figure grid**- Numerical grid references consist of an even number of digits. Eastings are written before Northings. Thus in a 6 digit grid reference 123456, the Easting component is 123 and the Northing component is 456.
5. **Map scale**- it refers to the relationship (or ratio) between distance on a map and the corresponding distance on the ground. For example, on a 1:100000 scale map, 1cm on the map equals 1km on the ground.
6. **Cartographer**- map maker

1.16. TASK

1. Convert Representative Fraction into graphical form in cms. to kms. R.F is 1:7820000
2. Convert Representative Fraction into vertical scale in cms. to kms. R.F is 1:2570000
3. Convert vertical scale into Representative Fraction when vertical scale is 2 cm: 5 kms.

1.17. REFERENCES FOR FURTHER STUDY

- Gupta K. K and Tyagi V. C., 1992: Working with Maps, Survey of India, DST, New Delhi.
- Singh R. L. and Singh R. P. B., 1999: Elements of Practical Geography, Kalyani Publishers
- Sarkar A.K Practical Geography: A Systematic Approach, Oriental Longman, Calcutta, 1997.
- Oxford dictionary



MAP PROJECTIONS

2.0. After going through this chapter you will be able to understand the following features:

- 2.1 Objectives
- 2.2 Introduction
- 2.3 Subject discussion
- 2.4 Concept of Map Projections
- 2.5 Need of Map Projections
- 2.6 Classification and suitability of Map Projections
- 2.7 Construction and properties Map Projections
- 2.8 Graphical methods of drafting selected projections
- 2.9 The different types of projection
 - 2.9.1 Zenithal polar equal area
 - 2.9.2 Zenithal equidistant
 - 2.9.3 Conical one standard parallel
 - 2.9.4 Conical two standard parallel
 - 2.9.5 Cylindrical equal area
 - 2.9.6 Cylindrical equidistant
- 2.10 Summary
- 2.11 Check your Progress/Exercise
- 2.12 Answers to the self learning questions
- 2.13 Technical words and their meaning
- 2.14 Task
- 2.15 References for further study

2.1. OBJECTIVES

By the end of this unit you will be able to:

- Discuss about the Concept of Map Projections
- Understand the Need of Map Projections
- Learn the Classification and suitability of Map Projections
- Understand the Construction and properties of Map Projections
- Learn Graphical methods of drafting selected projections
- Learn Zenithal polar equal area

- Learn Zenithal equidistant
- Learn Conical one standard parallel
- Learn Conical two standard parallel
- Learn Cylindrical equal area
- Learn Cylindrical equidistant

2.2. INTRODUCTION

In this unit we will study about Map Projections its concept, need, classification and suitability, construction and properties. We will learn about Graphical methods of drafting selected projections such as Zenithal polar equal area, Zenithal equidistant, Conical one standard parallel, Conical two standard parallel, Cylindrical equal area, Cylindrical equidistant in the latter part of this unit.

2.3. SUBJECT-DISCUSSION

A reduced model of the Earth that may be a globe or a map is essential for any study in geography. But neither of the two is perfect, as a globe is seldom practical, and flat maps are never free from errors. Maps are important and indispensable tools to geographers that help them understand important things about the surface of the Earth in a visual way. It is a two dimensional description of a specific area of land. Maps describe in a visual or graphic format certain key features of the territory being examined. A map projection is a systematic transformation of the latitudes and longitudes of locations from the surface of a sphere or an ellipsoid into locations on a plane. Maps cannot be created without map projections. All map projections necessarily distort the surface in some fashion.

2.4. CONCEPT OF MAP PROJECTIONS

A map projection is a mathematical formula used to transfer all or part of the curved surface of the earth onto the flat surface of a map.

2.5. NEED OF MAP PROJECTIONS

We know that the shape of the Earth is an oblate spheroid or an ellipsoid. A globe is a scaled down model of the Earth. Even though globes are capable of representing size, shape, distance and directions of the Earth features with reasonable accuracy, they are not suitable for many applications. They are hard to transport and store, not suitable for use at large scales, expensive to produce. Moreover, measuring terrain properties is difficult on a

curved surface and it is quite impossible to view large portions of the Earth at once. Nevertheless maps do not suffer from these shortcomings. They are more practical in most applications if compared to globes.

So to portray a curved plane that is the globe on a 2 dimensional plane or a map we need to construct a "projection" to alter the curved space and make it flat. Hence to give an accurate view of the Earth in a 2D sense, we need to project the Earth on to a reference point.

2.6. CLASSIFICATION AND SUITABILITY OF MAP PROJECTIONS

Down the ages cartographers have developed innumerable map projections among them three large families of map projections and several smaller ones have been acknowledged. These are based on the types of geometric shapes that are used to transfer features from a sphere to a plane. It may be said that Map projections are based on developable surfaces, and the three traditional families consist of cylinders, cones, and planes. Now the question arises that which developable surface should be used for a projection. It depends on what region is to be mapped, its geographical extent, and the geometric properties that areas, boundaries, and routes need to have, given the purpose of the map.

Now we have come to know that three classes of map projections are cylindrical, conical and azimuthal. The earth's surface projected on a map wrapped around the globe as a cylinder produces the cylindrical map projection. Projected on a map formed into a cone gives a conical map projection. When projected on a planar map it produces azimuthal or zenithal map projections.

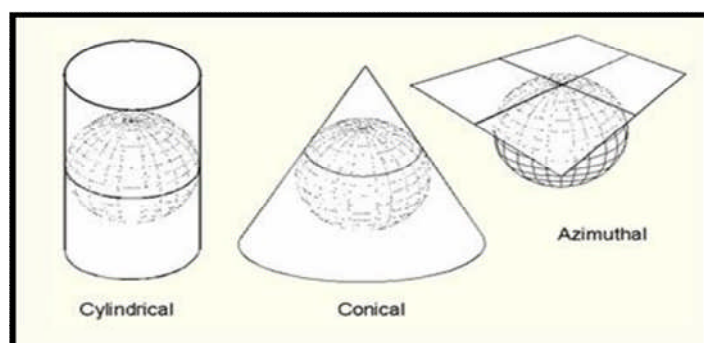


Fig showing Three classes of map projections: cylindrical, conical and azimuthal.

2.7. CONSTRUCTION AND PROPERTIES OF MAP PROJECTIONS

❖ The construction of a map projection involves three steps:

- Selection of a model for the shape of the earth or planetary body (usually choosing between a sphere or ellipsoid)
- Transformation of geographic coordinates (longitude and latitude) to plane coordinates (eastings and northings or x, y)
- Reduction of the scale

❖ Map projection properties:

The five essential map projection properties are shape, distance, direction, scale, and area. These map projection properties came into being when there is conversion from a three-dimensional object, such as the earth, to a two-dimensional representation, such as a flat paper map. Of them area and shape are considered major properties and are mutually exclusive, that is if area is held to its true form on a map, shape must be distorted, and vice versa. But distance and direction are minor properties that may coexist with any of the other projection properties. Nevertheless, distance and direction cannot be true everywhere on a map. A map can never show all the map projection properties, true direction, true distance, true area, and true shape at the same time. It may exhibit one or more map projection properties in one attempt.

Whenever we create a flat map of a three-dimensional object such as earth distortions occur. But it is not constant across the map. It is observed that distortion may take different forms in different parts of the map like it is usually less near the points or lines of intersection where the developable surface intersects the globe.

Different families of map projections aim to preserve at least one of the map projection properties. It is discussed below:

- The equal area map projection, aims to preserve the area relationships of all parts of the globe and here the meridians and parallels are not at right angles to each other. Moreover, distance distortion is usually present on equal area map projection, as well as shape is often skewed. However it is useful for general quantitative thematic maps.
- The Conformal map projections, also known as orthomorphic map projection, preserve angles around points, and shape of small areas. In Conformal map projections meridians intersect parallels at right angles, areas are distorted significantly in small scales, and shapes of large regions may be severely distorted.

- The Mercator projection is a conformal map projection that preserves shape.
- The equidistant map projection aims to preserve great circle distances meaning a distance can be held true from one point to all other points, or from a few select points, to others, but not from all points to all other points. Identifying marks of the equidistant map projection are that they are neither conformal nor equal area, and look less distorted. Equidistant map projections are useful for general purpose maps and Atlas maps.
- The azimuthal map projection, also known as the true direction map projection, preserves direction from one point to all other points in the map. Azimuthal map projection is most useful for preserving direction two or one from point, often used for navigation.

2.8. GRAPHICAL METHODS OF DRAFTING SELECTED PROJECTIONS

Map projection is the method of transferring the graticule of latitude and longitude on a plane surface. It can also be defined as the transformation of spherical network of parallels and meridians on a plane surface. As we know that, the earth on which we live in is not flat. It is geoid in shape like a sphere. A globe is the best model of the earth. Due to this property of the globe, the shape and sizes of the continents and oceans are accurately shown on it. It also shows the directions and distances very accurately. The globe is divided into various segments by the lines of latitude and longitude. The horizontal lines represent the parallels of latitude and the vertical lines represent the meridians of the longitude. The network of parallels and meridians is called graticule. This network facilitates drawing of maps. Drawing of the graticule on a flat surface is called projection.

But a globe has many limitations. It is expensive. It can neither be carried everywhere easily nor can a minor detail be shown on it. Besides, on the globe the meridians are semi-circles and the parallels are circles. When they are transferred on a plane surface, they become intersecting straight lines or curved lines.

2.9. THE DIFFERENT TYPES OF PROJECTION USE ARE AS FOLLOWS

2.9.1. Zenithal Polar Equal Area Projection

In this projection, a 2 dimensional plane of projection touches the generating globe at either of the poles. The meridians are straight lines drawn at true azimuth apart radiating from the

pole. At any point the product of the two principal scales is unity. The parallels are spaced with varying radii in such a way that area on the projection exactly conforms to the area on the earth's surface.

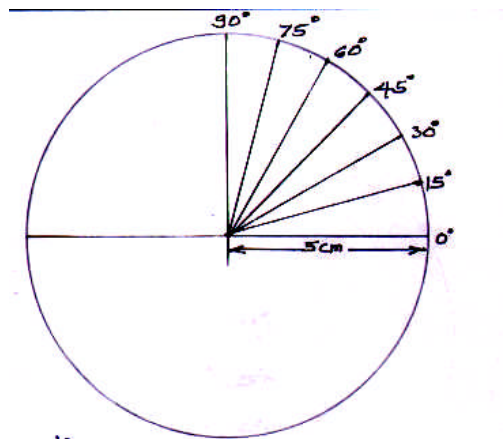
Zenithal Polar Equal Area Projection -

Draw Zenithal Polar Equal Area Projection with the help of following details.

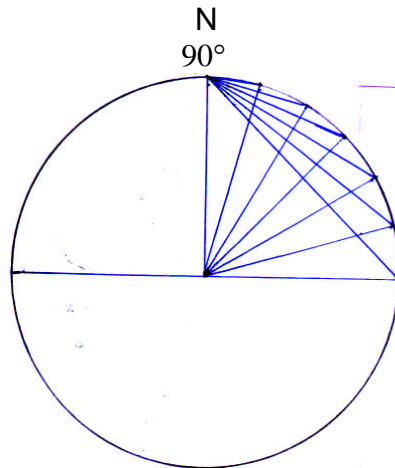
- Radius of the globe = 5cm.
- Latitudinal distance (interval) = 15°
- Longitudinal interval = 30°

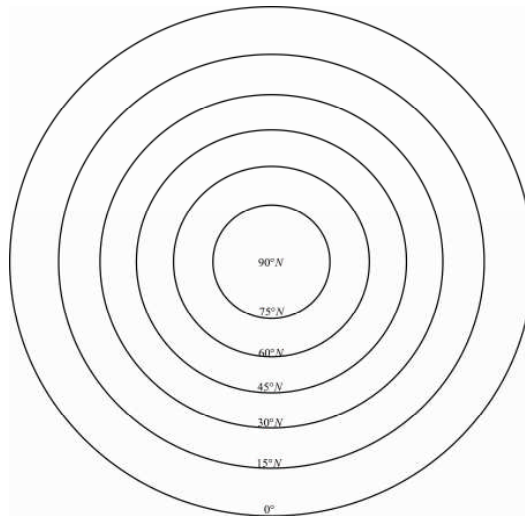
Draw projection for northern hemisphere.

- 1) Draw circle of 5cm radius to represent Earth
- 2) Latitudinal interval is 15° & so draw sever lines at the interval of 15° from Equator to Pole.

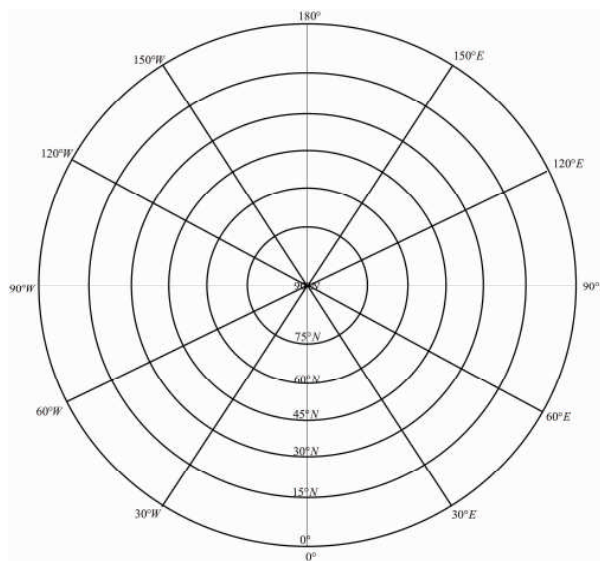


Draw lines connecting 90°N. To equator (0°), 15°, 30°, 45°, 60° & 75° as shown in the diagram. Take these distances as radius & draw concentric circles to represent latitudes.





- 3) Longitudinal interval is 30° & so draw straight vertical line at the center of concentric circles. Keep protractor near to this line & take angles at an interval of 30° - i.e. $0^\circ, 30^\circ, 60^\circ, 90^\circ, 120^\circ, 150^\circ, 180^\circ$



- 4) Give numbers to all longitudes.

Properties:-

- 1) The parallel are concentric circles. The pole is a point forming the centre of this projection.
- 2) The meridians are straight lines radiating from the pole. They are spaced correctly at true angular interval i.e. the azimuths are true in this projection.
- 3) The meridians intersect the parallels at right angle.
- 4) The scale along the parallels increases away from the centre of the projection.

- 5) The distance between the parallels go on decreasing away from the centre of the projection. It means there is a decrease in the scale along the meridians towards the margin of the projection. The decrease in the scale along the meridians is in the same proportion in which there is increase in the scale along the parallels away from the centre of the projection with the result that the projection is equal area.
- 6) Shapes are more and more distorted away from the centre of the projection because the scale along the meridians is too small and that along the parallels is too large. The shape compressed along the meridians but stretched along the parallels.
- 7) The shape of the central area of the projection is represented in a satisfactory way for here the shapes are very slightly distorted.
- 8) Shapes are distorted away from the centre of the projection, hence only central part of the projection can be presented in a satisfactory way.

Advantages:-

- 1) It is used for preparing political and distribution maps of Polar Regions. (Shapes of the countries in the central part are preserved).
- 2) Used for the general purpose maps of large areas in the northern hemisphere.

Disadvantages:-

- 1) Shapes of objects are distorted more and more as you proceed from the centre of the map outward.
- 2) Distances are not accurately represented except along the one or two base parallels (latitudes).

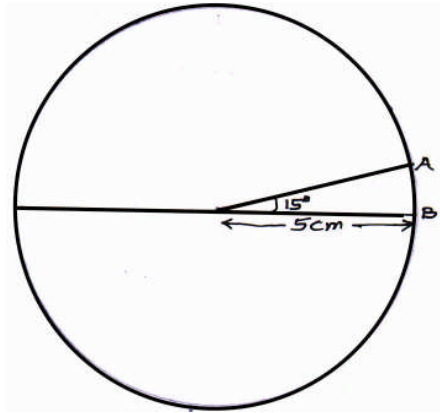
2.9.2. Zenithal Polar Equi-Distant Projection

In this projection, a 2 dimensional plane of projection touches the generating globe at either of the poles. The radial scale along a meridian is truly maintained so that parallels are equi-distant on the meridians. True azimuth at the pole is preserved in spacing circles while meridians are straight lines radiating from the poles.

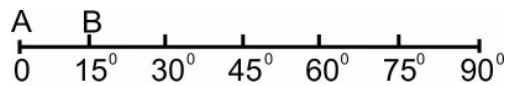
Draw Zenithal Polar Equidistance projection -

- 1) Radius of the globe = 5cm
- 2) Latitudinal interval = 15°
- 3) Longitudinal interval = 30°
- 4) Extent - Northern Hemisphere.

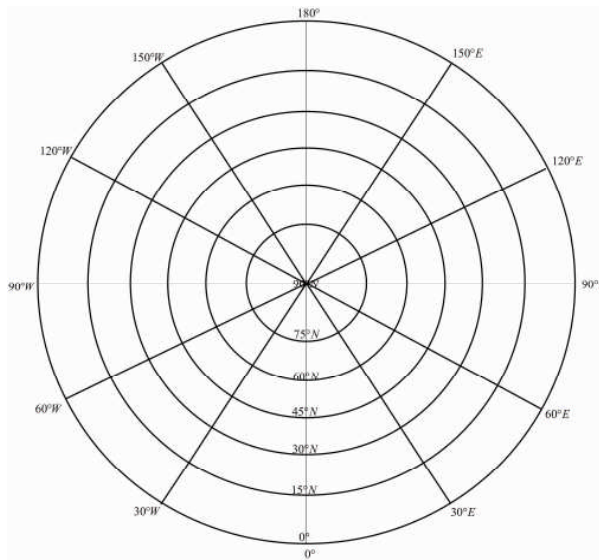
1) Draw circle of 5cm radius Latitudinal interval is 15° . hence draw line at the interval of 15° .



2) To draw latitudes at an interval of 15° draw straight line & mark six divisions of an interval of A - B to represent $0^{\circ}, 15^{\circ}, 30^{\circ}, 45^{\circ}, 60^{\circ}, 75^{\circ}$ & 90° .



3) Take these distances as radius & draw concentric circles to represent parallels of latitudes.



4) Draw longitudes at an interval of 30° . Give number to all parallels of latitudes & meridian of longitude.

Properties:-

1) The parallels are concentric circles. The pole is a point forming centre of the projection.

- 2) The meridians are straight lines radiating from the pole and space correctly at true angular interval i.e. azimuths are true in this projections.
- 3) The meridians intersect the parallels at right angles.
- 4) Since the spacing between the parallels represents true distance the scale along the meridian is correct.
- 5) The scale along the parallels increases away from the centre of this projection.
- 6) The areas are exaggerated and shapes distorted exaggeration and distortion increasing away from the centre of the projection.
- 7) The projection is neither equal- area nor orthomorphic.
- 8) Shape being greatly distorted away from the centre of the projection, it is only a small area in the central part of the projection that can be represented in a satisfactory way. The area lying between the pole and 60 degree parallel is shown satisfactorily.

Advantages:-

- 1) This projection is commonly used for preparing maps of polar areas used for general purposes.
- 2) Since the scale along the meridians is correct, narrow strips running along the meridians are shown fairly correctly.

Disadvantages:-

- 1) The distortion increases away from the equator.
- 2) This projection is not orthomorphic. So the shape of countries is not same as on the globe.

2.9.3. Conical one standard parallel

A conical projection is one, which is drawn by projecting the image of the graticule of a globe on a developable cone, which touches the globe along a parallel of latitude called the standard parallel. As the cone touches the globe located along AB, the position of this parallel on the globe coinciding with that on the cone is taken as the standard parallel. The length of other parallels on either side of this parallel are distorted.

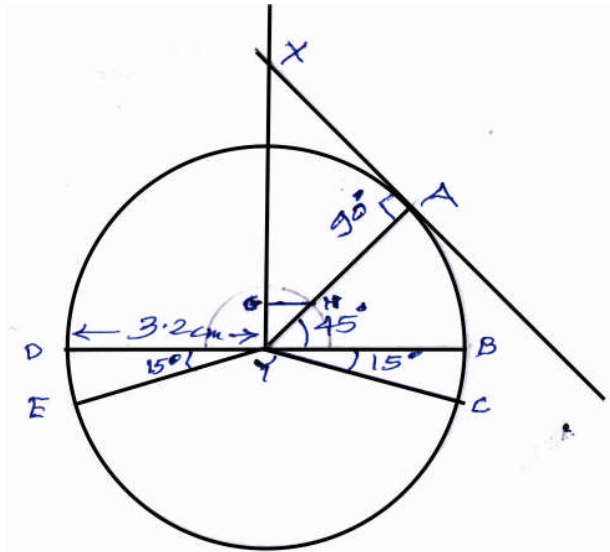
Conical one standard parallel projection

- 1) $R = 3.2\text{cm}$
- 2) Standard Parallel = $45^\circ N$.
- 3) Latitudinal interval = 15°
- 4) Longitudinal interval = 15°
- 5) Extent - Longitudinal - $75^\circ E$ to $75^\circ W$.

Answer -

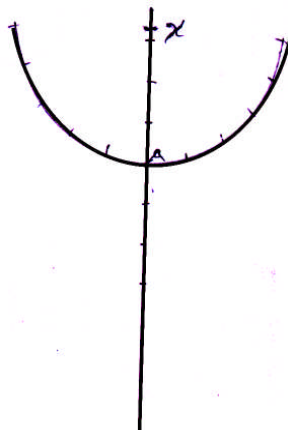
Draw circle of 3.2 cm.

Draw angles of 90° 45° N.
 Draw XA line perpendicular to the line of 45° .



Draw angles of 15° BYC and DYE for Latitudinal & longitudinal intervals. Take a distance / measurement DE on the compass & draw semi circle at Y. The line of semicircle will intersect line of 45° . From this point draw line perpendicular to XY line. This distance GH is for our longitudinal interval of 15° (at 45° N)

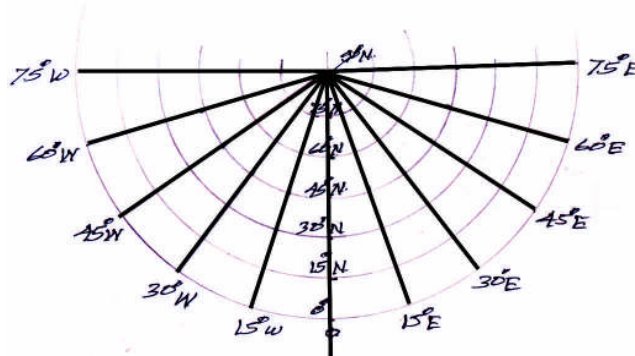
Draw straight line for drawing final projection. Mark point X
 Take a distance / radius XA on the compass and draw semicircle.



A is at 45° N. Our extent is from 0° to 90° N. Sol take a distance of BC on the compass & mark divisions of 15° to the north and south of 45° N. (3 - 3 divisions) Take a distance of GH on the compass & mark 5 divisions on either sides of XA line on 45° N. (Standard parallel) for longitudes.

Draw curves from X for all markings on XA line to represent latitudes.

Draw straight lines from markings on 45° N. line to point X to represent Latitudes.



Properties:-

- 1) The parallels are concentric arcs of circles. The pole is represented by an arc.
- 2) The meridians are straight lines.
- 3) The meridians intersect the parallel at right angle.
- 4) The distance between any two parallels on these projections is true. Thus scale along all the meridians is correct.
- 5) The distance between the meridians decreases towards the poles, i.e. the meridians are closer to each other towards the poles.
- 6) The scale is correct along the standard parallel but very large along other parallels, the exaggeration increase away from the standard parallels. Thus areas lying adjacent to the standard parallels are fairly correct on these projections.
- 7) This projection is neither equal-area nor orthomorphic.
- 8) The scale along the meridians is true. But it goes on increasing along the parallels away from the standard parallel. Therefore, away from the standard parallel, areas are exaggerated and their shapes distorted. It is suitable only for a narrow strip of lands lying adjacent to the standard parallel.

Advantages:-

- 1) This projection is commonly used for showing areas of mid-latitudes with limited latitudinal and larger longitudinal extent.
- 2) A long narrow strip of land running parallel to the standard parallel and having east-west stretch is correctly shown on this projection.

- 3) Direction along standard parallel is used to show railways, roads, narrow river valleys and international boundaries.
- 4) This projection is suitable for showing the Canadian Pacific Railways, Trans-Siberian Railways, international boundaries between USA and Canada and the Narmada Valley.

Disadvantages:-

- 1) It is not suitable for a world map due to extreme distortions in the hemisphere opposite the one in which the standard parallel is selected.
- 2) Even within the hemisphere, it is not suitable for representing larger areas as the distortion along the pole and near the equator is larger.

2.9.4. Conical Two Standard Parallel

In this projection, a simple right circular cone is taken as the projection plane. Two circles of the cone correspond to two different parallels on the generating globe and form an ordinary cone independent of the globe. These are the standard parallels which are so selected as to cover two-thirds of the latitudinal extent of the area to be mapped. The parallels appear as concentric arcs of circle while meridians appear as straight lines converging at the vertex of the cone.

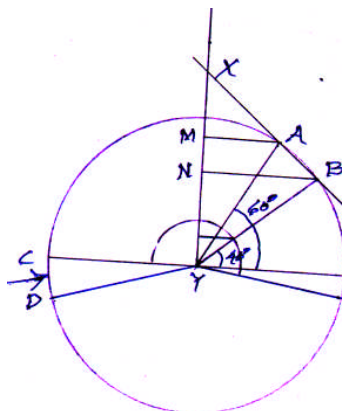
Conical Two Standard Parallel Projection -

$R = 3.2\text{cm}$ Standard Parallels - $40^\circ N$ & $60^\circ N$. Lat interval = 10° , Longitudinal interval = 15°

Extent - Lon - $90^\circ E$ to $90^\circ W$ -

Lat - 0° to $90^\circ N$

Draw globe with a radius of 3.2cm.



Draw XY perpendicular line and AY, BY lines at an angles 60° & 40° respectively. Join AB points & extend line upto the perpendicular line, to get X point.

Draw lines AM and BN perpendicular to XY line from points A & B. In order to find out distance between A & B we can use following formula

$$AB = 2\pi R \times \frac{20^\circ \rightarrow (60^\circ - 40^\circ)}{360^\circ}$$

$$\pi = 3.14 \quad R = 3.2 \text{ cm}$$

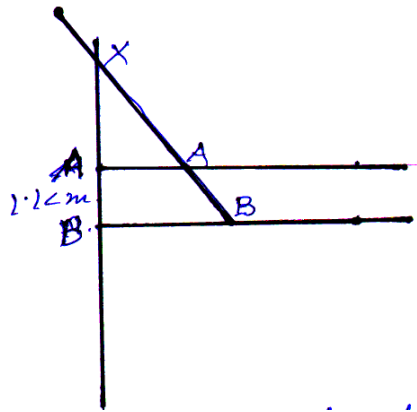
$$AB = 2\pi R \times \frac{1}{18}$$

$$= 1 \times 3.14 \times 3.2 \times \frac{1}{9}$$

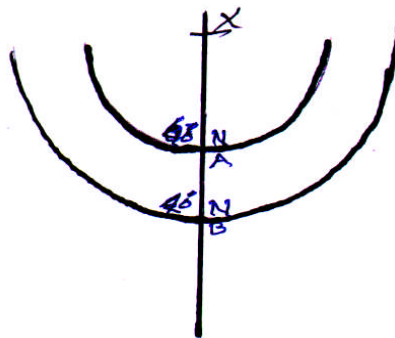
$$= \frac{3.14 \times 3.2}{9}$$

$$= 1.1 \text{ cm}$$

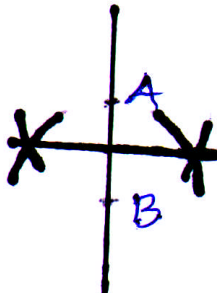
Draw straight vertical line take a distance of 1.1cm.



Draw lines perpendicular from A & B take measurement MA & NB on these lines to get points M & N. Join M, N points & extend line to get X point. Take XA distance on the compass & draw semicircle to represent standard parallel 60° & take XB distance on the compass & draw semicircle to represent 40° N.

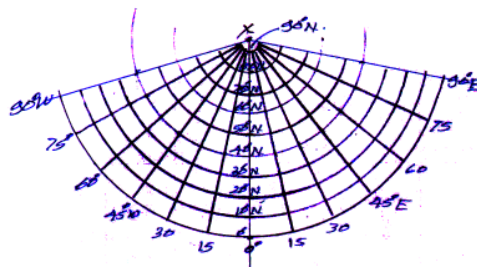


Take distance A-B = 1.1cm on straight line & draw curves on either side with measurement of radius as 1.0cm.



We get two equal divisions of AB (latitudinal interval of 10°). Mark these divisions of 10° on the vertical line to represent latitudes from 0° to 90° N. (Use strip of paper)

Draw semi circle at Y with radius equal to CD. This semicircle will intersect YB line (40° N) draw line perpendicular to XY line from this point. (This procedure is same as conical one standard. Parallel projection) Complete projection & give names to all latitudes & longitudes.



Conical Two Standard parallels projections.

Properties

- 1) The parallels are concentric arcs of circles. The pole is represented by an arc.
- 2) The meridians are straight lines.
- 3) The meridians intersect the parallels at right angles.
- 4) The meridians are correctly divided for spacing the parallels. The scale along all the meridians is, therefore, correct.
- 5) The scale is correct along the standard parallels and relatively large along all other parallels. This projection is therefore, suitable for an area which has small extent in latitude only. In such a case those standard parallels are chosen which are quite close to each other. We thus eliminated to some extent the inaccuracy caused due to different scales of the parallels lying between the standards parallels and outside the standard parallels.

- 6) A belt of an area having very small latitudinal extent but great longitudinal extent can be shown quite satisfactorily on this projection.
- 7) This projection is neither equal-area nor orthomorphic.
- 8) The scale being either too large or too small along the parallels other than the standard parallels are far away from the standard parallels are not accurately represented on this projection. Therefore, for better representation, an area should be of small latitudinal extent.

Advantages:-

- 1) This projection is used for general purpose of maps.
- 2) A long narrow strip of land running in the east-west direction is shown fairly correctly on this projection. The Canadian pacific Railway, Trans-Siberian Railway and international boundary between U.S.A and Canada can be shown fairly accurately on this projection, the accuracy being more than it is in the case of conical projection with one standard parallel.
- 3) The projection is quite satisfactory for showing small countries having small latitudinal extent.

Disadvantages:-

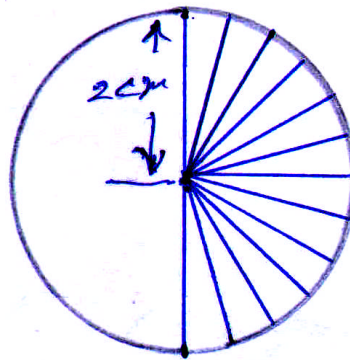
- 1) Being neither equal-area nor orthomorphic this projection is not used for a specific purpose.
- 2) It is not used for displaying large areas because distortion became greater and greater the further we move from the lines where the cone intersects the globe.

2.9.5. Cylindrical Equal Area Projection

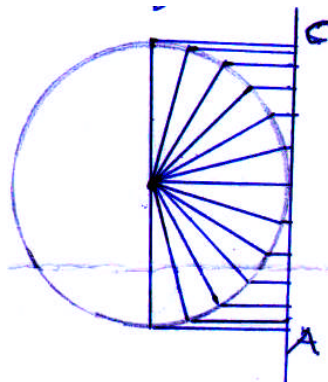
The cylindrical equal area projection, also known as the Lambert's projection, has been derived by projecting the surface of the globe with parallel rays on a cylinder touching it at the equator. Both the parallels and meridians are projected as straight lines intersecting one another at right angles. The pole is shown with a parallel equal to the equator; hence, the shape of the area gets highly distorted at the higher latitude.

R = 2cm
 Lat interval = 15°
 Lon interval = 30°
 Extent = Entire world.

- 1) Draw circle with a radius of 2cm to represent globe. Mark divisions of 15° (Latitudinal interval)



- 2) Draw perpendicular line at equator and transfer all markings for latitudes from the curved surface of globe to straight line.



- 3) Our longitudinal extent is the entire world. Hence the total length of circumference of globe can be calculated using formula

$$C = 2\pi R$$

$$\pi = 3.14 \quad R = 2\text{cm}$$

$$C = 2\pi R$$

$$= 2 \times 3.14 \times 2$$

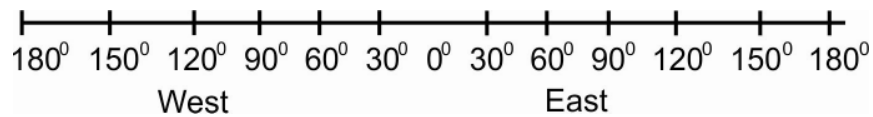
$$= 12.56\text{cm}$$

$$= 12.6\text{cm}$$

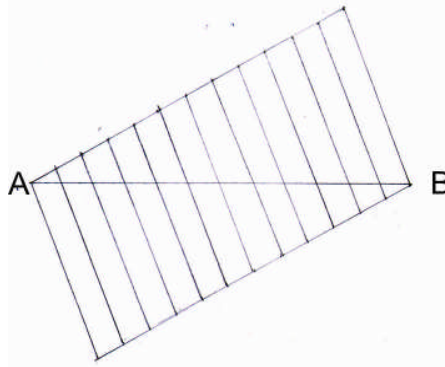
- 4) Rough diagram of our projection.



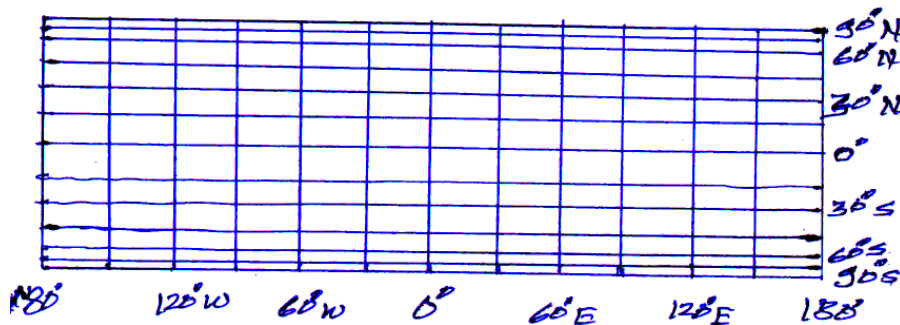
- 5) Our longitudinal interval is 30° . We can draw rough diagram to know total number of divisions (Total 12 divisions).



- 6) Divide line of 12.6cm into 12 equal parts as shown in cylindrical equidistant projection



- 7) Draw rectangle of 12.6cm X 4cm and transfer divisions from AC line (latitudes) and from AB line (longitudes) to get cylindrical equal area projection.



Properties

- 1) All the parallels are of the same length and every one of them is equal to the length of equator.
- 2) The Length of equator on this projection is equal to the length of the equator on the globe. Therefore, the scale along the equator is correct. The parallels are longer than the corresponding parallels on the globe. For an example, 30 degree parallel, 60 degree parallel and 80 degree parallel on this projection are 1.154 times, 2.000 times, and 5.758 times longer than the corresponding parallel on the globe respectively. A pole which is the point on the globe is equal to the length of the equator on this projection. The scale along the parallels is, therefore, exaggerated, the exaggeration increasing away from the equator.

- 3) All the meridians are of the same length and the length of each meridian is equal to the length of the diameter of the globe but their lengths between the parallels go on decreasing towards the poles. Thus, the meridians on this projection are shorter in length than the corresponding meridians on the globe. Their lengths have been shortened in the same ratio in which the parallels are made longer with the result that area of a strip lying between any two parallels on this projection is equal to the area between the corresponding parallels on the globe. Thus, equal-area property is maintained over the entire projection. Therefore, this projection is an equal-area and useful for showing distribution of products.
- 4) In the polar area, the parallels are markedly stretched in the east-west direction and the meridians are shortened greatly in the north-south direction. Consequently the countries are stretched in the east-west direction and compressed in the north-south direction. Thus, there is increased distortion in the shapes of the countries towards the poles. The distortion in the shapes of tropical countries is almost negligible.
- 5) Parallels and meridians are straight lines.
- 6) The meridians intersect the parallels at right angles.
- 7) The distances between the parallels go on decreasing towards the poles but the distances between the meridians remain the same.

Advantages

- 1) This projection is used for showing tropical countries.
- 2) Being an equal-area projection, it is drawn mainly for showing the world distribution of tropical products such as rubber, coconut, rice, cotton, groundnut, etc.

Disadvantages

- 1) Distortion increases as we move towards the pole.
- 2) The projection is non-orthomorphic.
- 3.) Equality of area is maintained at the cost of distortion in shape.

2.9.6. Cylindrical Equi-Distant Projection

This projection is very simple to construct because it forms a grid of equal rectangles. Because of its simple calculations, its usage was more common in the past. In this projection, the Polar Regions are less distorted in scale and area

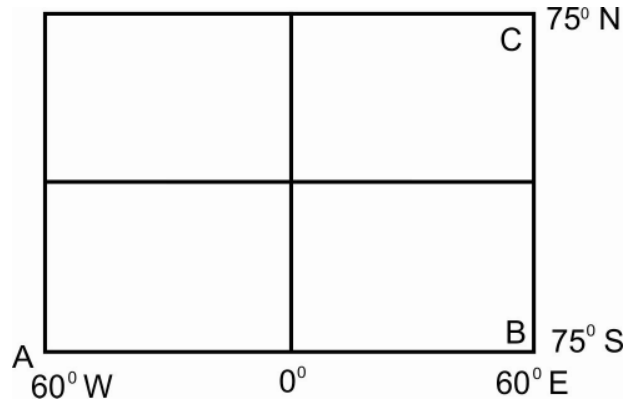
Draw cylindrical Equi-distance Projection.

- 1) Radius of the reduced globe = 3.2cm.
- 2) Latitudinal interval = 15°
- 3) Longitudinal interval = 30°

- 4) Extent - Latitudinal - 75°N Latitude to 75°S Latitude
 Longitudinal extent 60°W to 60°E

Procedure -

- 1) Draw rough diagram for understanding extent of the map.

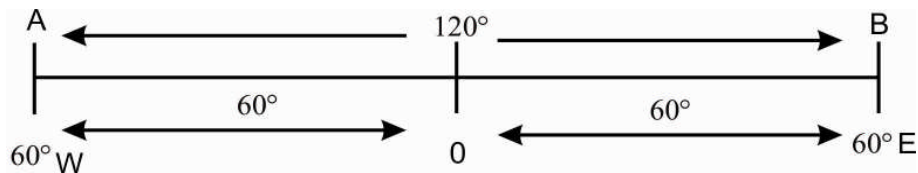


- 3) For latitudinal extent find out measurement of distance B-C & for longitudinal extent A-B.

$$R = 3.2\text{cm} \quad \pi = 3.14$$

$$\odot = 2\pi R$$

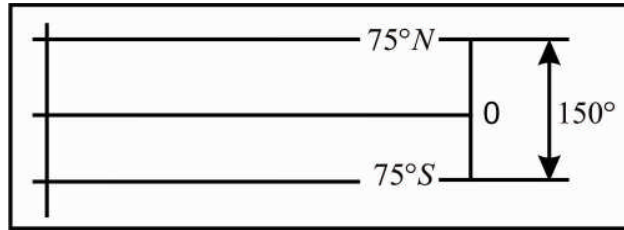
$$AB = 2\pi R \times \frac{120}{360}$$



Distance AB covers angular distance of 120° on the earth's surface.

$$\begin{aligned} AB &= 2\pi R \times \frac{120}{360} \\ &= 2 \times 3.14 \times 3.2 \times \frac{1}{3} \\ &= \frac{2 \times 3.14 \times 3.2}{3} \\ &= \frac{20.096}{3} \\ &= 6.7\text{cm} \end{aligned}$$

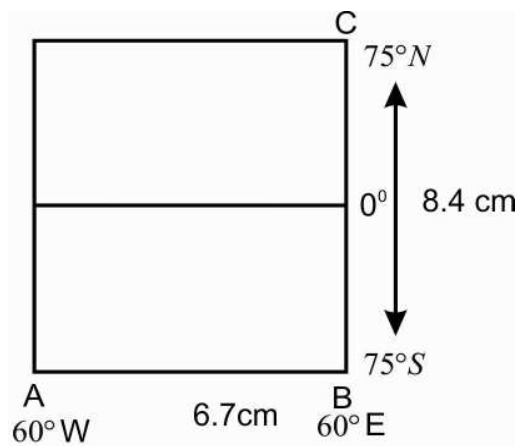
$$BC = 2\pi R \times \frac{150}{360}$$



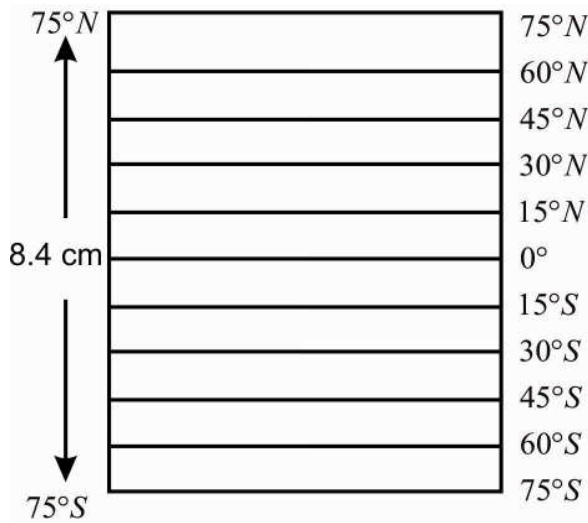
$$\begin{aligned}
 &= 2 \times 3.14 \times 3.2 \times \frac{150}{360} \\
 &= 1 \times 3.14 \times 3.2 \times \frac{5}{6} \\
 &= \frac{3.14 \times 3.2 \times 5}{6} \\
 &= \frac{50.24}{6} \\
 &= 8.37 \text{ cm} \\
 &BC = 8.4 \text{ cm}
 \end{aligned}$$

- 4) Latitudinal extent BC = 6.4cm Longitudinal extent AB = 6.7cm.

Draw rectangle of $8.4 \times 6.7 \text{ cm}$

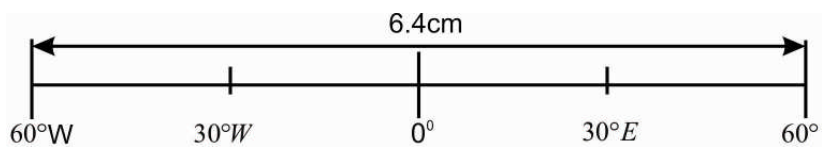


- 5) Our latitudinal interval is 15° . Let us draw rough diagram



Latitudinal extent $75^{\circ}N$ to $75^{\circ}S$. (10 Parts)

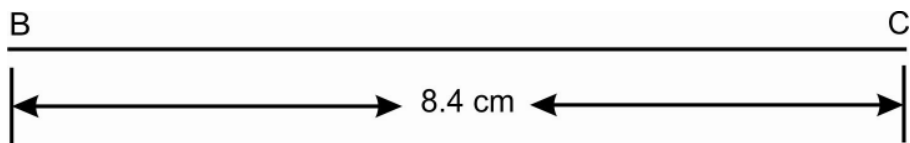
Our Longitudinal interval is 30°



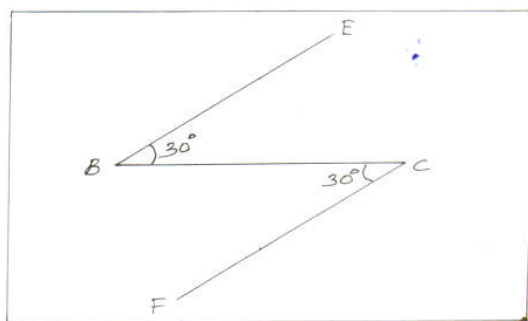
Longitudinal extent $60^{\circ}W$ to $60^{\circ}E$ (4 parts)

6) In order to mark divisions for latitudes, draw line of 8.4cm and divide it into 10 equal parts. Similarly for longitudes, draw line of 6.4cm & divide it into 4 equal parts.

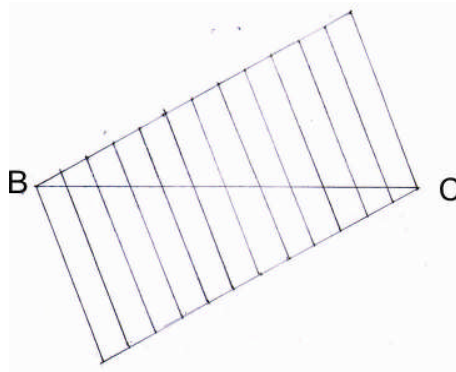
7) Longitudinal extent $75^{\circ}N$ to $75^{\circ}S$ Draw line of 8.4cm.



Draw lines / angles at 30° at B & C as shown in the diagram.



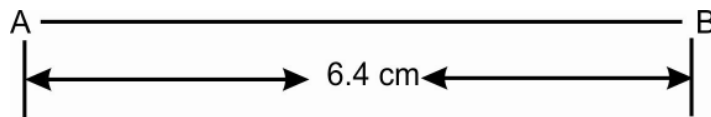
Mark 10 divisions of one cm each on BE and CF lines.



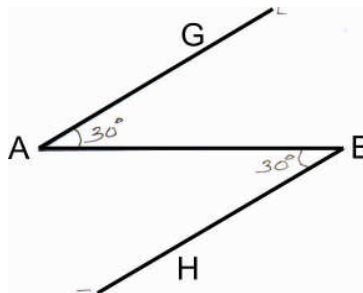
Join these divisions to get 10 equal parts of BC.

- 8) Latitudinal extent - 60°W to 60° .

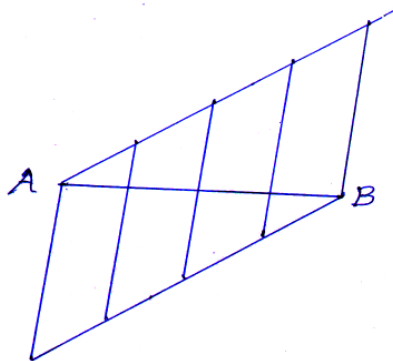
Draw line of 6.4 cm



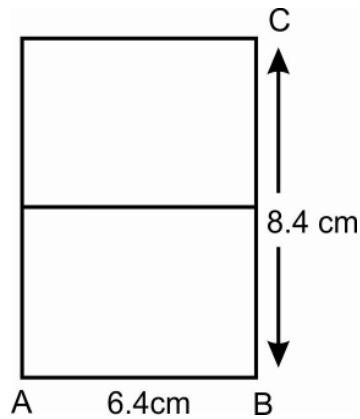
Draw line / angles at 30° at A & B as shown in the diagram.



Mark 4 divisions of 2cm each on A,G and BH lines.



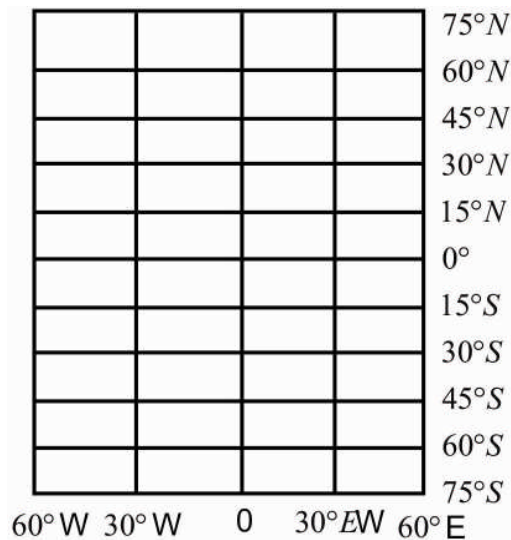
- 9) Join these divisions to get 4 equal parts of AB.
 Draw rectangle of 8.4cm x 6.4 cm.



Now transfer four equal divisions on AB line & ten equal divisions on BC line with the help of strip of paper.

Keep paper strip attached to line BC in (7) mark ten divisions on paper. Now transfer paper to our final diagram and transfer all divisions on BC line in final diagram.

Similarly transfer four equal divisions on AB line.



Cylindrical equi-distance projection.

Properties :

- 1) Parallels and meridians are straight lines.
- 2) The meridians intersect the parallels at right angles.
- 3) The distances between the parallels and those between the meridians remain the same throughout the projection.
- 4) All the parallels are of the same length and every one of them is equal to the length of equator.

- 5) The Length of equator on this projection is equal to the length of the equator on the globe. Therefore, the scale along the equator is correct. The parallels are longer than the corresponding parallels on the globe. For an example, 30 degree parallel, 60 degree parallel and 80 degree parallel on this projection are 1.154 times, 2.000 times, and 5.758 times longer than the corresponding parallel on the globe respectively. A pole which is the point on the globe is equal to the length of the equator on this projection. Therefore the scale along the parallels is exaggerated and the exaggeration increases away from the equator.
- 6) Shapes are more and more distorted away from the centre of the projection because the scale along the meridians is too small and that along the parallels too large. The shapes are compressed along the meridians but stretched along the parallels.
- 7) The shapes of the central areas of the projection are represented in a satisfactory way for the shapes are distorted here but very slightly.
- 8) Shapes being distorted away from the centre of the projection, it is only the central part of the projection that can be represented in a satisfactory way.
- 9) Generally, the area lying between a pole and 45 degree parallel can be shown on this projection satisfactorily.

Advantages :

- 1) It is used for preparing political and distribution maps of polar region. (shapes of the countries in the central part are preserved).
- 2) Used for the general purpose maps of large areas in the Northern Hemisphere.

Disadvantages:-

- 1) The distortion increases away from the equator.
- 2) This projection is not orthomorphic. The shape of countries is not same as on the globe.

2.10. SUMMARY:

After going through the chapter we have come to know that map projection is a mathematical formula used to transfer all or part of the curved surface of the earth onto the flat surface of a map. Earth is represented as a sphere and the process of flattening the earth causes distortions in one or more of the following spatial properties such as: a. Distance, b. Area, c. Shape, d. Direction. We have also learnt that no projection is capable of preserving all these properties. Hence all flat maps are distorted to some extent. There

are many different map projections and each is distinguished by its suitability for representing a particular portion and amount of the earth's surface. Some map projections minimize distortion in one property at the expense of another, while others strive to balance the overall distortion. Cartographers decide which properties are most important and choose a projection that suits their needs. We have studied different types of projection such as Zenithal polar equal area, Zenithal equidistant, Conical one standard parallel, Conical two standard parallel, Cylindrical equal area and Cylindrical equidistant.

2.11. CHECK YOUR PROGRESS/ EXERCISE

1. True false

- a. A globe is a scaled down model of the Earth.
- b. To portray a conical plane on a 2 dimensional plane or a map we need to construct a "projection" to alter the curved space and make it flat.
- c. The earth's surface projected on a map wrapped around the globe as a cone produces the cylindrical map projection.
- d. In Zenithal Polar Equal Area Projection the parallel are concentric circles and the pole is a point forming the centre of this projection.
- e. Conical one standard parallel projection is commonly used for showing areas of low-latitudes with larger latitudinal and limited longitudinal extent.

2. Fill in the blanks

- a. A long narrow strip of land running in the east-west direction is shown fairly correctly on _____ projection.
- b. In _____ Projection all the parallels are of the same length and every one of them is equal to the length of equator.
- c. In Cylindrical Equal Area Projection all the _____ are of the same length and the length of each meridian is equal to the length of the diameter of the globe but their lengths between the parallels go on _____ towards the poles.
- d. In Cylindrical Equi-Distant Projection Parallels and meridians are _____ lines and the meridians intersect the parallels at _____ angles.
- e. In Conical Two Standard Parallel the pole is represented by an_____.

3. Multiple choice question

- a. The equal area map projection
 - i. aims to preserve the area relationships of all parts of the globe and here the meridians and parallels are not at right angles to each other
 - ii. preserves shape.
 - iii. preserves angles around points, and shape of small areas.
- b. The globe is divided into various segments
 - i. by rivers and mountains.
 - ii. by the lines of latitude and longitude.
 - iii. by roads and rail lines.
- c. The network of parallels and meridians is called
 - i. projection.
 - ii. drainage network.
 - iii. graticule.
- d. In Zenithal Polar Equal Area Projection
 - i. The meridians intersect the parallels at right angles.
 - ii. The scale along the meridians is true.
 - iii. a 2 dimensional plane of projection touches the generating globe at either of the poles.
- e. In Conical one standard parallel
 - i. the scale is correct along the standard parallel but very large along other parallels.
 - ii. the parallel are concentric circles.
 - iii. the scale along the parallels increases away from the centre of the projection.

4. Answers the following Questions

1. What is a map projection?
2. What is the need of map projection?
3. What do you understand by classification and suitability of Map Projections?
4. What are the properties of Zenithal Polar Equi-Distant Projection? State its advantages.
5. State the properties of Conical Two Standard Parallel and its disadvantages.

6. Compare the advantages and disadvantages of Cylindrical equal area and Cylindrical equidistant projections.
7. Write short notes on:
 - a. Equal area map projection
 - b. Conformal map projections
 - c. Mercator projection
 - d. Equidistant map projection

2.12. ANSWERS TO THE SELF LEARNING QUESTIONS

- 1.a. true
- 1.b. false, To portray a curved plane on a 2 dimensional plane or a map we need to construct a "projection" to alter the curved space and make it flat.
- 1.c. false, The earth's surface projected on a map wrapped around the globe as a cylinder produces the cylindrical map projection.
- 1.d. true
- 1.e. false, Conical one standard parallel projection is commonly used for showing areas of mid-latitudes with limited latitudinal and larger longitudinal extent.
- 2.a. Conical Two Standard Parallel
- 2.b. Cylindrical Equal Area
- 2.c. meridians , decreasing
- 2.d. straight, right
- 2.e. arc
- 3.a. i.
- 3.b. ii
- 3.c. iii
- 3.d. iii
- 3.e. i.

2.13. TECHNICAL WORDS

1. **Projection:** a systematic presentation of intersecting coordinate lines on a flat surface upon which features from a curved

surface (as of the earth or the celestial sphere) may be mapped such as an equal-area map projection.

2. **Graticule:** a network of lines representing meridians and parallels, on which a map or plan can be represented.
3. **Globe-** it is a three-dimensional, spherical, scale model of Earth

2.14. Task

1. In a chart define map projection and write down the properties of Zenithal polar equal area, Zenithal equidistant, Conical one standard parallel, Conical two standard parallel, Cylindrical equal area and Cylindrical equidistant projections.
-

2.15. REFERENCES FOR FURTHER STUDY

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INTERPRETATION OF TOPOGRAPHICAL MAPS

3.0. After going through this chapter you will be able to understand the following features:

- 3.1 Objectives
- 3.2 Introduction
- 3.3 Subject discussion
- 3.4 Definition of topographical map
- 3.5 Methods of showing relief and landforms
- 3.6 Topographical map index
- 3.7 Colour scheme used in topographical maps
- 3.8 Interpretation of map : a) S.O.I. Topographical Maps
- 3.9 Conventional signs and symbols
- 3.10 Utility of topographical maps in geographical analysis
- 3.11 Summary
- 3.12 Check your Progress/Exercise
- 3.13 Answers to the self learning questions
- 3.14 Technical words and their meaning
- 3.15 Task
- 3.16 References for further study

3.1. OBJECTIVES

By the end of this unit you will be able to:

- Understand the Definition of topographical map
- Learn Methods of showing relief and landforms
- Discuss Topographical map index
- Learn Understand Colour, skim used in topographical maps
- Understand Conventional signs and symbols
- Learn Utility of topographical maps

3.2 INTRODUCTION

In this unit we will study about topographical maps along with the methods of showing relief and landforms. After that there will be a discussion on Topographical map index. We will also study

colour, skin used in topographical maps. Conventional signs and symbols and utility of topographical maps will also be discussed in the latter part of this unit.

3.3. SUBJECT-DISCUSSION

The topographical maps represent the Earth's features accurately and to scale on a two dimensional surface. It is characterized by large-scale detailed and accurate illustration of man-made as well as natural features on the earth surface such as roads, railways, power transmission lines, contours, elevations, rivers, lakes and geographical names. Hence, Topographic maps are an excellent planning tool and guide. These maps give us a variety of information identifying innumerable ground features. We may group these features into the following categories:

- a. Relief: mountains, valleys, slopes, depressions as defined by contours
- b. Hydrography: lakes, rivers, streams, swamps, rapids, falls, coastal flats
- c. Vegetation: wooded and cleared areas, vineyards and orchards.
- d. Transportation: roads, trails, railways, bridges, airports/airfield, seaplane anchorages
- e. Culture: buildings, urban development, power transmission line, pipelines, towers
- f. Boundaries: international, provincial/territorial, administrative, recreational, geographical
- g. Toponymy: place names, water feature names, landform names, boundary names

The map legend gives us a complete list of all features present in the map along with their corresponding symbols. If we see the map minutely we will find some information along the map borders. These provide valuable details which in turn help us understand and use a topographic map. We can determine relative and absolute positions of mapped features from the geographic graticule and a coordinate grid that the Topographic maps usually show.

The most important part lies in the representation of these maps because as these are two-dimensional representation of the Earth's three-dimensional landscape at a given time, are not always entirely up to date.

Topographical maps for territorial coverage of India are prepared and published by Survey of India. In India topographical maps are available in two series:

- a. India and adjacent Countries Series and
- b. International Map Series of World or La carte International Du Monde (CIM) series.

Topographic maps are based on topographical surveys. Performed at large scales, these surveys are called topographical in the old sense of topography, showing a variety of elevations and landforms. This is in contrast to older cadastral surveys, which primarily show property and governmental boundaries. The first multi-sheet topographic map series of an entire country, the Carte géométrique de la France, was completed in 1789. The Great Trigonometric Survey of India, started by the East India Company in 1802, then taken over by the British Raj after 1857 was notable as a successful effort on a larger scale and for accurately determining heights of Himalayan peaks from viewpoints over one hundred miles distant.

These maps are also prepared on a fairly large scale. They are based on precise surveys conducted by the Survey of India, Dehradun. They show general surface features in detail both natural and cultural. Principal topographic features depicted on these maps are relief, drainage, swamps and lakes, forests, villages, towns, means of transport and communication like roads and railways, and canals. Indian toposheets are generally prepared on the scale of 1:50,000.

3.4. DEFINITION OF TOPOGRAPHICAL MAP:

In modern mapping, a topographic map is a type of map characterized by large-scale detail and quantitative representation of relief, usually using contour lines, but historically using a variety of methods. Traditional definitions require a topographic map to show both natural and man-made features. A topographic map is typically published as a map series, made up of two or more map sheets that combine to form the whole map. A contour line is a line connecting places of equal elevation.

Natural Resources Canada provides this description of topographic maps:

These maps depict in detail ground relief (landforms and terrain), drainage (lakes and rivers), forest cover, administrative areas, populated areas, transportation routes and facilities (including roads and railways), and other man-made features.

Other authors define topographic maps by contrasting them with another type of map; they are distinguished from smaller-scale "**chorographic maps**" that cover large regions, "**planimetric maps**" that do not show elevations, and "**thematic maps**" that focus on specific topics.

However, in the vernacular and day to day world, the representation of relief (contours) is popularly held to define the genre, such that even small-scale maps showing relief are commonly (and erroneously, in the technical sense) called "topographic".

The study or discipline of topography is a much broader field of study, which takes into account all natural and man-made features of terrain.

3.5. METHODS OF SHOWING RELIEF AND LANDFORMS:

Topography is the study of the shape and features of the surface of the Earth. This field of geoscience and planetary science is concerned with local detail in general, including not only relief but also natural and artificial features, and even local history and culture. Mapmakers use several methods to depict relief of the terrain.

A. Hachures: Hachures are short, broken lines used to show relief. Hachures are sometimes used with contour lines. They do not represent exact elevations, but are mainly used to show large, rocky outcrop areas. Hachures are used extensively on small-scale maps to show mountain ranges, plateaus, and mountain peaks. Hachures are an older mode of representing relief. They show orientation of slope, and by their thickness and overall density they provide a general sense of steepness.



Fig: showing contours

B. Contours: Imaginary lines joining all the points of equal elevation or altitude above mean sea level. They are also called “level lines”.

Cross-section: A side view of the ground cut vertically along a straight line. It is also known as a section or profile. .

A map showing the landform of an area by contours is called a **contour map**. The method of showing relief features through contour is very useful and versatile. The contour lines on a map provide a useful insight into the topography of an area. Earlier, ground surveys and levelling methods were used to draw contours on topographical maps. However, the invention of photography and subsequent use of aerial photography have replaced the conventional methods of surveying, levelling and mapping. Henceforth, these photographs are used in topographical mapping. Contours are drawn at different vertical intervals (VI), like 20, 50, 100 metres above the mean sea level. It is known as contour interval. It is usually constant on a given map. It is generally expressed in metres.

❖ **Some basic features of contour lines are as follows:**

- a. A contour line is drawn to show places of equal heights.
- b. Contour lines and their shapes represent the height and slope or gradient of the landform.
- c. Closely spaced contours represent steep slopes while widely spaced contours represent gentle slope.
- d. When two or more contour lines merge with each other, they represent features of vertical slopes such as cliffs or waterfalls.
- e. Two contours of different elevation usually do not cross each other.

❖ **Types of slope** -The slopes can broadly be classified into gentle, steep, concave, convex and irregular or undulating. The contours of different types of slopes show a distinct spacing pattern.

- **Gentle Slope** -When the degree or angle of slope of a feature is very low, the slope will be gentle. The contours representing this type of slope are far apart.
- **Steep Slope**-When the degree or angle of slope of a feature is high and the contours are closely spaced, they indicate steep slope.
- **Concave Slope**-A slope with a gentle gradient in the lower parts of a relief feature and steep in its upper parts is called the concave slope. Contours in this type of slope are widely spaced in the lower parts and are closely spaced in the upper parts.

- **Convex Slope**-Unlike concave slope, the convex slope is fairly gentle in the upper part and steep in the lower part. As a result, the contours are widely spaced in the upper parts and are closely spaced in the lower parts.

❖ **Types of Landforms:**

- **Conical Hill**-Conical hill rises almost uniformly from the surrounding land. A conical hill with uniform slope and narrow top is represented by concentric contours spaced almost at regular intervals.
- **Plateau** –Plateau is a widely stretched flat-topped high land, with relatively steeper slopes, rising above the adjoining plain or sea. The contour lines representing a plateau are normally close spaced at the margins with the innermost contour showing wide gap between its two sides.
- **V-Shaped Valley**-A Geomorphic feature lying between two hills or ridges and formed as result of the lateral erosion by river or a glacier is called a valley. It resembles the letter 'V'. A V-shaped valley occurs in mountainous areas. The lowermost part of V-shaped valley is shown by the innermost contour line with very small gap between its two sides and the low value of the contour is assigned to it. The contour value increases with uniform intervals for all other contour lines outward.
- **U-Shaped Valley**-A U-shaped valley is formed by strong lateral erosion of glaciers at high altitudes. The flat wide bottom and steep sides makes it resemble the letter U. The lowermost part of the U-shaped valley is shown by the innermost contour line with a wide gap between its two sides. The contour value increases with uniform intervals for all other contour lines outward.
- **Gorge**-In high altitudes gorges form in the areas where the vertical erosion by river is more prominent than the lateral erosion. They are deep and narrow river valleys with very steep sides. A gorge is represented by very closely-spaced contour lines on a map with the innermost contour showing small gap between its two sides.
- **Spur**-A tongue of land projecting from higher ground into the lower ground is called a spur. It is also represented by V-shaped contours but in the reverse manner. The arms of the V point to the higher ground and the apex of V to the lower ones.
- **Cliff**-Cliff is a very steep or almost perpendicular face of landform. On a map, a cliff may be identified by the way the contours run very close to one another, ultimately merging into one.

- **Waterfalls and Rapids**-A sudden and more or less perpendicular descent of water from a considerable height in the bed of a river is called a waterfall. Sometimes a waterfall succeeds and proceeds with cascading stream forming rapids upstream or downstream of a waterfall. The contours representing a waterfall merge into one another while crossing a river stream and the rapids are shown by relatively distant contour lines on a map.
- C. Form Lines:** Form lines are not measured from any datum plane. Form lines have no standard elevation and give only a general idea of relief. Form lines are represented on a map as dashed lines and are never labelled with representative elevations.
- D. Spot Height:** The term is generally applied to any item used to mark a point as an elevation reference. A spot height is an exact point on a map with an elevation recorded beside it that represents its height above a given datum. On the top of hills you will see a dot and a number written beside it. The dot will be inside a small enclosed contour line.
- E. Triangulation points:** Triangulation pillars are another way of spotting the top of a mountain on a map. The symbol for a trig point is a small triangle. Triangulation pillars are used by map makers. They are real concrete pillars that are placed at particular places which are usually the tops of hills.
- F. Bench mark:** Carved or screwed in to thousands of walls around the country are symbols or devices used for map making before the advent of the global positioning system (GPS).
- G. Hillshading** is a shaded relief (levels of gray) on a map, just to indicate relative slopes, mountain ridges, not absolute height. Hillshading is the process of adding light and dark areas or shading to a map to highlight the location of hills or mountains. Hillshading uses light and dark areas to highlight where sunlight would hit and where shadows would form in the presence of hills and mountains.
- H. Hypsometric tints** are colors used to indicate elevation, usually together with contour lines. They can be used to depict ranges of elevation as bands of color, usually in a graduated scheme, or as a colour ramp applied to contour lines themselves. A typical scheme progresses from dark greens for lower elevations up through yellows/browns, and on to grays and white at the highest elevations. Hypsometric tinting of maps and globes is often accompanied by a similar method of bathymetric tinting to convey depth of oceans; lighter shades of blue represent shallower water such as the continental shelf and darker shades deeper regions.

3.6. TOPOGRAPHICAL MAP INDEX:

The survey of India has published the following 5 types of topographical maps. They are as follows:

a. Million maps

The SOI has published topographical maps on the scale of 1:1000000 under the India and Adjacent Series. Each sheet cover 4° at 4° long and is numbered as 62, 63, 64 etc.

b. Degree or Quarter-Inch series

Each of the map is divided into 16 equal parts, each measuring as 4° at 1° long. Now it has been converted on the scale of 1:250000 on the Metric scale and is referred as 63A, 63B, 63C etc.

c. Half-degree or half-inch map Series

Each of the degree sheet maps has been divided into 4 equal parts.

Hence, the each sheet is numbered as 63A/NW, 63A/NE, 63A/SW, and 63A/SE.

d. Quarter Degree or One-inch Map series

Each degree has been divided into 16 equal parts, so the sheet has been measured as 15'lat and 15'long and is given as 63A/1, 63A/2, 63A/3, etc.

e. Town Guide maps

They are drawn under the scale of 1:25000, and are numbered as 63A/15/NE, 63A/15/NW, 63A/15/SE, etc. It covers the area of 7.5'lat and 7.5'long.

Million Sheet :

39	44	53
38	45	54
37	46	53

Degree Sheet

A	E	I	M
B	F	J	N
C	G	K	O
D	H	L	P

Half inch sheet
45H/NW

Inch sheet
45H/6

NW	NE
SW	SE

1	5	9	13
2	45H/6	10	14
3	7	11	15
4	8	12	16

3.7. Colour Scheme Used in Topographical Maps:

To facilitate the identification of features on a map, the topographical and cultural information is usually printed in different colours. These colours may vary from map to map. On a standard large-scale topographic map, the colours used and the features each represent are stated under:

- a. **Black:** Indicates cultural (man-made) features such as buildings and roads, surveyed spot elevations, and all labels.
- b. **Red-Brown:** The colours red and brown are combined to identify cultural features, all relief features, non-surveyed spot elevations, and elevation, such as contour lines on red-light readable maps.
- c. **Blue:** Identifies hydrography or water features such as lakes, swamps, rivers, and drainage.
- d. **Green:** Identifies vegetation with military significance, such as woods, orchards, and vineyards.
- e. **Brown:** Identifies all relief features and elevation, such as contours on older edition maps, and cultivated land on red-light readable maps.
- f. **Red:** Classifies cultural features, such as populated areas, main roads, and boundaries, on older maps.
- g. **Other:** Occasionally other colours may be used to show special information. These are indicated in the marginal information as a rule.

3.8. INTERPRETATION OF TOPOGRAPHICAL MAPS

The study of topographical maps requires a careful planning, patience and proper attention. Conventional signs are given on the maps which should be read carefully. The study of topographical maps is classified into three broad sections.

a. Marginal Information

It is important to find out the marginal information before interpreting the topographical maps. One must know the following information's of maps:

1. States and districts to which the map belongs.
2. Latitudes and longitudes, scale, and contour interval.
3. Year of publication, name and number of the map, and its approximate area.

b. Physiographic Information

These are basic and important information and should be studied under the following heads:

1. **Relief:** nature and types of the landform (mountain, plateau or plain), average height and general slope, important hills, peaks, ridges, valleys etc. with their heights and their locations.
2. **Drainage:** important rivers their tributaries and their stages; type of drainage pattern; drainage density and texture.

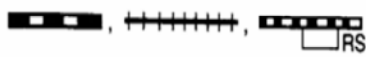
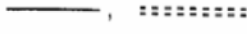
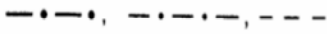




3. Vegetation: areas covered by vegetation, types of forest (protected and reserved) and other types of trees and their distribution.

c. Cultural Information

Topographical maps bear sufficient information pertaining to cultural aspects. These include the study of following information:

1. Land use: cultivated land, other uses of land and waste land; means of irrigation, (canal, well, tank), occupation of people (cultivation, mining, forestry etc.).
2. Means of Communications: railway, roadway, cart-tracks etc.; postal and telegraphic offices; Aerodrome, harbours, ports etc.
3. Settlement: Urban Centres, their sites and their sizes; rural settlements, their types and patterns, archaeological sites and their details.

3.9. CONVENTIONAL SIGNS AND SYMBOLS

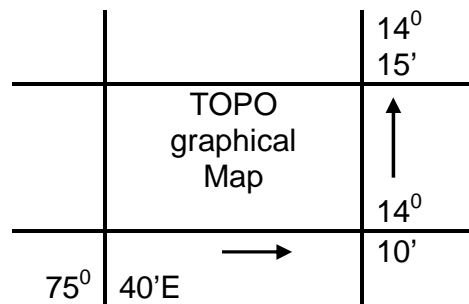
Railway Line : Broad gauge, Metre gauge, Railway station	
Roads : Metalled, Unmetalled	
Boundary : International, State, District,	
River, Well, Tank, Canal, Bridge	
Temple, Church, Mosque, Chhatri	
Post Office, Post and Telegraph Office, Police Station	PO, PTO, PS
Settlement, Graveyard	
Trees, Grass	

Topographical Map
Karnataka - 48/N/12 (C-1)

Q.1 With reference to the map (Karnataka - 48/N/12) answer the following questions.

- 1) State extent of the map.

Ans - 'Extent' refers to the Latitudinal and Longitudinal extent of the map.



- a) Latitudinal extent = 1
14° 10' N to 14° 15' North
- b) Longitudinal extent
75° 40' E to 75° 45' East
- 2) Calculate area represented in the map.

Ans. Formula for the calculation of area

Area = Length x Width

Measure length and width of the map

Length = 18.0cm

Width = 18.2 cm

Scale of the map is 2cm to 1km.

Let us convert length & width into kms.

∴ 2cm to 1 km

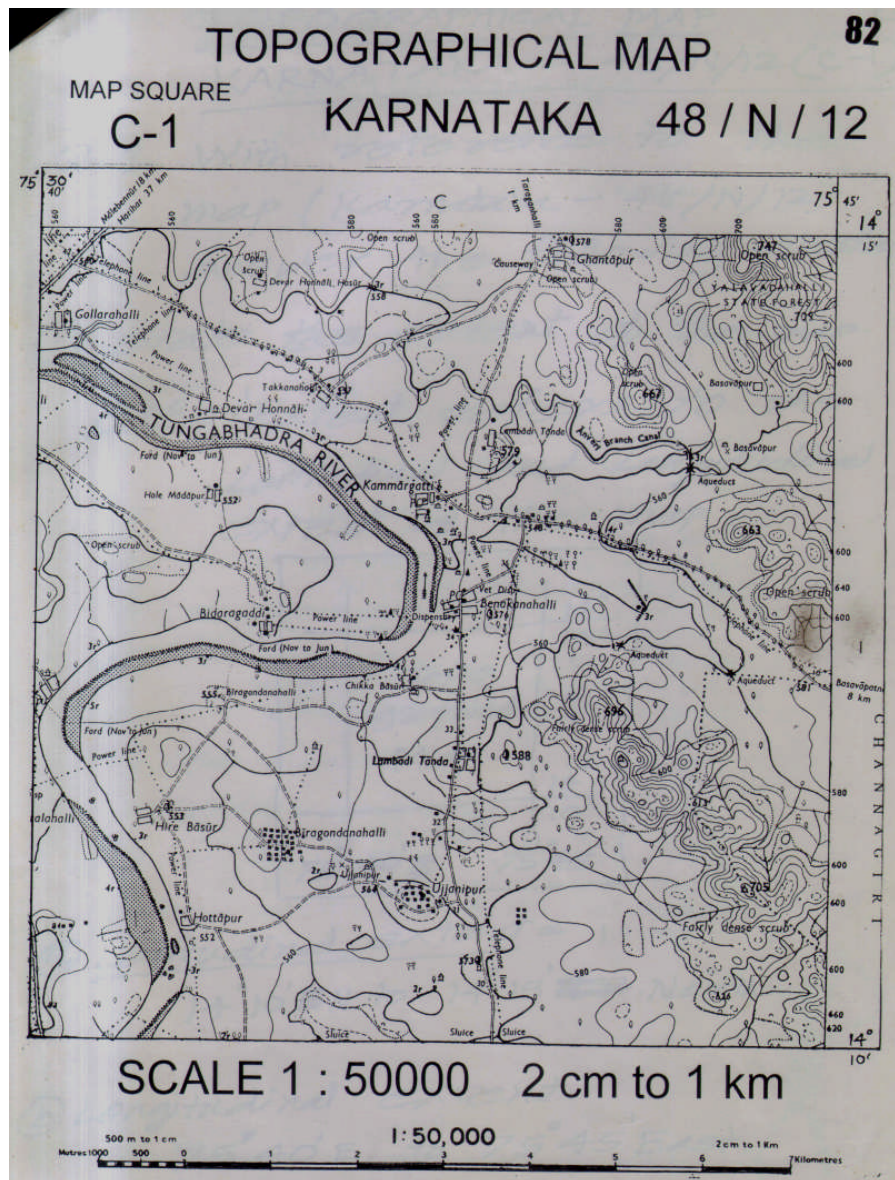
(18/2=9)

∴ 18cm to 9.1 km

Length = 9km, Width = 9.1km

Area = 9x 9.1 = 81.9 sq. kms.

Area of the map is 81.9 sq. kms.



3.10. Utility of Topographical maps:

Topographic maps, which are two-dimensional representations of landforms and geographic features, are invaluable for landscape study and often attractive works of art. What follows is a survey of some of the major uses of these cartographic tools.

1. Route-planning

Study a topographic map from the U.S. Geological Survey or another source to assist in planning an itinerary to a wilderness region. Backpackers and cross-country hikers especially need these maps to route their travels along an efficient route (often with as little change in elevation as possible), avoid obstacles (like

landslides, deep canyons and other generally rugged terrain), and locate water sources and potential shelter.

2. Safety & Survival

Choose a detailed-enough topographic map and keep it handy on treks to ensure your personal safety. Sharing your route with friends and family, not to mention other members of your own party, is made far easier with the detailed geographic information coded in a topographic map. If you do find yourself off-course, injured, beset by rough weather or otherwise threatened, the map can help you find springs, high points (where cellular phone and GPS reception might be stronger), nearby roads and buildings.

3. Professional and Scientific Uses

For planners, topographic maps can suggest potentially unstable landscapes like landslide slopes, bottomlands or cut banks and eroding shorelines that do not lend themselves easily to development. For botanists and biologists, they can be overlain with other map layers, like vegetation or soil zones, to predict species distribution. Developers might scrutinize such depictions of terrain, in concert with other data, to identify good spots for, say, wind-turbine placement. The applications are as endless as geography's impacts on our lives.

3.11. SUMMARY:

After going through the unit we have come to know that the topographical maps are sufficiently large scale maps prepared to show the micro details of the ground. The variation in the relief, vegetation, land use, forms of settlements, location of urban and market centre, drainage patterns, transport network and communication lines are some important information given on the topographical map. These maps are usually prepared and published by the official organization of national government and cover the country in continuous series of maps at various scale. Contour lines determine elevations of mountains and flat areas. The closer together the lines are, the steeper the slope. Colours like red, blue, brown and styles such as dotted, dashed, and curvy usually criss-cross a topographic map. From the colour red on a toposheets we are able to find out roads. The colour black indicates manmade or cultural features while blue, brown, green show water-related features, contour lines and elevation numbers, vegetation features respectively. White indicates any landscape feature except for trees or water - including desert, grass, sand, rocks, boulders, and so on. But remembering map colors is a fairly trivial task.

Most topographic maps show more than just topography and are updated periodically because changes occur in streets, roads,

buildings; other infrastructure like power lines, wells as well as in boundaries and land-use patterns.

3.12. CHECK YOUR PROGRESS/ EXERCISE

1. True false

- a. Closely spaced contours represent steep slopes while widely spaced contours represent gentle slope.
- b. The convex slope is fairly steep in the upper part and gentle in the lower part.
- c. A V-shaped valley occurs in lower course of a river.
- d. A U-shaped valley is formed by strong lateral erosion of glaciers at high altitudes.
- e. On a map, a Spur is identified when the contours run very close to one another, ultimately merging into one.

2. Fill in the blanks

- a. The topographical maps represent the Earth's features accurately and to _____ on a two _____ surface.
- b. Two contours of _____ elevation usually do not cross each other.
- c. A _____ hill with uniform slope and narrow top is represented by concentric contours spaced almost at regular intervals.
- d. The _____ part of the U-shaped valley is shown by the innermost contour line with a wide gap between its two sides
- e. _____ tints are colors used to indicate elevation, usually together with contour lines.

3. Multiple choice question

- a. The slopes can broadly be classified into
 - i. gentle, steep, concave, convex and irregular or undulating.
 - ii. big, small, concave, tall and irregular.
 - iii. sharp, pointed, gentle, steep, smooth and rough.
- b. A gentle slope occur
 - i. when the degree or angle of slope of a feature is high and the contours are closely spaced.
 - ii. a slope with a gentle gradient in the lower parts of a relief feature and steep in its upper parts
 - iii. when the degree or angle of slope of a feature is very low.
- c. A gorge is represented by

- i. very widely-spaced contour lines on a map with the innermost contour showing huge gap between its two sides.
- ii. very closely-spaced contour lines on a map with the innermost contour showing small gap between its two sides.
- iii. very closely-spaced contour lines on a map with the outermost contour showing small gap between its two sides.
- d. In half-degree or half-inch map series
 - i. each of the degree sheet maps has been divided into 8 equal parts.
 - ii. each of the degree sheet maps has been divided into 4 equal parts.
 - iii. each of the degree sheet maps has been divided into 2 equal parts.
- e. The contours representing a waterfall
 - i. merge into one another while crossing a river stream and the rapids are shown by relatively distant contour lines on a map.
 - ii. the contours run very close to one another, ultimately merging into one.
 - iii. the contour value increases with uniform intervals for all other contour lines outward.

4. Answers the following Questions

1. Define of Topographical Map.
2. State the methods of showing relief and landforms on Topographical Map.
3. What is Cross-section?
4. Discuss Topographical map index.
5. What are the various properties of contours

3.13. ANSWERS TO THE SELF LEARNING QUESTIONS.

- 1.a. true
- 1.b.false, the convex slope is fairly gentle in the upper part and steep in the lower part.
- 1.c. false, A V-shaped valley occurs in mountainous areas.
- 1.d.true
- 1.e. false, On a map, a cliff is identified when the contours run very close to one another, ultimately merging into one.

- 2.a. scale, dimensional
- 2.b. different
- 2.c. conical
- 2.d. lowermost
- 2.e. Hypsometric
- 3.a.i
- 3.b.iii.
- 3.c.ii.
- 3.d.ii.
- 3.e.i.

3.14. Technical Words:

- **Contour lines:** Contour lines connect a series of points of equal elevation and are used to illustrate relief on a map. Numerous contour lines that are close to one another indicate hilly or mountainous terrain; when further apart they indicate a gentler slope; and when far apart they indicate flat terrain.
- **Projection:** Geometric representation of the curved surface of the Earth on a flat sheet of paper.
- **Relief:** The physical configuration of the Earth's surface, depicted on a topographic map by contour lines and spot heights.
- **Topography:** Surface features both natural and man-made, collectively depicted on topographic maps.
- **Bearing:** The horizontal angle at a given point, measured clockwise from magnetic north or true north to a second point.
- **Elevation:** Vertical distance from a datum (usually mean sea level) to a point or object on the Earth's surface.
- **Legend:** A description, explanation table of symbols, or other information, on a map or chart to provide a better understanding and interpretation of it.
- **Magnetic north:** Direction to which a compass needle points.
- **Mean sea level:** The average height of the surface of the sea for all stages of tide, used as a reference surface from which elevations are measured.

3.15. TASK

1. In a chart draw a complete conventional Signs and symbol sheet present on toposheets.

3.16. REFERENCES FOR FURTHER STUDY

- Gupta K. K and Tyagi V. C., 1992: Working with Maps, Survey of India, DST, New Delhi.
- Singh R. L. and Singh R. P. B., 1999: Elements of Practical Geography, Kalyani Publishers
- Sarkar A.K Practical Geography: A Systematic Approach, Oriental Longman, Calcutta, 1997.
- Oxford dictionary



INTERPRETATION OF THEMATIC MAPS

4.0. After going through this chapter you will be able to understand the following features:

- 4.1 Objectives
- 4.2 Introduction
- 4.3 Subject discussion
- 4.4 Concept of Thematic Maps
- 4.5 Distinguishing characteristics of Thematic Maps
- 4.6 Various categories of Thematic Maps
- 4.7 Reading and interpretation of Thematic Maps
- 4.8 Utility of thematic maps of Thematic Maps
- 4.9 Techniques of representation of the theme of Thematic Maps
- 4.10 Interpretation and appreciation of Thematic Maps
- 4.11 Summary
- 4.12 Check your Progress/Exercise
- 4.13 Answers to the self learning questions
- 4.14 Technical words and their meaning
- 4.15 Task
- 4.16 References for further study

4.1. OBJECTIVES

By the end of this unit you will be able to:

- Understand the Concept of Thematic Maps
- Learn about Distinguishing characteristics of Thematic Maps
- Discuss Various categories of Thematic Maps
- Evaluate Reading and interpretation of Thematic Maps
- Discuss Utility of Thematic Maps
- Understand Techniques of representation of the theme of Thematic Maps
- Learn Interpretation and appreciation of Thematic Maps

4.2. INTRODUCTION

In this unit we will study about the concept and the distinguishing characteristics of Thematic Maps. There will be a discussion on the various categories of Thematic Maps along with reading and interpretation of the same. Utility of Thematic Maps as well as the techniques of representation of the theme of Thematic Maps is very important. We will learn this in this unit. Interpretation and appreciation of Thematic Maps will be discussed in the latter part of this unit.

4.3. SUBJECT-DISCUSSION

A map is a drawn or printed representation of the Earth. Visualization of geographic and geo-referenced information is normally made through maps. There are a huge variety of maps such as Political Maps, Physical Maps, Contour Maps, Road Maps, Street Maps, Transit Maps, Thematic Maps, Resource Maps and Inventory Maps. However maps can broadly be classified into the following three main types:

- 1) General reference maps
- 2) Mobility maps
- 3) Thematic Maps

In this unit we are going to study Thematic Maps. A thematic map is a map that emphasizes a particular theme or special topic such as the average distribution of rainfall in an area whereas general reference maps show natural features like rivers, cities, political subdivisions and highways. These items are often present on a thematic map which is simply used as reference points to enhance one's understanding of the map's theme and purpose.

Thematic maps show the distribution of a single attribute or the relationship between several attributes. These maps can cover a variety of characteristics from soil types to population density. Here the cartographer bears the responsibility to make sure that the map shows the correct distribution or the relationship between the various attributes.

Initially thematic maps were made with a small scale as the available data was rather coarse, and importance was given to show the basic distribution pattern than the map's location for the data. However, with the availability of better data thematic maps are made with a larger scale to show more accurate spatial information at present. To make a good thematic map a cartographer must be careful to portray the data on the map when designing the same. This will in turn help one to use and

understand that particular map. This is accomplished mainly with the marks and symbols that the cartographer uses to represent the data. Moreover the sources of a thematic map's data are very important. Cartographers must find accurate, recent and reliable sources of information in a wide range of subjects varying from environmental features to demographic data to make the best possible maps. The designer should also give an adequate locational base for the map.

4.4. CONCEPT OF THEMATIC MAPS

Thematic map is a map that emphasizes on a particular theme or a special topic. Thematic map did not develop as a map type until the middle of 17th century. Thematic maps are used to show soil types, vegetation, land use, geology, etc. It also shows geographical concept like density and distribution of population.

4.5. DISTINGUISHING CHARACTERISTICS OF THEMATIC MAPS

- Thematic map focuses on specific theme of subject area.
- a. Sometimes the thematic map also emphasizes on spatial variation of one or small number of geographic distribution.
 - b. Thematic maps are sometimes referred to as graphic essays.

4.6. VARIOUS CATEGORIES OF THEMATIC MAPS

There are many different types of thematic maps. Many types have been designed for special purposes such as flow maps used in transportation analysis. Thematic mapping is the process of shading a map according to a given theme.

4.6.1. Common thematic map types include the following:

- A. Choropleth maps
- B. Dot density maps
- C. Isopleth Map or Contour Maps
- D. Proportional symbol maps
- E. Colour patch

A. Choropleth maps

The term 'Choropleth Map' was introduced in 1938. The earliest known Choropleth map was created in 1826. Choropleth maps are most common type of thematic map that usually portrays quantitative data as a colour and can show density, percent, average value or quantity of an event within a geographic area. Sequential colors on these maps represent increasing or decreasing positive or negative data values. Generally, each colour

also represents a range of values. These maps represent a single geo-referenced variable and show variations over discrete regions.

❖ Disadvantages of Choropleth Maps

Choropleth maps give a good visual impression of change over space but there are certain disadvantages to using them:

- They give a false impression of abrupt change at the boundaries of shaded units.
- Choropleth maps are often not suitable for showing total values. Proportional symbols overlays (included on the choropleth map above) are one solution to this problem.
- It can be difficult to distinguish between different shades.
- Variations within map units are hidden, and for this reason smaller units are better than large ones.

B. Dot density maps

The Dot density maps show a symbol i.e. a dot for each individual or group of individuals. These are used together with polygons and are useful to show densities or values in a continuous way. These maps are generally used to show multiple variables (e.g., through multiple colors, dot sizes, symbols, etc.) but fails when many individuals or groups are present. Dot density maps are only used when exact location is unknown.

❖ Demerits of Dot density maps

- The limitations of Dot density maps include the difficulty of counting large numbers of dots in order to get a precise value and the need to have a large amount of initial information before drawing the map.

C. Isopleth Map

These maps are used for rendering differences in absolute or relative values on a surface perceived as a continuum. Isopleth Maps use line symbols to portray a continuous distribution such as temperature or elevation. Isopleths are lines that connect points of equal numeric value. One of the best-known types of Isopleth map is the contour map, which shows elevation above sea level.

❖ The merits and demerits of Isopleth Maps are as follows:

• Merits

- i. Isopleth are more scientific than other methods of showing distribution and effectively show the distribution and variations.
- ii. This is especially useful for climatic maps such as isobars, isotherms, isohyets etc. and is known as the main tool for the meteorologists.

- iii. It is very easy to determine the gradient (rate of change) with the help of isopleth maps.
 - iv. When isopleth are wide apart, they show low gradient but when they are closer together they show high gradient.
 - v. Isopleth lines are independent of political boundaries and best suited to show the natural pattern of distribution of an element.
 - vi. Isopleth is the most suited method for showing elements having transitional values, this is a reason that isopleth are invariably used to show the distribution of temperature, pressure and other climatic elements.
- Demerits
 - i. The drawing of isotherm often needs interpolation, which is a difficult process.
 - ii. The method often suffers from lack of sufficient data.

D. Proportional symbol maps

Proportional symbol maps are used for rendering absolute quantitative data. These maps represent data associated with point locations such as cities. The populations of different cities are frequently depicted on Proportional symbol maps. Data is displayed on these maps with proportionally sized symbols to show differences in occurrences. The symbols have different sizes in proportion to some quantity that occurs at that point. Circles are most often used with these maps but squares and other geometric shapes are suitable as well.

E. Colour patch

Another type of thematic map is colour patch where colour is used for identifying different groups. When these types of maps show urban or rural settlements each of them is shown through different colours such as if urban settlement is shown by red colour then rural is shown by yellow colour.

4.7. READING AND INTERPRETATION OF THEMATIC MAPS

To develop map reading abilities along with skills one should apply certain basic principles to translate map symbols into landscape images. A map reader must have ideas about the symbol as well as the landscape present in real world. This is known as the perception of the symbols and the real world. However when these two are revealed correctly the understanding of the map will coincide exactly with the real world. How a reader should interpret Thematic Maps have been discussed below.

A **Choroplethmap** portrays quantitative data as a specific color and can show density, percent, average value or quantity of an event within a geographic area. There are several different types of color progressions used by cartographers. Sequential colors on these maps represent increasing or decreasing positive or negative data values. Usually, each color represents a range of values. When there is a single-hue progression fading from a dark shade of a specific color to a very light shade of relatively the same hue the darkest hue represents the greatest number in the data set while lightest shade represents the least number.

Dot density maps use dots to show the presence of a theme and display a spatial pattern. The distribution of points on a map represents the distribution of the given phenomenon in reality, and also shows the change in the intensity or dispersion. Quantitative characteristics are expressed using dots where each dot is attached by a particular value, for example 1 dot = 100 people. For the distribution of dots, topographical and cartogram approaches are used.

In an **Isopleth map** a line is drawn on a map through all points having the same value of some measurable quantity. We visually interpret the symbols to perceive areas of higher values and areas of lower values. The information in the Isopleth maps can be interpreted through the following ways:

- a. Observe all points made from the base map.
- b. Observe lines which pass in accordance to interval made, and these lines direct the reader about the number of the same values from the base map.
- c. Observe the lowest value and highest value and look on numbers where lines pass according to the made interval.
- d. Use color or shades if has been used to get more information.

The **proportional symbol map** is a widely-used form of thematic mapping. In this technique, the cartographer selects a symbol and alters its size based on the data values. The larger the symbol, the "more" of something exists at a location. The symbols increase in size as the data increase in value. In these maps the symbol sizes are directly proportional to the data values. For example in a map of the 50 states there can be up to 50 minutely different circle sizes, each one proportional to the number it represents.

In **colour maps** cartographers utilize colour on a map to represent certain features. Map colors are always consistent on a single map as well as across different types of maps by different

cartographers or publishers. Many colours used on maps have a relationship to the object or feature on the ground. For example, blue is almost always the color chosen for fresh water or ocean.

4.8. UTILITY OF THEMATIC MAPS

Thematic maps serve the following three primary purposes:

- a. They provide information about particular location.
- b. They provide information about spatial pattern.
- c. They can be used to compare patterns on 2 or 3 maps.

4.9. TECHNIQUES OF REPRESENTATION OF THE THEME OF THEMATIC MAPS

I. Choropleth Map

Choropleth maps show statistical data. As the shades or pattern becomes darker or denser the values increase. Choropleth maps provide an easy way to visualize how a measurement varies across a geographical area.

❖ Usage of colors on Choropleth maps:

- Specific color progressions should be used to depict the data properly, in a way that facilitates interpretation.
- Single-hue progressions fade from a dark shade of the chosen color to a very light shade of relatively the same hue. Common method used to show magnitude.
- Bi-polar progressions use two hues and are normally used to show a change in data numbers from negative to positive.
- Blended hue progressions use related hues to blend together the two end point hues. This type of color progression is typically used to show elevation changes.
- Full spectral progression contains hues from blue through red. Usually not recommended.

II. Isopleth Map or Contour Maps

Isopleth maps show a range of quantity. Isopleth maps usually have ranges of similar values filled with similar colours or patterns showing changes over space. Isopleth maps differ from Choropleth maps. In those maps, the data is not grouped to define a region like a state or a country. Isopleth are used to show climatic elements, temperature, pressure and cloudiness. Care should be taken to show the index of concentration before actually plotting them on the map while showing density of population and distribution of crops etc. These maps are generated from data that occur over geographical areas and values represent numerical

(quantitative) differences between features on an interval or ratio scale of measurement. Isopleth maps also require a large amount of data for accurate drawing.

III. Dot Map

A Dot map is used as a distribution map or density map. Actually the dot symbol shows the presence of a feature. These maps represent the distribution of discrete phenomena with point symbols that each denotes the same quantity.

❖ When constructing a dot map, two parameters must be considered:

- a. the graphical size of each dot and
- b. the value associated with each dot

❖ There are different types of dot maps.

a. One-to-one

In this type of dot map, each dot represents one single phenomenon since the location of the dot corresponds to only one piece of data, care must be taken to assure that the dot is represented in correct spatial location.

b. One-to-many

In this type of dot map, each dot on the map represents more than one type of phenomenon being mapped.

IV. Proportional symbol Maps

The proportional technique uses symbols of different sizes to represent data. For example: A square may be shown of each city to represent the population of the respective cities in the map.

V. Colour patch

This map uses colour for identifying different groups, for example: The map shows urban or rural settlements. Here urban are shown by purple colour and rural are shown by yellow colour.

4.10. Interpretation and appreciation of Thematic Maps

As the name suggests, thematic maps are concerned with a particular theme or topic of interest. While reference maps emphasize the location of geographic features, thematic maps are more concerned with how things are distributed across space. These maps are one of the most compelling forms of information for several reasons. These are artistic and scientific. These maps while preserving history clarify and reveal the invisible. We also get information of the future. Regardless of the reason, these maps

capture the imagination of people around the world. One of the strengths of thematic mapping is that it can make some abstract and invisible concepts such as life expectancy around the world, per capita gross domestic product (GDP) in Europe, or literacy rates across India visible and comparable on a map.

4.11. SUMMARY:

After going through this unit of thematic maps we can conclude that these maps are usually made with a single purpose in mind. Often, that purpose has to do with revealing the spatial distribution of one or two attribute data sets. We have also explored different types of thematic maps and which type of map is conventionally used for different types of data along with different goals. The discussed thematic maps include choropleth, dot density, proportional symbol, isopleths and colour patches. We have come to know that thematic maps are considered as primary mechanism for summarizing and communicating the increased volumes of geographically related information. In this unit we have learnt about the most common thematic mapping techniques as well as their interpretation.

4.12. CHECK YOUR PROGRESS/ EXERCISE

1. True false

- a. A map is a drawn or printed representation of the globe.
- b. Thematic maps are sometimes referred to as graphic essays.
- c. Thematic mapping is the process of shading a map according to a given time.
- d. The term 'Choropleth Map' was introduced in 2017.
- e. Isopleth Maps use line symbols to portray a continuous distribution such as temperature or elevation.

2. Fill in the blanks

- a. One of the best-known types of Isopleth map is the _____ map, which shows elevation above sea level.
- b. Isopleth lines are independent of _____ boundaries and best suited to show the natural pattern of distribution of an element.
- c. The drawing of isotherm often needs _____, which is a difficult process.
- d. _____ maps are used for rendering absolute quantitative data.

- e. Sequential colours on _____ maps represent increasing or decreasing positive or negative data values.

3. Multiple choice question

- a. The most common type of thematic map that usually portrays quantitative data as a colour and can show density, percent, average value or quantity of an event within a geographic area is known as

- i. Colour patch
- ii. Choropleth map
- iii. Dot density maps

- b. The Dot density maps

- I. use line symbols to portray a continuous distribution such as temperature or elevation.
- II. a dot is used together with polygons and is useful to show densities or values in a continuous way.
- III. circles are most often used but squares and other geometric shapes are suitable as well.

IV. In an Isopleth map

- i. a line is drawn on a map through all points having the same value of some measurable quantity.
- ii. quantitative data is portrayed as a specific colour and can show density of population in a specific area.
- iii. the symbol sizes are directly proportional to the data values.

V. In One-to-one dot maps

- i. different coloured dots represent urban or rural settlements only.
- ii. each dot on the map represents more than one type of phenomenon being mapped.
- iii. each dot represents one single phenomenon since the location of the dot corresponds to only one piece of data.

VI. In Choropleth maps

- i. bi-polar progressions use two hues and are normally used to show a change in data numbers from negative to positive.
- ii. use of each point symbols denotes the same quantity.
- iii. isopleth is used to show elements having transitional values.

4. Answers the following Questions

1. What is a map?
2. What are the distinguishing characteristics of Thematic Maps?
3. State the disadvantages of Choropleth Maps.
4. Define Dot density maps and state its demerits of the same.
5. Discuss the merits and demerits of Isopleth Maps.
6. How will you interpret Isopleth maps?
7. Define thematic maps. Elaborate your answer describing utility of thematic maps.
8. What are the different techniques of representation of the theme of Thematic Maps?
9. Write short notes on:
 - a. Choropleth maps
 - b. Dot density maps
 - c. Isopleth Map or Contour Maps
 - d. Proportional symbol maps
 - e. Colour patch

4.13. ANSWERS TO THE SELF LEARNING QUESTIONS

- 1.a. false, A map is a drawn or printed representation of the Earth.
- 1.b. true
- 1.c. false, Thematic mapping is the process of shading a map according to a given theme.
- 1.d. false, The term 'Choropleth Map' was introduced in 1938
- 1.e. true
- 2.a. contour
- 2.b. political
- 2.c. interpolation
- 2.d. Proportional symbol
- 2.e. choropleth
- 3.a.ii
- 3.b.ii
- 3.c.i
- 3.d.iii
- 3.e.i

4.14. TECHNICAL WORDS:

1. **Maps:** a diagrammatic representation of an area of land or sea showing physical features, cities, roads, etc.
2. **Cartographer:** a person who draws or produces maps.
3. **Reference map:** It shows the location of the geographic areas for which census data are tabulated and disseminated.
4. **Mobility map:** gives information on facilities and access in the city centre for aged and disabled people.
5. **Thematic Maps:** A thematic map is a map that emphasizes a particular theme or special topic such as the average distribution of rainfall in an area. They are different from general reference maps because they do not just show natural features like rivers, cities, political subdivisions and highways.
6. **Choropleth maps:** a map which uses differences in shading, colouring, or the placing of symbols within predefined areas to indicate the average values of a particular quantity in those areas.
7. **Dot density map:** It is a map type that uses a dot symbol to show the presence of a feature or phenomenon. Dot maps rely on a visual scatter to show spatial pattern.
8. **Isopleth:** a line on a map connecting points at which a given variable has a specified constant value.

4.15. TASK

1. In a chart show different techniques of representation of the theme of Thematic Maps.

4.16 REFERENCES FOR FURTHER STUDY

- Gupta K. K and Tyagi V. C., 1992: Working with Maps, Survey of India, DST, New Delhi.
- Singh R. L. and Singh R. P. B., 1999: Elements of Practical Geography, Kalyani Publishers
- Sarkar A.K Practical Geography: A Systematic Approach, Oriental Longman, Calcutta, 1997.
- Oxford dictionary



INTERPRETATION OF WEATHER MAPS AND GRAPHS

5.0. After going through this chapter you will be able to understand the following features:

- 5.1 Objectives
- 5.2 Introduction
- 5.3 Subject discussion
- 5.4 Line and bar graph
- 5.5 Climograph
- 5.6 Hythergraph
- 5.7 Wind rose
- 5.8 Weather maps: Reading and interpretation
- 5.9 Summary
- 5.10 Check your Progress/Exercise
- 5.11 Answers to the self learning questions
- 5.12 Technical words and their meaning
- 5.13 Task
- 5.14 References for further study

5.1. OBJECTIVES

By the end of this unit you will be able to:

- Understand Line and bar graph,
- Learn Climograph,
- Discuss Hythergraph and
- Evaluate Wind rose
- Understand Weather maps; Reading and interpretation

5.2. INTRODUCTION

In this unit we will study about Line and Bar graph which are mathematical representation of data. We will learn what are they used for along with how to interpret the data presented in the same. Next we will study Climograph which is a graphic presentation of the temperature and precipitation averages for a particular station.

Discussions will also be done on Hythergraph and Wind rose. Last but not the least comes Weather maps. In the latter part of this unit reading and interpretation of Weather maps will be done.

5.3. SUBJECT-DISCUSSION

Statistics is a special subject that usually deals with large numerical data which can be represented graphically. In fact, the graphical representation of statistical data is an essential step during statistical analysis. A graph is the representation of data by using graphical symbols such as lines, bars, pie slices, dots etc. A graph does represent a numerical data in the form of a qualitative structure and provides important information. The most astonishing part is that these graphs tell a story with visuals rather than in words or numbers and thus help readers understand the substance of the findings instead of the technical details behind each number. There are innumerable graphing options to present data. In this unit we will learn most popularly used ones such as line and Bar Graphs, Climograph, Hythergraph, Wind Rose and Weather Maps.

5.4. LINE AND BAR GRAPH.

5.4.1. A **line graph** is a graphical display of information that changes continuously over time. It is a type of graph which displays information as a series of data points called 'markers' connected by straight line segments. A line graph has two axes. The x-axis of a line graph shows the occurrences and the categories being compared over time and the y-axis represents the scale, which is a set of numbers that represents the data and is organized into equal intervals.

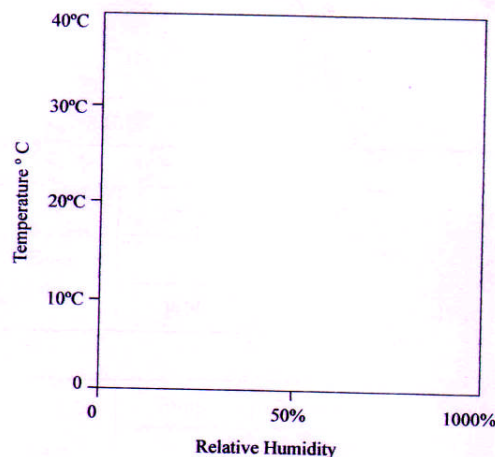
5.4.2. A **bar graph** is a pictorial presentation of statistical data and is drawn using rectangular bars to show how large each value is. It is a chart where bars are used to show comparisons between categories of data. The bars are either horizontal or vertical. A bar graph has two axes where one axis describes the types of categories being compared, and the other has numerical values that represent the values of the data. It does not matter which axis is which, but it will determine what bar graph is shown. If the descriptions are on the horizontal axis, the bars will be oriented vertically, and if the values are along the horizontal axis, the bars will be oriented horizontally.

Generally temperature and rainfall data of a particular station is shown by combined line and Bar graph.

5.5. CLIMOGRAPH

According to National Geographic, a climograph is a graphic representation of climate information. It is considered a useful tool for studying climate and its effects on the human environment. Thus we may say that a climograph is a graphical representation of basic climatic parameters that is monthly average temperature and Relative Humidity (R.H), at a certain location. It is used for a quick-view of the climate of a location. Hence climograph is a 12 sided polygon required for plotting mean, monthly vales of selected climatic elements of a particular station against one another. The shape and position of the resulted graph provides an idea about the general climatic character of a place.

Climograph or Climogram is very interesting and useful diagram designed by Griffith Taylor in 20th Century. This diagram is very useful in understanding climatic characteristics of the places. This diagram is drawn in a square frame. Where Relative humidity is represented along X-axis and Temperature is represented among Y-axis.



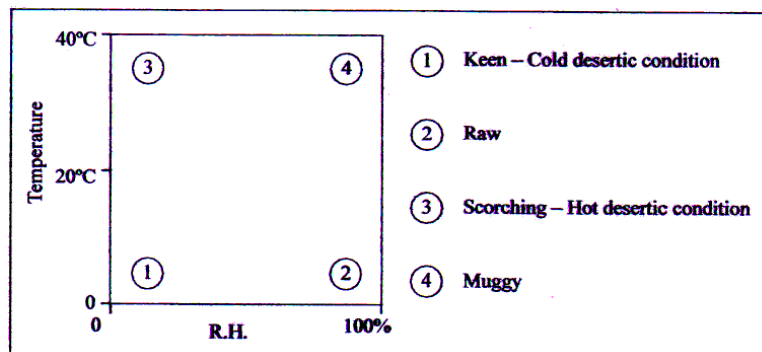
Monthly averages of relative humidity and temperature are required for the construction of this diagram. These 12 points (12 months) are plotted on this square frame (considering relative humidity and temperature of the month) by joining these points the twelve sided figure is obtained.

This is climograph of the place or weather station it represents.

Climograph represents climatic condition of a weather station in a diagrammatic form and hence it becomes very easy to understand nature of climate at a particular place. (Because one picture / diagram is equivalent to 1000 words).

At the same time climograph helps us to compare climatic conditions at two or more weather stations.

Human comfort is related to temperature and relative humidity. Hence climograph also provides us useful information of climate, related to our comfort.



Keen	Temp.	< 4°C	Low
	R.H.	< 40%	Low
Raw	Temp.	< 4°C	Low
	R.H.	> 70%	High
Scorching	Temp.	> 16°C	High
	R.H.	< 40%	Low
Muggy	Temp.	> 16°C	High
	R.H.	> 70%	High

This diagram - climograph was devised to show the scale of habitability for white settlers within the tropics.

5.6. HYTHERGRAPH

The Hythergraph is another Climograph devised by G. Taylor in the year 1949. Here mean monthly temperature values and mean monthly rainfall values are plotted. This is also a 12 sided polygon and it is drawn in a same way as that of Climograph.

This climatic diagram is also devised by Griffith Taylor. The procedure of construction of Hythergraph is similar to the procedure of construction of climograph. Difference in these two diagrams is show below.

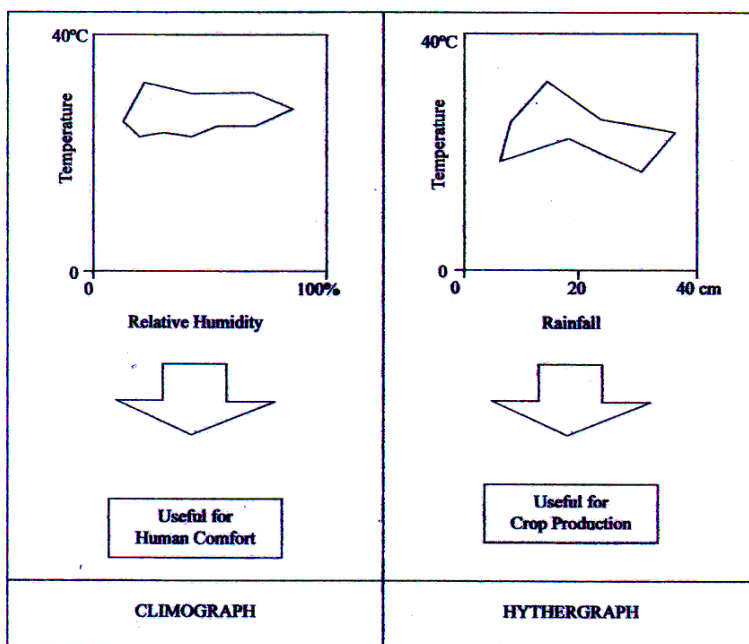


Fig. Climograph and Hythergraph

Exercises - Wind Rose

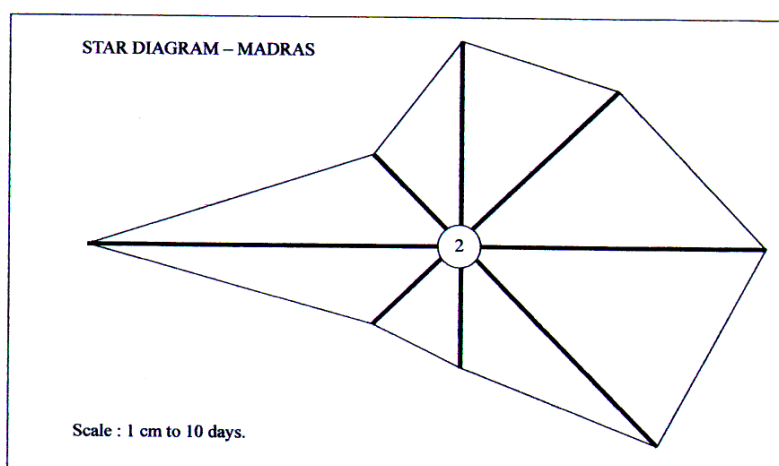
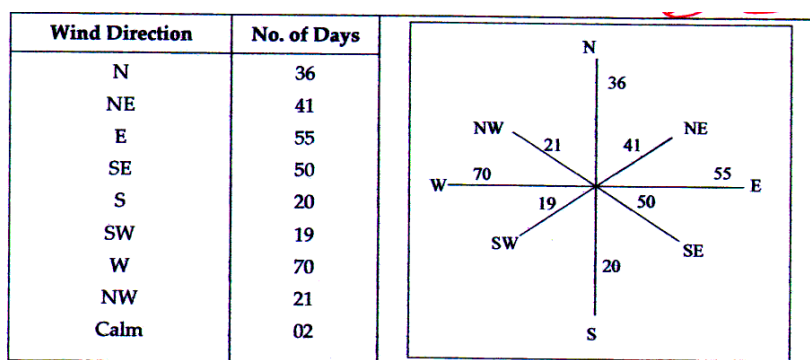
Draw wind rose for the date given below :

Direction of wind	N	NE	E	SE	S	SW	W	NW	Caln.
No. of Days	2	1	3	3	5	8	6	3	2

Direction of wind	N	NE	E	SE	S	SW	W	NW	Caln.
No. of Days	8	10	7	5	4	3	4	2	2

5.7. WIND ROSE

Wind Rose is a graph that shows the relative frequency, duration of the wind and strength of wind from different directions at a place. It is also called a Star Diagram. The number of calm days is marked in the center of graph and wind direction with a straight line.



Wide Rose

Represent the following data with the help of wind rose.

Station : Panvel

Wid Direction	N	NE	E	SE	S	SW	W	NW	Caln.
No. of Days	5	2	2	8	4	3	1	3	2

5.8. WEATHER MAP

A synoptic chart showing weather conditions, compiled from simultaneous observations taken at various weather stations is known as a weather map. It shows the condition of the weather in a certain area at a given time by indicating barometric pressures, temperatures, wind direction, etc.

5.9. SUMMARY:

After going through this unit of interpretation of weather maps and graphs we may come to the conclusion that these graphs and maps are a way to display the geographic distribution of data.

Sometimes we find frequency tables or other forms of numerical statistical results terrifying. But when the same information is presented in graphical form it helps us immensely making it easier to understand and less intimidating.

5.10. CHECK YOUR PROGRESS/ EXERCISE

1. True false

- a. A line graph is a pictorial presentation of statistical data and is drawn using rectangular bars to show how large each value is.
- b. Generally temperature and rainfall data of a particular station is shown by combined line and Bar graph.
- c. A Climograph is a graphic representation of temperature information.
- d. Hydergraph shows the condition of the weather in a certain area at a given time.
- e. A Wind Rose is also called a Star Diagram.

2. Fill in the blanks

- a. Statistics is a special subject that usually deals with large numerical data which can be represented_____.
- b. A line graph has _____axes.
- c. _____ is used for a quick-view of the climate of a location.
- d. Hydergraph is a 12 sided _____.
- e. In wind rose the number of calm days is marked in the _____of graph and wind direction with a _____ line.

3. Multiple choice question

- a. In line graph
 - i. the y-axis shows the occurrences and the categories being compared over time and the x-axis represents the scale.
 - ii. the x-axis shows a 12 sided polygon and the y-axis represents the scale.
 - iii. the x-axis shows the occurrences and the categories being compared over time and the y-axis represents the scale.
- b. The Hydergraph
 - i. is another Climograph devised by G. Taylor in the year 1949.

- ii. is another Climograph devised by G. Tomkins in the year 1959.
 - iii. is another Histogram devised by G. Taylor in the year 1949.
- c. Wind Rose
- i. is a map that shows the duration of the rainfall and strength of wind from different directions at a place.
 - ii. is a graph that shows the duration of the rainfall and strength of wind and temperature of different days at a place
 - iii. is a graph that shows the relative frequency, duration of the wind and strength of wind from different directions at a place.
- d. A weather chart
- i. shows the condition of the health in a certain area at a given time by indicating blood pressures, body temperatures, etc.
 - ii. shows the condition of the weather in a certain area at a given time by indicating barometric pressures, temperatures, wind direction, etc.
 - iii. shows the weather condition of a city only on Mondays by indicating barometric pressures, temperatures, wind direction, etc.
- e. A graph
- i. helps readers understand the substance of the findings instead of the technical details behind each number.
 - ii. never helps readers understand the substance of the findings instead one has to try hard to follow the technical details behind each number.
 - iii. helps readers understand the substance of the findings but one should have a profound knowledge of statistics to understand it.

4. Answers the following Questions

1. What is line graph?
2. What are bar graphs?
3. Write short notes on:
 - a. Climograph
 - b. Hythergraph
 - c. Wind rose
 - d. Weather maps:

5.11. ANSWERS TO THE SELF LEARNING QUESTIONS

- 1.a. false, A bar graph is a pictorial presentation of statistical data and is drawn using rectangular bars to show how large each value is.
- 1.b. true
- 1.c. false, A Climograph is a graphic representation of climate information
- 1.d. false, Weather map shows the condition of the weather in a certain area at a given time.
- 1.e. true
- 2.a. graphically
- 2.b. two
- 2.c. Climograph
- 2.d. polygon
- 2.e. Centre, straight
- 3.a.iii
- 3.b.i.
- 3.c.iii
- 3.d.ii
- 3.e.i.

5.12. TECHNICAL WORDS:

- **Scale** – it is the relation between the units that are used and their representation on the graph i.e., the distance between marks.
- **Weather Map**- it is a map that displays various meteorological features across a particular area at a particular point of time and has various symbols with specific meanings.
- **Climograph**- it is a graphical representation of basic climatic parameters.
- **Bar Graphs**- it is a diagram that shows the numerical values of variables represented by the height or length of lines or rectangles of equal width.
- **Wind Rose**- it is a diagram that shows the relative frequency of wind directions at a place.

5.13. Task

1. Draw a Line and Bar graph using the following data.

Months	Rainfall (in cm)	Temperature (in degree Celsius)
January	2	14
February	1	16
March	2	12
April	1	25
May	1	32
June	10	35
July	30	28
August	28	30
September	25	28
October	15	25
November	5	22
December	3	20

2. Draw a Climograph using the value below:

Months	Rainfall (in degree F)	Relative Humidity (in %)
January	65	68
February	68	63
March	76	60
April	84	64
May	85	70
June	84	77
July	81	82
August	83	83
September	84	80
October	79	78
November	72	71
December	66	63

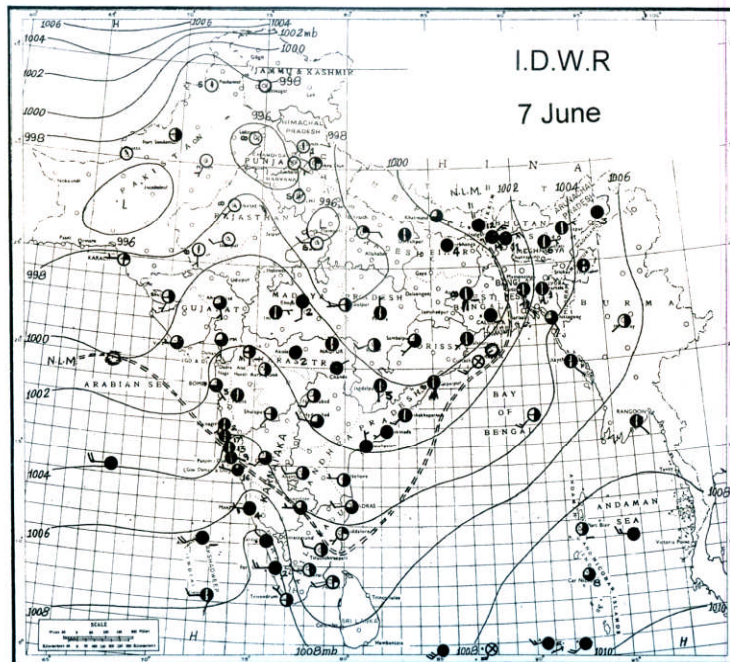
3. Draw a Hydergraph using the values below:

Months	Rainfall (in degree F)	Relative Humidity (in %)
January	65	68
February	68	63
March	76	60
April	84	64
May	85	70
June	84	77
July	81	82
August	83	83
September	84	80
October	79	78
November	72	71
December	66	63

4. Draw a Wind Rose using the following data:

Direction	Duration (in days)
North	75
North East	60
East	20
South East	25
South	50
South West	55
West	10
North West	55
Calm	15

5. Interpret the Weather Map



5.14. REFERENCES FOR FURTHER STUDY

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STATISTICAL TECHNIQUE, COMPUTER AND SURVEYING

Unit Structure :

- 6.1 Objective
- 6.2 Introduction
- 6.3 Need and importance of the statistical techniques
- 6.4 Nature of the statistical data
- 6.5 Frequency distribution
- 6.6 Measures of Central tendency - Mean
- 6.7 Measures of Central tendency - Median
- 6.8 Measures of Central tendency - Mode

6.1 OBJECTIVE

- To understand the need & importance of the statistical techniques.
- To understand classification & tabulation of data.
- To study statistical techniques.

6.2 INTRODUCTION

We are in the 21st century. In the era of Globalization - Scientific inventions & Widespread use of technology lot of information is available in different forms. This information can be in the qualitative form e.g. Information about the people, area, subject etc. or it can be in the quantitative form i.e. Numerical data.

Quantitative information is more precise than the qualitative information. Hence it is widely use in research & development processes. Statistical techniques help us to store, classify and analyse data so that we can compare it & draw inferences or to make use of this data for our projects. Hence it is necessary & very interesting to study various statistical techniques.

6.3 NEED AND IMPORTANCE OF THE STATISTICAL TECHNIQUES

Last century witnessed large scale development in the field of science and technology. Modern machines like calculator and computers have become common and are part of our everyday life. But these are just machines. They can do analysis of data but they require suitable programme or software for all operations. It is necessary to understand various statistical techniques so that we can select suitable programme for the analysis of our data. Statistical techniques help us to compress large amount of data and help us in the analysis of the data so that we can interpret results and can take proper decision instantly.

Statistical operations form basis of the entire field of science & commerce. These are very essential for our development.

6.4 NATURE OF THE STATISTICAL DATA

Information or data can be in different forms.

a) Qualitative data - Descriptive data e.g. Biography of a person, description of a project etc.

b) Quantitative data - Numerical data e.g. Amount of rainfall in different regions; Agricultural production, population etc. various statistical techniques are designed for the analysis of the quantitative data.

Data can also be classified as

- a) Spatial data
- b) Temporal data

a) Spatial data - Data related to space, area, region, village, Town, Taluka, District, State, Nation etc.

b) Temporal data - Data related to time e.g. growth of population from 1901 to 2011, Production of wheat from 1961 to 2011

Statistical data can be obtained from various sources. On the basis of collection of data it can be classified as

- a) Primary data
- b) Secondary data

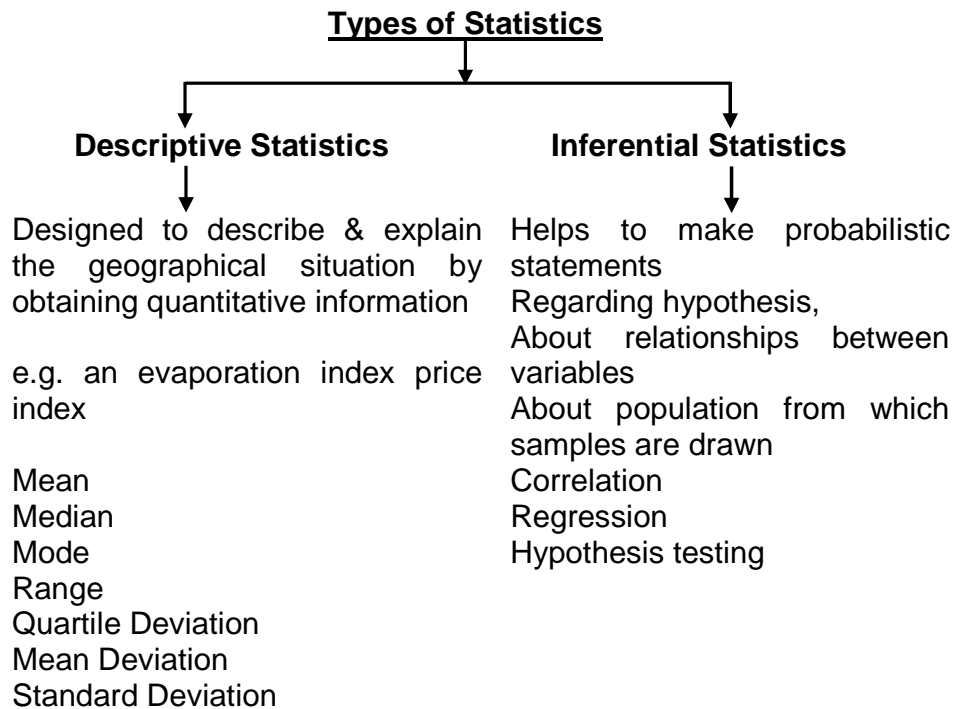
a) Primary data - As the name indicates, primary data are collected for the first time and are thus original in character.

Primary data can be collected in different forms.

- 1) Direct personal investigation
- 2) Indirect oral investigation
- 3) By schedules and questionnaires
- 4) By local reports

b) Secondary data - Secondary data are those which have already been collected and analysed by someone else. Secondary data may be either published or unpublished. The sources of published data (secondary data) are as follows -

- 1) Central, State & local government publications.
- 2) United nation's reports, World Bank report etc.
- 3) Reports of companies, NGO & other organization.
- 4) Journals related to different subjects.
- 5) Research reports



6.5 FREQUENCY DISTRIBUTION

Frequency distribution helps us to classify large amount of data into 5-10 classes, so that it becomes more compact and can be used for further analysis. Let us understand following examples.

- Q.1 Prepare frequency distribution table for the following data.
Amount of rainfall at 50 places of 'X' district. (Rainfall in cm)

25	210	420	170	370	290	310	185	280	240
125	310	30	470	220	110	40	410	75	127
490	90	320	140	22	175	130	130	190	60
410	138	410	95	360	380	80	170	45	260
330	470	140	280	130	160	420	230	270	140

Let us find out smallest and largest number in the given data.

Smallest number = 25
Largest number = 490

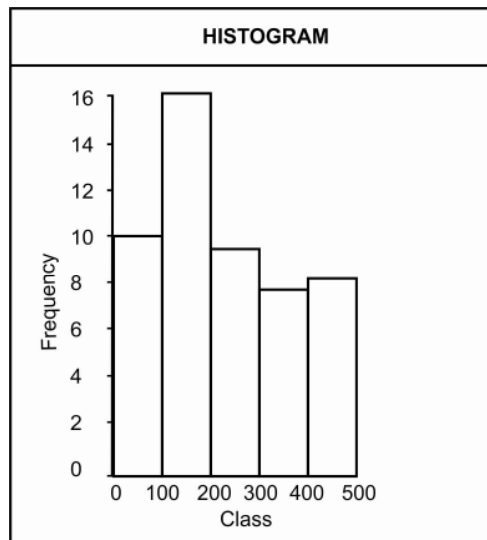
Now we can take five classes to cover this data as a 0-100, 100-200, 200-300, 300-400 and 400-500.

Let us prepare frequency distribution table.

Class	Tally Score	Frequency
0 - 100		10
100 - 200		16
200 - 300		09
300 - 400		07
400 - 500		08
	Total	30

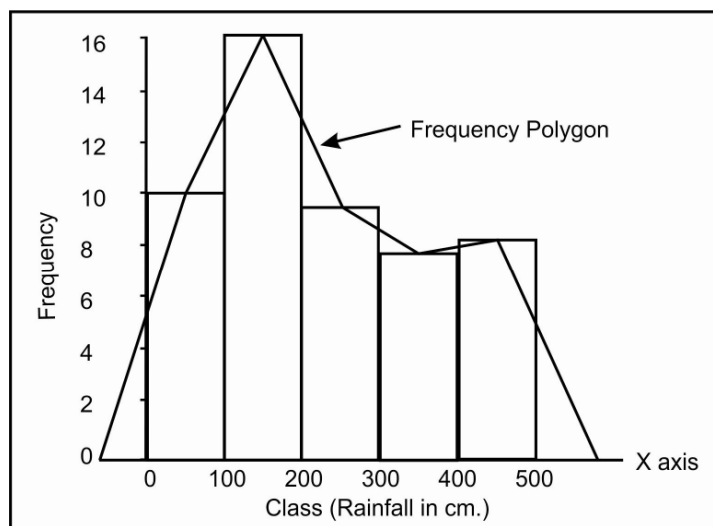
Tally score are the slant lines used for classification of data. A bunch of 5 is formed as it becomes easy to count numbers in the multiples of 5.

We can prepare Histogram for this frequency distribution table.



Histogram is a graphical representation of the frequency distribution table. Just by looking at the Histogram we get complete idea of the distribution of data in different classes; because bars in the histogram are drawn proportional to the number of variables in a particular class.

We can also draw frequency polygon for the same data. In order to prepare frequency polygon join mid points of the top portions of bars drawn in Histogram.



Join extreme ends of the frequency polygon to the 'X' axis as shown in the diagram.

Frequency Curve can be drawn for the same data. Procedure for drawing frequency curve is same as drawing of frequency polygon. But instead of joining points by straight line, these points are joined by curved line.

The statistical data obtained in primary survey, which is not grouped or classified is termed as the ungrouped data. e.g. Agricultural yield in 20 farms (in thousand tonnes).

500	290	290	180	470
100	800	750	980	850
420	960	700	775	500
150	300	400	375	400

When this data is grouped into different classes in frequency distribution table it is termed as group data. grouped data can be related to Discrete or Continuous series.

Discrete Series - In this type of data the items are capable of exact measurement. (No fraction) e.g. Number of persons, Number of Countries, Number of rivers etc.

Continuous Series - In this type of data the items are capable of division and can be measured in fractions of any size. E.g. Amount of rainfall, temperature, weight, height of the person etc.

Discrete series		Continuous series	
No. of Children per couple	No. of couples	Height in cm.	No. of persons
2	40	140 - 150	20
3	10	150 - 160	15
4	05	160 - 170	22

Cumulative Frequency -

Consider following two examples.

- 1) You wish to distribute milk products for children whose age is less than 5 years.
- 2) You are preparing / updating list of persons whose age is more than 18 years, for the purpose of election.

We require less than or more than type of data frequently, for which cumulative frequency distribution table is prepared.

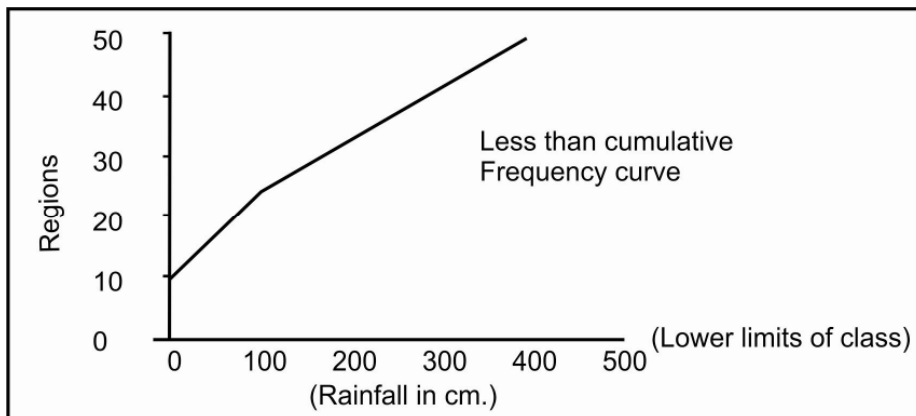
Q.1 Prepare cumulative frequency distribution table for the following data.

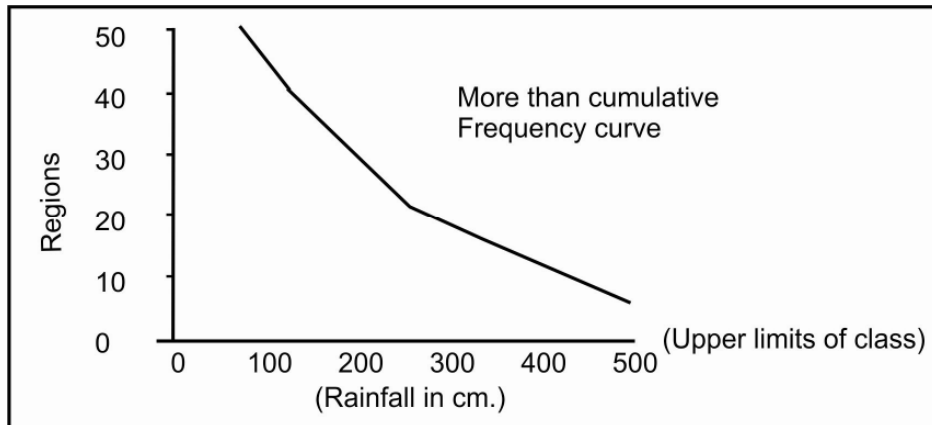
Rainfall (in cm)	No. of regions
0 - 100	10
100 - 200	16
200 - 300	09
300 - 400	07
400 - 500	08
Total	50

To prepare cumulative frequency table, values are progressively added or subtracted as shown in the following table.

Rainfall (in cm)	Regions	Cumulative frequency less than	Cumulative frequency more than
0 - 100	10	10	50
100 - 200	16	26	40
200 - 300	09	35	24
300 - 400	07	42	15
400 - 500	08	50	08
Total	50		

Cumulative frequency curve are also termed as ogive.





6.6 MEASURES OF CENTRAL TENDENCY

In order to compare one set of data (1000 values) with another set of data (1000 values) we require average or central number which represents the entire data.

“Average is an attempt to find one single figure to describe whole of figures.”

- Clark

Average is normally value near to the middle value in the given data, so it is also called as the Central value. Some values in the data are less than the average value and some values are more than the average value.

e.g. Find out average of following numbers.

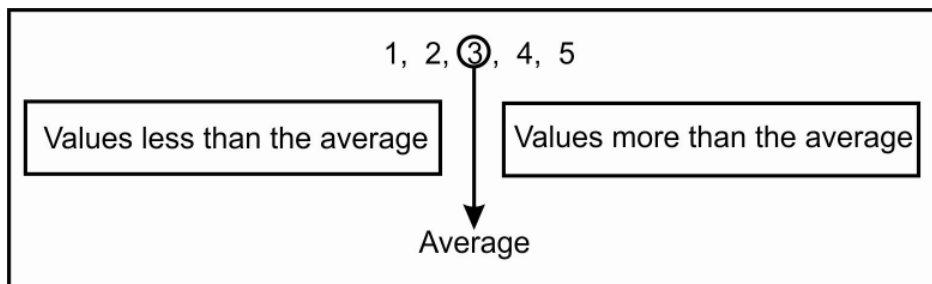
1, 2, 3, 4, 5

Let us add these numbers $1 + 2 + 3 + 4 + 5 = 15$.

Total number of values = 5

$$\text{Average} = \frac{15}{5} = 3$$

Average of the given numbers is 3.



Average value, being central value is also termed as Measures of Central Tendency. Different types of measures of central tendency are

- 1) Mean
- 2) Median
- 3) Mode

1) Mean - It is also termed as 'average' or arithmetic mean. It is obtained by adding together all items and by dividing this total by the number of items.

$$\bar{X} = \frac{\sum X}{n}$$

Where \bar{X} = Arithmetic average or mean

$\sum X$ = Total of all values in the data.

n = Total number of values.

Find out mean of the following data 0, 10, 20

$$\sum X = 0 + 10 + 20 = 30 \text{ Total of all values in the data.}$$

$n = 3$ Total number of values.

$$\bar{X} = \frac{\sum X}{n} = \frac{30}{3} = 10$$

$$\bar{X} \text{ (Mean)} = 10$$

Ungrouped data

Mean - 1, 2, 4, 6, 8, 10, 10

$$\sum X = 1 + 2 + 4 + 6 + 8 + 10 + 10 = 41$$

$$n = 7$$

$$\therefore \bar{X} = \frac{\sum X}{N}$$

$$= \frac{41}{7}$$

$$= 5.85$$

The average value of the given data according to the Mean is 5.85

**Grouped data - discrete -
Mean -**

Rainfall (in cm)	Regions
100	2
200	5
300	3

Rainfall (in cm) X	Regions f	fx
100	2	200
200	5	1000
300	3	900

$$\sum X = 2100$$

$$\sum f = 10$$

$$\begin{aligned}\bar{X} &= \frac{\sum fX}{\sum f} \\ &= \frac{2100}{10} \\ &= 210 \text{ cms}\end{aligned}$$

The average amount of rainfall per region according to mean is 210 cms.

**Grouped data - continuous -
Mean -**

Rainfall (in cm) X	Regions f	Mid point x	fx
0 - 100	4	50	200
100 - 200	10	150	1500
200 - 300	6	250	1500
	$\sum f = 20$		$\sum fX = 3200$

$$\sum fX = 3200$$

$$\sum f = 20$$

$$\begin{aligned}\text{Mean } \bar{X} &= \frac{\sum fX}{\sum f} \\ &= \frac{3200}{20} \\ \bar{X} &= 160\end{aligned}$$

The average agricultural yield per region according to mean is 160 thousand tonnes.

Merits of Arithmetic Mean -

- 1) It is central value, it is the centre of gravity balancing values on either side of it.
- 2) It is affected by the value of every item in the series.
- 3) It is easy to understand and calculate.
- 4) It is calculated by a rigid formula.
- 5) It is useful for further statistical analysis.

Limitations of Arithmetic Mean -

- 1) Extreme values of the data affect Mean -
e.g.
 - a) Average of 1, 2, 3 is $1 + 2 + 3 = 6$
 $6 \div 3 = 2$
 - b) but average of 1, 2, 1002 is $1 + 2 + 1002 = 1005 \div 3 = 335$

In the second example the extreme value affects Mean.

- 2) It can not be calculated for incomplete data. i.e. all values are required for calculation of mean.

6.7 MEASURES OF CENTRAL TENDENCY - MEDIAN

'Median' means middle value in a distribution (of data). Median splits the observation into two parts. (lower & higher values) median is also termed as a Positional average.

The term 'Position' means the place of value in a given data.

e.g.

Q.1 Find out median for the following data 1, 2, 4, 6, 8, 10, 10

Median -

1	Median value = $\frac{n+1}{2}$ $= \frac{7+1}{2}$ $= \frac{8}{2}$ $= 4^{\text{th}} \text{ value}$
2	
4	
6 ← Median	
8	
10	
10	
10	

∴ The average value according to median is 6

Q.2 Find out median for the following data 3, 4, 2, 1, 5, 7

Let us rearrange numbers in proper order - 1, 2, 3, 4, 5, 7

As the number is even (six) the mid point will be between 3rd & 4th value. Hence Median = $\frac{3+4}{2} = \frac{7}{2} = 3.5$

Grouped data - discrete

Median -

Rainfall (in cms) - 100, 200, 300

Regions - 2, 5, 3

Rainfall (in cms)	Regions f	Cumulative frequency less than
100	2	2
200	5	7
300	3	10
	$\sum f = 10$	

$$\text{Median} = \frac{n+1}{2} = \frac{11}{2} = 5.5^{\text{th}} \text{ value}$$

As this number - (5.5th value) is more than 2 (cumulative frequency) but less than 7, hence the median is located in the class whose cumulative frequency is 7. the rainfall amount of this class is 200 cm.

∴ The average amount of rainfall per region according to median is 200 cms.

Median -

Agricultural yield in thousand tons	Regions	Cumulative frequency less than
0 - 100	4	4
100 - 200	10	14
200 - 300	6	20
	$\sum f = 20$	

$$m = \text{middle value} = \frac{n}{2} = \frac{20}{2} = 10$$

∴ As number 10 is more than 4 but less than 14, median will be found in the class 100 - 200 - (median class)

$$\text{Median} = l_1 + \frac{l_2 - l_1}{f_1}(m - c)$$

$$l_1 = 100, l_2 = 200, f_1 = 10$$

$$= 4 \quad m = 10$$

$$= 100 + \frac{200 - 100}{10}(10 - 4)$$

$$= 100 + \frac{100}{10}(6)$$

$$= 100 + 10(6)$$

$$= 100 + 60$$

$$= 160$$

The average agricultural yield per region according to median is 160 thousand tonnes.

$$\text{Median} = l_1 + \frac{l_2 - l_1}{f_1}(m - c)$$

l_1 = lower limit of the class

l_2 = upper limit of the class

f_1 = Frequency of the median class

m = middle value

c = Cumulative frequency of the preceding class

Merits of Median -

- 1) Extreme values do not affect the median.
- 2) It is useful for open and data as only the position and not the values of items must be known.
- 3) It is easier to compute than the mean.
- 4) It can be used for qualitative data i.e. where ranks are given.
- 5) The value of median can be found out graphically.

Limitations of the median -

- 1) It is necessary to arrange data in proper order for calculation of median.
- 2) As it is a positional average, its value is not determined by each and every observation.
- 3) It is not much used for further statistical analysis.
- 4) The value of median is affected by sampling fluctuation than the value of the arithmetic mean.

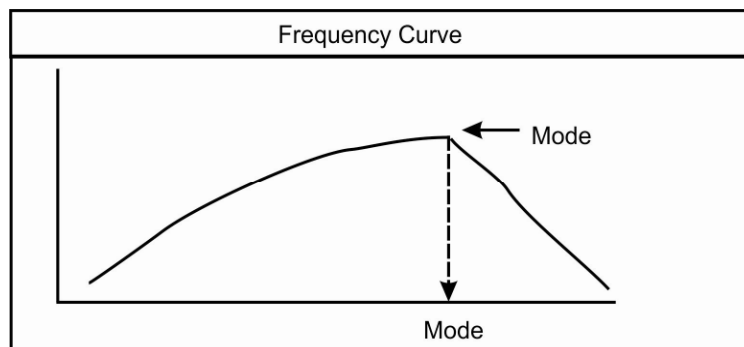
6.8 MEASURES OF CENTRAL TENDENCY - MODE

The mode or the modal value is that value in a series of observations which occurs with the greatest frequency.

Mode - 1, 2, 4, 6, 8, 10, 10

Mode = 1 - as 10 is the most common number in the given data.

The Mode, this word is derived from the French word 'La Mode' means fashion. Where most of the people in the society use similar type of dress. Mode is at the highest peak of the frequency curve.



Mode - Discrete series

Rainfall (in cms)	Regions
100	2
200	5
300	3

← Maximum value - ∴ Modal class

Mode = 200 cms.

The average amount of rainfall received by each region according to mode is 200 cms.

Mode - Continuous Series

Agricultural production in thousand tons	Regions
0 - 100	4
100 - 200	10
200 - 300	6

← Maximum value -
Modal class

$$\begin{aligned}
 \text{Mode} &= l_1 + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} (l_2 - l_1) \\
 &= l_1 = 100, f_1 = 10, f_0 = 4, f_2 = 6 \\
 &\quad l_2 = 200 \\
 &= 100 + \frac{10 - 4}{2(10) - 4 - 6} (200 - 100) \\
 &= 100 + \frac{6}{20 - 10} (100) \\
 &= 100 + \frac{6}{10} (100) \\
 &= 100 + \frac{600}{10} \\
 &= 100 + 60 \\
 &= 160
 \end{aligned}$$

The average amount of agricultural production per region according to mode is 160 thousand tonnes.

The mode can also be obtained by using following formula based upon the relationship between mean, median & mode.

$$\text{Mode} = 3 \text{ Median} - 2 \text{ Mean}$$

Merits of mode -

- 1) It is easy to find mode in a given data.
- 2) It is not affected by the extreme values.
- 3) It can be used for the qualitative data.

e.g. Most preferred colour of dress by girls.

- 1) Alka - Pink
- 2) Swati - Blue
- 3) Narendra - Red
- 4) Sonali - Pink
- 5) Soni - Pink
- 6) Kshama - Red

From the data it is clear that 3 out of 6 girls prefer Pink and so mode is pink colour. We can say that girls prefer pink dresses.

- 4) The value of mode can also be obtained from frequency curve (without doing calculation)

Limitations of Mode -

- 1) The value of mode cannot always be determined. - e.g. in the bimodal (Two modes) or multimodal frequencies.
- 2) It is not multi used in further statistical analysis.
- 3) It does not include all items of the data.
- 4) It is not much used.



MEASURES OF DISPERSION

Unit Structure :

- 7.1 Objective
- 7.2 Introduction
- 7.3 Measures of dispersion-Range
- 7.4 Quartile Deviation
- 7.5 Mean Deviation
- 7.6 Standard Deviation
- 7.7 Moving Average
- 7.8 Area Mean

7.1 OBJECTIVE

- To understand the concept of dispersion.
- To study various types of dispersion.
- To understand techniques of moving average & area mean.

7.2 INTRODUCTION

In measures of central tendency we get one representative number (Mean, Median or Mode) for the given data. hence we can compare two sets of data easily.

e.g. Set A = Mean = 80% marks
Set B = Mean = 40% marks

In this case distinction between two sets of data is very clear. So we can compare them & take decision.

Now consider following example.

Set X = 0, 10, 20
Set Y = 10, 10, 10

Set X = 0+10+20 = 30

$$\bar{X} = \frac{\sum X}{n} = \frac{30}{3} = 10$$

$$\text{Set } Y = 10 + 10 + 10 = 30$$

$$\bar{X} = \frac{\sum X}{n} = \frac{30}{3} = 10$$

Average value or mean for set X & set Y is same. Now it is difficult to compare these two sets.

Hence we require Measures of dispersion.

It is degree to which numerical data tend to spread about an average value is called the variation of dispersion of the data.

Range is one of the type of dispersion technique.

$$\text{Range} = \text{Max. Value} - \text{Min. Value}$$

$$\text{Set } X = 0, 10, 20 = \text{Maximum Value} = 20$$

$$\text{Min. Value} = 0$$

$$\text{Range} = 20 - 0 = 20$$

$$\text{Set } Y = 10, 10, 10 = \text{Maximum Value} = 10$$

$$\text{Min. Value} = 10$$

$$\text{Range} = 10 - 10 = 0$$

Range is zero for Set Y. Which means the average value for Set 'Y' is more reliable than the average value for Set 'X'

7.3 RANGE

Range is the difference between the value of the smallest item and the value of the largest item included in the distribution.

$$\text{Range} = \text{Max. Value} - \text{Min. Value}$$

For ungrouped data

Find out range for the following data.

5, 1, 7, 8, 15, 20, 9, 10, 12, 14, 21, 3, 6, 5, 5, 2, 4, 10

$$\text{Maximum Value} = 21$$

$$\text{Minimum Value} = 1$$

$$\text{Range} = 21 - 1 = 20$$

**Grouped data - discrete -
Range -**

Rainfall (in cm)	Regions
100	2
200	5
300	3

Maximum amount of rainfall = 300 cms.
 Minimum amount of rainfall = 100 cms
 Range = 200 cms.

∴ Range, is 200 cms of rainfall. i.e. the amount of variation in the rainfall according to range is 200 cms.

**Grouped data - Continuous -
Range -**

Agricultural Production in thousand tons	Regions
0 - 100	4
100 - 200	10
200 - 300	6

Maximum agricultural production = 300 thousand tons
 Minimum agricultural production = 0 thousand tons
 Range = 300 thousand tons

Merits of Range -

- 1) Simplest & easiest method of dispersion.
- 2) It requires minimum time to calculate range.

Limitations of Range -

- 1) Range is not based on each and every item of the distribution.
- 2) Range is most unreliable measure of dispersion.
e.g.

7.4 QUARTILE DEVIATION

Quarter means 25%. In quartile deviation data is divided into four parts (25% each). First quarter is at 25%, Second quarter is at 50%, third quarter is at 75%, Fourth quarter is at 100%.

Difference in the third (Q3) and first (Q1) quartiles is termed as inter quartile range.

$$\text{Inter quartile range} = Q3 - Q1$$

Inter quartile range is reduced to the form or semi-inter quartile range or quartile deviation; by dividing it by 2.

Quartile Deviation -

$$Q.D. = \frac{Q3 - Q1}{2}$$

Quartile deviation gives the average amount by which the two quartiles differ from the median (50%)

Quartile deviation -

Rainfall (in cms)	Regions	Cumulative frequency less than	
100	2	2	
200	5	7	Q.1
300	3	10	Q3
	$\sum f = 10$		

$$Q1 = \frac{1}{4} \times 10 = 2.5 \text{ region } \therefore Q1 = 200$$

$$Q3 = \frac{3}{4} \times 10 = 7.5 \text{ region } \therefore Q3 = 300$$

$$\begin{aligned} \text{Quartile deviation} &= \frac{Q3 - Q1}{2} \\ &= \frac{300 - 200}{2} \\ &= \frac{100}{2} \\ &= 50 \text{ cms} \end{aligned}$$

Quartile deviation -

Agricultural yield thousand tons	Regions	Cumulative frequency less than
0 - 100	4	4
100 - 200	10	14
200 - 300	6	20
	$\sum f = 20$	

$$Q1 = \frac{1}{4} \times 20 = 5 = 100 - 200 \text{ Agricultural production thousand tons}$$

$$Q3 = \frac{3}{4} \times 20 = 15 = 200 - 300 \text{ Agricultural production thousand tons}$$

$$\text{Median} = l_1 + \frac{\frac{l_2 - l_1}{f_1}(m - c)}$$

$$\begin{aligned} Q1 &= 100 + \frac{200 - 100}{10}(5 - 4) \\ &= 100 + \frac{100}{10}(1) \\ &= 100 + 10 \\ &= 110 \end{aligned}$$

$$\begin{aligned} Q3 &= 200 + \frac{300 - 200}{10}(15 - 14) \\ &= 200 + \frac{100}{10}(1) \\ &= 200 + 16.6 \\ &= 216.6 \end{aligned}$$

$$\begin{aligned} \text{Quartile deviation} &= \frac{Q3 - Q1}{2} \\ &= \frac{216.6 - 110}{2} \\ &= 53.3 \end{aligned}$$

The variation in the agricultural yield among different regions according to quartile deviation is 53.3 thousand tonnes.

Merits of Quartile Deviation

- 1) It is superior to range as a measure of dispersion.
- 2) It can be used for open end distributions.
- 3) Quartile deviation is not affected by the extreme values.

Limitations of Quartile Deviation

- 1) Quartile deviation ignores 50% items. i.e. the first 25% and last 25%.
- 2) It is not much used for further statistical analysis.
- 3) It's value is affected by sampling fluctuations.

7.5 MEAN DEVIATION

The Mean deviation is also known as the average deviation. It is the average difference between the items in a distribution and the median or mean of that series.

In mean deviation of each item in the series is found out from the median. All deviations are added together (ignoring + or - signs). This total is divided by the number of observations.

$$\text{Mean Deviation} = \frac{\sum d}{n}$$

$\sum d$ = Sum of all deviations
 n = number of observations / items

Calculate mean deviation for the following series.

X	10	11	12	13	14
F	3	12	18	12	3

Answer -

X	f	d	fd	c.f
10	3	2	6	3
11	12	1	12	15
12	18	0	0	33
13	12	1	12	45
14	3	2	6	48
	$n = 48$		$\sum fd = 36$	

$$\text{Mean deviation} = \frac{\sum fd}{n}$$

$$\begin{aligned}\text{Median} &= \text{size of } \frac{n+1^{\text{th}}}{2} \text{ item} \\ &= \frac{48+1}{2} = 24.5^{\text{th}} \text{ item}\end{aligned}$$

Size of 24.5th item is 12

Hence Median = 12

$$\text{M.D.} = \frac{36}{48} = 0.75$$

Mean Deviation - Continuous series

Q.2 Calculate the median and mean deviation of the following data.

Size	Frequency
0 - 10	7
10 - 20	12
20 - 30	18
30 - 40	25

Size	Frequency
40 - 50	16
50 - 60	14
60 - 70	8

Answer -

Size	f	c.f.	Mid point m	d = m - 35.2	fd
0 - 10	7	7	5	30.2	211.4
10 - 20	12	19	15	20.2	242.4
20 - 30	18	37	25	10.2	183.6
30 - 40	25	62	35	0.2	5.0
40 - 50	16	78	45	9.8	156.8
50 - 60	14	92	55	19.8	277.2
60 - 70	8	100	65	29.8	238.4
	$\sum f = 100$				$\sum fd = 1314.8$

$$\text{Median} = \text{size of } \frac{n}{2} \text{ item} = \frac{100}{2} = 50^{\text{th}} \text{ item}$$

Median lies in the class 30 - 40

$$\text{Median} = l_1 + \frac{n/2 - c.f.}{f} \times i$$

$$l_1 = 30, n/2 = 50, c.f. = 35, f = 25, i = 10(40 - 30)$$

$$\begin{aligned}\text{Median} &= 30 + \frac{50 - 37}{25} \times 10 \\ &= 30 + 5.2 = 35.2\end{aligned}$$

$$\text{Mean deviation} = \frac{\sum fd}{n} = \frac{1314.8}{100} = 13.148$$

Merits of Mean Deviation -

- 1) It is relatively simple to understand & compute.
- 2) It is based on each and every item of the data.
- 3) It is less affected by the extreme items of the data.

Limitations of M.D. -

- 1) Algebraic signs (+, -) are ignored in M.D.
- 2) It may not give us accurate results.
- 3) It is not capable of further statistical analysis.

7.6 STANDARD DEVIATION

Standard deviation is the square root of the arithmetic average of the squares of the deviations measured from the mean.

To find the S.D. the following steps are taken.

- 1) Find the deviations from the mean.
- 2) Square those deviations.
- 3) Find the mean of the sum of these deviations squared.
- 4) Find the square root of this mean.

Standard deviation-Grouped data - discrete.

Q. Find out S.D. for the following data.

Yield (in 000' kg) (X)	No. of regions (f)
40	10
45	15
50	25
55	30
60	28
65	13
70	9

Yield (X)	Regions (f)	fx
40	10	400
45	15	675
50	25	1250
55	30	1650
60	28	1680
65	13	845
70	9	630
	$\sum f = 130$	$\sum fx = 7130$

$$\text{Mean} = \frac{\sum fx}{\sum f} = \frac{7130}{130}$$

$$\text{Mean} = \bar{X} = 55$$

**Ungrouped data -
Standard deviation -**

1, 2, 4, 6, 8, 10, 10

X	d	d^2
1	- 4.9	24.0
2	- 3.9	15.2
4	- 1.9	3.6
6	0.1	0.01
8	2.1	4.4
10	4.1	16.8
10	4.1	16.8
$\sum x = 41$		$\sum d^2 = 80.8$

$$\text{Mean} = \frac{\sum x}{n}$$

$$= \frac{41}{7}$$

$$= 5.85$$

$$\bar{X} = 5.9$$

$$d = X - \bar{X}$$

$$\begin{aligned} \text{Standard deviation} &= \sqrt{\frac{\sum d^2}{n}} \\ &= \sqrt{\frac{80.8}{7}} \\ &= \sqrt{11.54} \\ &= 3.39 \end{aligned}$$

\therefore Standard deviation of the given data is 3.39.

Standard deviation - ungrouped data.

Find out S.D. for the following data.

Height (in inches) 60, 60, 61, 62, 63, 63, 63, 64, 64, 70

Height (in inches) X	Deviations from mean (63°) d	d^2	Mean = $\frac{\sum x}{n}$
60	- 3	9	$= \frac{630}{10}$ $= 63''$ $= (X - \bar{X})$
60	- 3	9	
61	- 2	4	
62	- 1	1	
63	0	0	
63	0	0	
63	0	0	
64	+1	1	
64	+1	1	
70	+7	49	
$\sum x = 630$		$\sum d^2 = 74$	

$$\begin{aligned} \text{Standard deviation or } \sigma &= \sqrt{\frac{\sum d^2}{n}} \\ &= \sqrt{\frac{74}{10}} \\ &= \sqrt{7.4} \\ &= 2.72'' \end{aligned}$$

∴ Deviation in height according to Standard deviation is 2.72'' .

**Group data -
Standard deviation - Continuous series.**

Find out S.D. for the following data.

Rainfall (in cm)	Regions
0 - 100	2
100 - 200	5
200 - 300	4
300 - 400	2

Rainfall (in cm)	Mid point X	f	fx	$\text{Mean} = \frac{\sum fx}{\sum f}$ $= \frac{2550}{13}$ $= 196.15$ $d = (X - \bar{X})$
0 - 100	50	2	100	
100 - 200	150	5	750	
200 - 300	250	4	1000	
300 - 400	350	2	700	
		$\sum f = 13$	2550	

Rainfall (in cm)	Mid point X	f	Deviation from mean 196.15 (d)	fd	fd ²
0 - 100	50	2	- 146.15	292.3	42719.6
100 - 200	150	5	- 46.15	230.75	10649.1
200 - 300	250	4	53.85	215.4	11599.3
300 - 400	350	2	153.85	307.7	47339.6
		$\sum f = 13$		$\sum fd = 1046.2$	$\sum fd^2 = 112307.6$

$$\begin{aligned}\sigma &= \sqrt{\frac{\sum fd^2}{\sum f}} \\ &= \sqrt{\frac{112307.6}{13}} \\ &= \sqrt{8639} \\ &= 92.95 \text{ cms}\end{aligned}$$

∴ Rainfall variability according to S.D. is 92.95 cms.

Standard deviation -

Rainfall (in cm) X	Regions f	fx
100	2	200
200	5	1000
300	3	900
	$\sum f = 10$	$\sum fx = 2100$

$$\begin{aligned} \text{Mean} &= \frac{\sum fx}{\sum f} \\ &= \frac{2100}{10} \\ \bar{X} &= 210 \\ d &= X - \bar{X} \end{aligned}$$

Rainfall (in cm) X	Regions f	Deviation from mean =210 d	fd	fd ²
100	2	- 110	- 220	24,200
200	5	- 10	- 50	500
300	3	90	270	24,300
	$\sum f = 10$			$\sum fd^2 = 49,000$

$$\begin{aligned} \text{S.D.} &= \sqrt{\frac{\sum fd^2}{\sum f}} \\ &= \sqrt{\frac{49000}{10}} \\ &= \sqrt{4900} \end{aligned}$$

S.D. = 70 cms. of rainfall

Variation in the amount of rainfall according to standard deviation is 70 cms.

Standard deviation -

Agricultural Production in thousand tonnes	Mid point X	Regions f	fx
0 - 100	50	4	200
100 - 200	150	10	1500
200 - 300	250	6	1500
		$\sum f = 20$	$\sum fx = 3200$

$$\text{Mean} = \frac{\sum fx}{\sum f} = \frac{3200}{20} = 160$$

$$\bar{X} = 160 \text{ thousand tons. } d = (X - \bar{X})$$

Agricultural Production in thousand tons	Mid point X	Regions f	Deviation from mean 160 d	fd	fd^2
0 - 100	50	4	- 110	440	48,400
100 - 200	150	10	- 10	100	1000
200 - 300	250	6	90	540	48600
		$\sum f = 20$			$\sum fd^2 = 98,000$

$$\begin{aligned} \text{Standard Deviation} &= \sqrt{\frac{\sum fd^2}{\sum f}} \\ &= \sqrt{\frac{98,000}{20}} \\ &= \sqrt{4900} \\ &= 70 \end{aligned}$$

The variation in the agricultural production among diff regions according to standard deviation is 70 thousand tons.

Merits of S.D.

- 1) It is the best method of deviation.
- 2) It is based on every item of the distribution.
- 3) It is used in further statistical analysis.

Limitations of S.D.

- 1) It is difficult & time consuming to calculate than other methods.
- 2) It gives more weight to extreme items & less to those which are near the mean.

7.7 MOVING AVERAE

In moving average method averages of three or five years are calculated, so that we are able to remove yearly fluctuations in the data & we can get general trend. The 3 yearly moving average shall be computed as follows.

$$\frac{a+b+c}{3}, \frac{b+c+d}{3}, \frac{c+d+e}{3} \dots$$

The 5 yearly moving average shall be computed as follows :

$$\frac{a+b+c+d+e}{5}, \frac{b+c+d+e+f}{5}, \frac{c+d+e+f+g}{5} \dots$$

Q.1 Calculate 3 yearly moving average of the production figures given below & draw trend line.

Year	Production
1973	15
1974	21
1975	30
1976	36
1977	42

Year	Production
1978	46
1979	50
1980	56
1981	63
1982	70

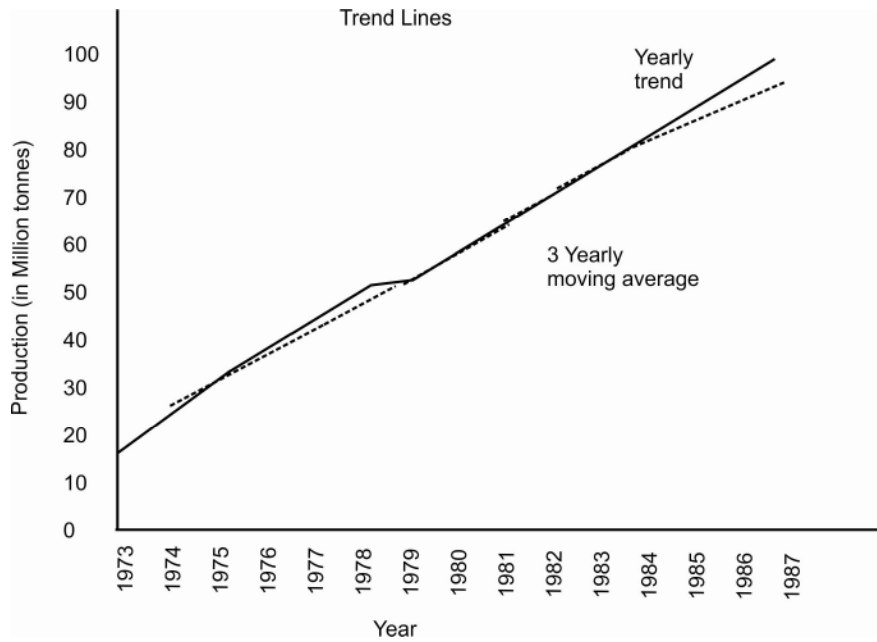
Year	Production
1983	74
1984	82
1985	90
1986	95
1987	102

(Note : Production in million tonnes)

Answer :

Year	Production	3 Yearly total	3 yearly average
1973	15	--	--
1974	21	66	22
1975	30	87	29
1976	36	108	36
1977	42	124	41.33
1978	46	138	46

1979	50	152	50.67
1980	56	169	56.33
1981	63	189	63
1982	70	207	69
1983	74	226	75.33
1984	82	246	82
1985	90	267	89
1986	95	287	95.67
1987	102	--	



CORRELATION & REGRESSION

Unit Structure :

- 8.1 Concept / Objective
- 8.2 Introduction
- 8.3 Correlation
- 8.4 Regression
- 8.5 χ^2
- 8.6 Introduction to SPSS package

8.1 OBJECTIVE

- To understand correlation between two series.
- To study the concept of Regression
- To understand χ^2 test.
- To understand SPSS package.

8.2 INTRODUCTION

Correlation analysis deals with the association between two or more variables.

Correlation analysis attempts to determine the 'degree of relationship' between variables.

Regression analysis reveals average relationship between two variables and this makes possible estimation or prediction.

The χ^2 test (pronounced as chi-square test) is one of the simplest & most widely used non-parametric test in statistics. The quantity χ^2 describes the magnitude of the discrepancy between theory and observation.

SPSS means statistical package for social studies.

Correlation -

Association or correlation between two variables can be studied in different ways.

- 1) Scatter diagram
- 2) Rank correlation

Scatter diagram -

In this method dots are given on the paper with reference to 'X' and 'Y' axis. Each dot represents co-ordinates of that point. Alignment of dots (or scatter) represents correlation or association between two variables. Let us understand this concept with the help of following examples.

Q.1 Draw scatter diagrams for the data given below and decide nature of association between two variables.

Example 1

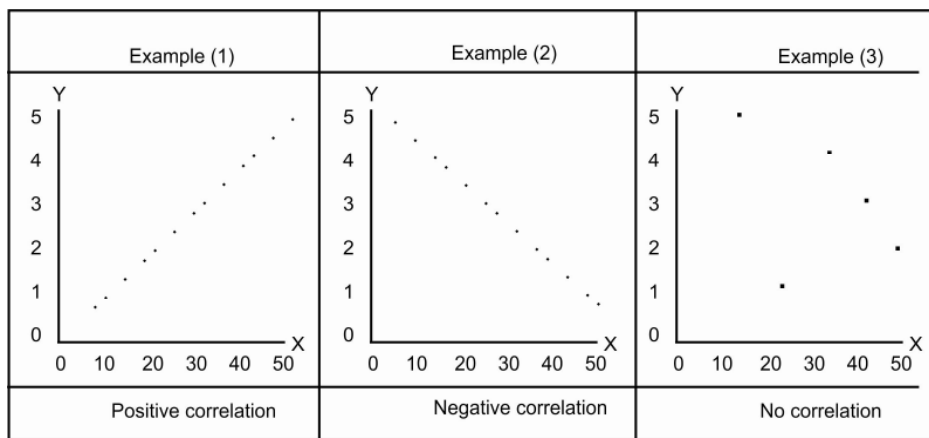
X	10	20	30	40	50
Y	1	2	3	4	5

Example 1

X	10	20	30	40	50
Y	5	4	3	2	1

Example 1

X	10	20	30	40	50
Y	5	1	4	3	2



8.3 RANK CORRELATION

This method of correlation was developed by the British psychologist Charles Edward Spearman in 1904.

In this method ranks are given to the values in 'X' and 'Y' sets of variables correlation is calculated using following formula.

$$r = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

Where r = Rank correlation.

d = Difference in the rank 'X' and rank 'Y'

$\sum d^2$ = Total & square of all differences.

n = number of pairs.

Q.1 Calculate the coefficient of correlation from the following data by the Spearman's Rank difference method.

Height (in cm)	140	145	150	155	160
Weight in kg	50	52	55	60	65

Answer -

Height (in cm)	Weight in kg	Rank X	Rank Y	d=Rank X - Rank Y	$n =$
140	50	1	1	0	0
145	52	2	2	0	0
150	55	3	3	0	0
155	60	4	4	0	0
160	65	5	5	0	0
					$\sum d^2 = 0$

$$\begin{aligned} r &= 1 - \frac{6 \sum d^2}{n(n^2 - 1)} \\ &= 1 - \frac{6 \times 0}{5(25 - 1)} \\ &= 1 - \frac{6 \times 0}{5 \times 24} \\ &= 1 - 0 \\ &= +1 \end{aligned}$$

Hence there is perfect positive correlation between height & weight which means if the height is more, weight is also more & if the height is less weight is also less.

Q.2 Calculate the coefficient of correlation from the following data by the Spearman's Rank method.

Price of Tea (Rs.)	Price of Coffee (Rs.)	Price of Tea (Rs.)	Price of Coffee (Rs.)
75	120	60	110
88	134	80	140
95	150	81	142
70	115	50	100

Answer -

Price of Tea (Rs.)	Price of Coffee (Rs.)	Rank X	Rank Y	d= X - Y	n =
75	120	4	4	0	0
88	134	7	5	2	4
95	150	8	8	0	0
70	115	3	3	0	0
60	110	2	2	0	0
80	140	5	6	-1	1
81	142	6	7	1	1
50	100	1	1	0	0
					$\sum d^2 = 6$

$$\begin{aligned}
 R &= 1 - \frac{6 \sum d^2}{n(n^2 - 1)} \\
 &= 1 - \frac{6 \times 6}{8(64 - 1)} \\
 &= 1 - \frac{36}{504} \\
 &= 1 - 0.071 \\
 &= +0.929
 \end{aligned}$$

There is strong positive correlation between price of tea & price of coffee.

8.4 REGRESSION

Regression is the measure of the average relationship between two or more variables. Hence it provides a mechanism for prediction or forecasting.

Regression analysis provides estimates of values of the dependent variable from values of the independent variable.

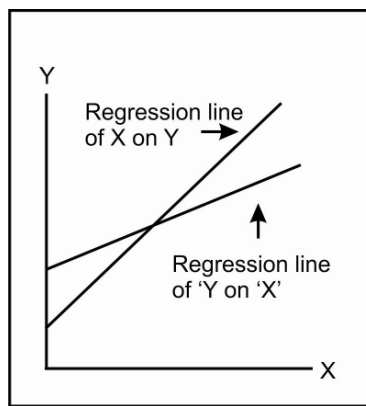
Regression lines -

Normally we deal with 'X' and 'Y' variables in correlation & regression. We can draw two regression lines as

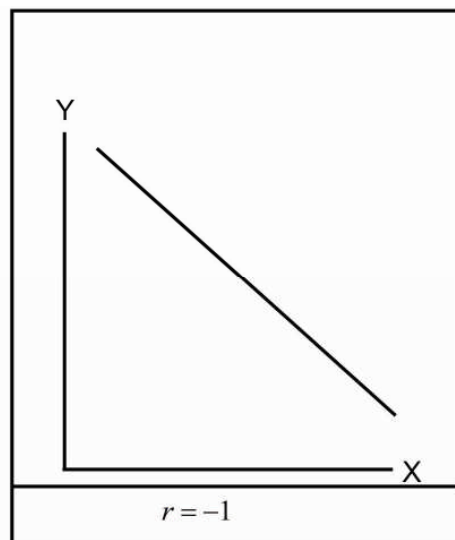
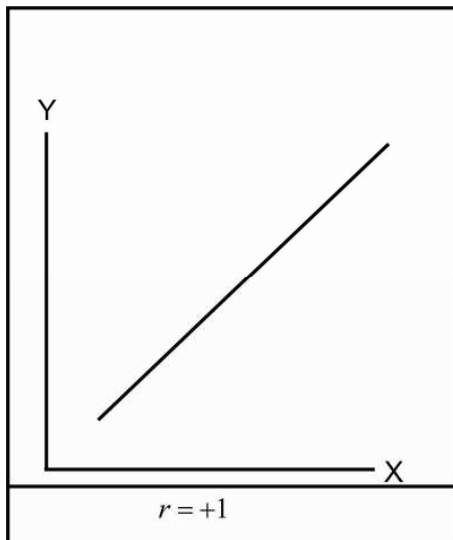
- Regression of 'X' on 'Y' &
- Regression of 'Y' on 'X'

Regression line of 'X' on 'Y' gives the most probable values of 'X' for given values of 'Y'.

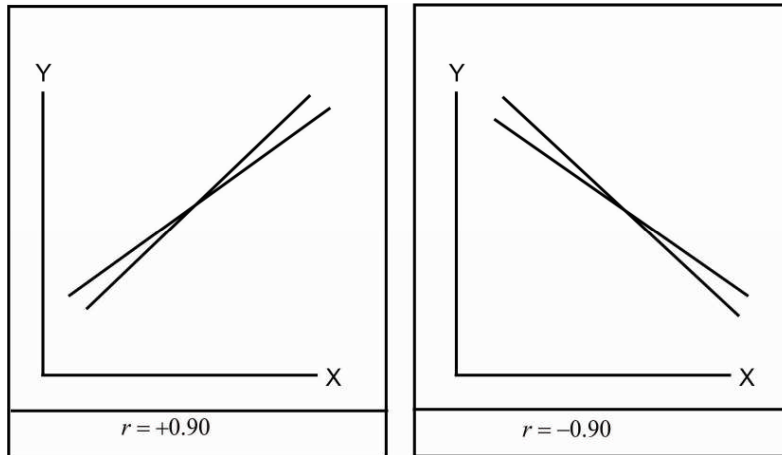
Similarly the regression line of 'Y' on 'X' gives the most probable value of 'Y' for given value of 'X'.



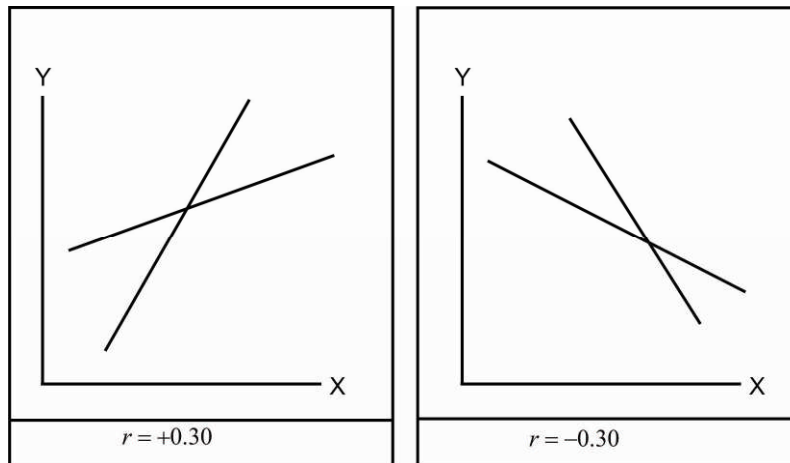
However when there is either perfect positive or perfect negative correlation between the two variables ($r = +1$ or $r = -1$) the regression lines will coincide. i.e. we will have only one line.



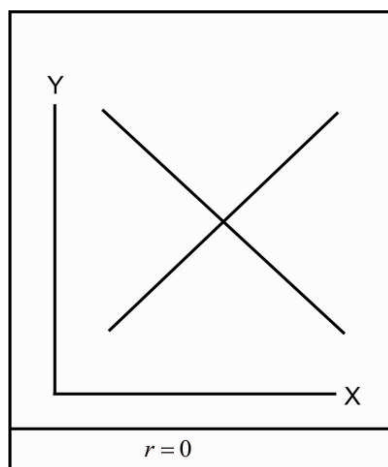
When two regression lines are near to each other, the degree of correlation will be higher.



When two regression lines are away from each other the degree of correlation will be lower.



If there is no correlation between the two variables ($r=0$) i.e. if the variables are independent, the regression lines are at right angles to each other.



Q.1 From the following data obtain two regression equations.

X	6	2	10	4	8
Y	9	11	5	8	7

Answer -

X	6	XY		
6	9	54	36	81
2	11	22	4	121
10	5	50	100	25
4	8	32	16	64
8	7	56	64	49
$\sum X = 30$	$\sum Y = 40$	$\sum XY = 214$	$\sum X^2 = 220$	$\sum Y^2 = 340$

Regression equation of Y on X $Y_0 = a + bX$

To find out the values of a and b the following two normal equations are used.

$$\sum Y = Na + b \sum x$$

$$\sum XY = a \sum X + b \sum X^2$$

Substituting the values

$$40 = 5a + 30b \quad (1)$$

$$214 = 30a + 220b \quad (2)$$

Multiplying equation (1) by 6 $240 = 30a + 180b \quad (3)$

$$214 = 30a + 220b \quad (4)$$

Deducting equation (4) from (3)

$$-40b = 26$$

$$b = -0.65$$

Substituting the value of b in equation (1)

$$40 = 5a + 30(-0.65)$$

$$5a = 40 - 19.5$$

$$= 59.5$$

$$a = 11.9$$

Putting the values of a and b in the equation, the regression of Y on X is $Y = 11.9 - 0.65X$.

Regression line of X on Y $X_0 = a + bY$ and the two normal equations are

$$\sum X = Na + b\sum Y$$

$$\sum XY = a\sum Y + b\sum Y^2$$

$$30 = 5a + 40b \quad (1)$$

$$214 = 40a + 340b \quad (2)$$

Multiplying equation (1) by 8

$$240 = 40a + 320b \quad (3)$$

$$214 = 40a + 340b \quad (4)$$

From equation (3) from (4)

$$-20b = 26$$

$$b = -1.3$$

Substituting the value of b in equation (1)

$$30 = 5a + 40(-1.3)$$

$$5a = 30 + 52$$

$$= 82$$

$$a = 16.4$$

Putting the values of a and b in the equation, the regression line of X on Y is $X = 16.4 - 1.3Y$.

Drawing Regression Lines -

Steps for drawing regression lines are as follows.

- 1) Choose any two values (Preferably well apart) for the unknown variable on the right hand side of the equation.
- 2) Compute the other variable
- 3) Plot the two pairs of values.
- 4) Draw straight line through the plotted points.
 - a) Regression line of Y on X
($Y = 11.9 - 0.65X$)
 - 1) Let $X = 2, Y = 11.9 - 0.65(2)$
 $= 11.9 - 1.3$
 $= 10.6$
 - 2) Let $X = 10, Y = 11.9 - 0.65 \times (2)$
 $= 5.4$

These points and the regression line through them can be represented on graph paper.

b) Regression line of X on Y.

$$X = 16.4 - 1.3Y$$

1) Let $Y = 10$,

$$X = 16.4 - 1.3(10)$$

$$= 16.4 - 13$$

$$= 3.4$$

2) Let $Y = 6$,

$$X = 16.4 - 1.3(6)$$

$$= 16.4 - 7.8$$

$$= 8.6$$

Let us plot these values on the graph.

a) Regression line of Y on X

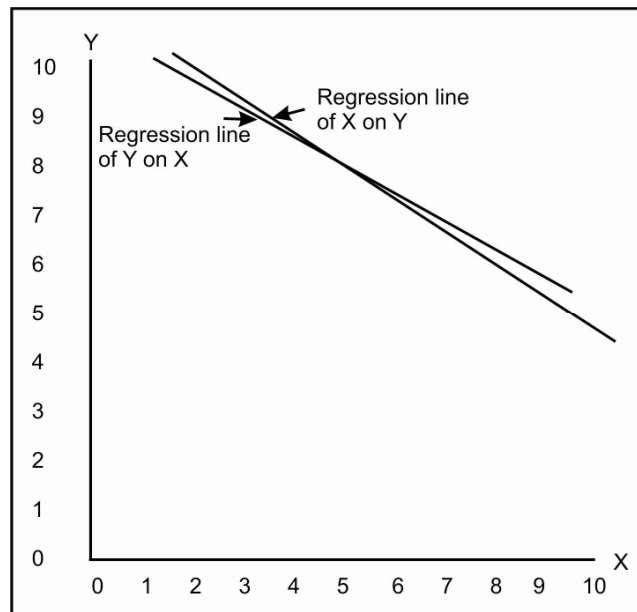
$$X = 2, Y = 10.6$$

$$X = 10, Y = 5.4$$

b) Regression line of X on Y

$$Y = 10, X = 3.4$$

$$Y = 6, X = 8.6$$



8.5 X^2 TEST

The X^2 test (pronounced as Chi-square test) is one of the simplest and most widely used non-parametric test.

The X^2 indicates the extent of difference between theory (expected) and observation (actual).

$$X^2 = \sum \frac{(O - E)^2}{E}$$

x^2 = Chi-square test

O = Observed frequencies

E = Expected frequencies

Steps for determination of x^2

- 1) It is necessary to calculate expected frequencies.

$$E = \frac{CT \times RT}{n}$$

E = Expected frequencies

CT = Column total

RT = Row total

n = Total number of observations

- 2) Find out difference between observed and expected frequencies and calculate the squares of these differences i.e. obtain the values of $(O - E)^2$.

- 3) Divide the values of $(O - E)^2$ by the respective expected frequency and obtain the total $\sum [(O - E)^2 / E]$. We get the value of x^2 which can be from zero to infinity.

$x^2 = 0$ means that the observed and expected frequencies completely coincide.

Greater the difference between the observed and expected frequencies greater will be the value of x^2 .

The calculated value of χ^2 is compared with the table value of χ^2 for given degrees of freedom at a certain specified level of significance.

If at the stated level (normally 5% level is selected) the calculated value of χ^2 is more than the table value of χ^2 , the difference between theory and observation is considered to be significant. Which means it could not have arisen due to fluctuations of simple sampling. If on the other hand the calculated value of χ^2 is less than the table value, the difference between theory and observation is not considered as significant. Which means it is regarded as due to fluctuations of simple sampling and hence ignored.

Degrees of freedom -

Degrees of freedom means the number of classes to which the values can be assigned at will without violating the restrictions or limitations placed. e.g. If we wish to prepare a table which contains 5 numbers and total of all numbers is 100 then we can select four out of five numbers as per our wish but fifth number we will have to put after adding four numbers & subtracting total from 100.

1	2	3	4	5	
					= 100

Total of these five numbers is 100. We can put any four numbers as per our choice in these boxes.

1	2	3	4	5	
05	30	15	40		= 100

Now total of these four numbers is $05 + 30 + 15 + 40 = 90$. We can not put fifth number as per our choice.

We can obtain fifth number by subtracting total of four numbers (90) from 100.

$$100 - 90 = 10$$

Hence fifth number is 10.

In this example the degrees of freedom is 4.

In this example our constraint is only one (1).

We can use following formula for calculation of degrees of freedom.

$$V = n - K$$

V = degrees of freedom

n = number of boxes / rows / column

K = constraint

In our example $n = 5$ & $K = 1$. Hence the degrees of freedom is four.

$$V = n - k$$

$$V = 5 - 1$$

$$V = 4$$

For a contingency table used in χ^2 test following formula is used for the calculation of degrees of freedom.

$$\text{Degrees of freedom} = (c-1)(r-1)$$

C = Column

r = Rows

If our table contains two columns & two rows.

5	20	Total
10	08	Total
Total	Total	Grand Total

This is 2×2 table.

The degrees of freedom for all cells is :

$$V = (c-1)(r-1)$$

$$= (2-1)(2-1)$$

$$= 1 \times 1$$

$$V = 1$$

For 3×3 table.

			Total
			Total
			Total
Total	Total	Total	

$$\begin{aligned}
 V &= (c-1)(r-1) \\
 &= (3-1)(3-1) \\
 &= 2 \times 2 \\
 V &= 4
 \end{aligned}$$

It means only four expected frequencies need to be computed. The others are obtained by subtraction from normal totals.

Q.1 In an antimalarial campaign in a certain area, quinine was administered to $\frac{8}{2}$ persons out of a total population of 3248. The number of fever cases is shown below.

Treatment	Fever	No Fever	Total
Quinine	20	792	812
No Quinine	220	2216	2436
Total	2401	3008	3248

Discuss the usefulness of quinine in checking malaria.

Answer -

It is necessary to prepare hypothesis. Hypothesis in this example is as follows.

Hypothesis = Quinine is not effective in checking malaria.

χ^2 test - Expected frequency of first column & first row

$$\begin{aligned}
 &= \frac{(\text{column total}) \times (\text{Row total})}{(\text{Total number of observations})} \\
 &= \frac{240 \times 812}{3248} \\
 &= 60
 \end{aligned}$$

	Column 1	Column 2	Total
Raw 1	60		812
Raw 2			
Total	240		3248

	Column 1	Column 2	Total
Raw 1	60	752	812
Raw 2	180	2256	2436
Total	240	3007	3248

O	E	$(O - E)^2$	$(O - E)^2 / E$
20	60	1600	26.66
220	180	1600	8.88
792	752	1600	2.12
2216	2256	1600	0.70
			$\sum (O - E)^2 / E = 38.39$

$$\begin{aligned}
 x^2 &= \left[\sum (O - E)^2 / E \right] \\
 &= 38.9
 \end{aligned}$$

Degrees of freedom $V = (C - 1)(r - 1)$

$$\begin{aligned}
 &= (2 - 1)(2 - 1) \\
 &= 1 \times 1 \\
 &= 1
 \end{aligned}$$

For degree of freedom ($V=1$), χ^2 at 0.05 or 5% level of significance table value for χ^2 is 3.84.

The calculated value of χ^2 is greater than the table value, $38.39 > 3.84$.

The hypothesis is rejected.

Hence quinine is useful in checking malaria.



COMPUTER

9.0. After going through this chapter you will be able to understand the following features:

- 9.1 Objectives
- 9.2 Introduction
- 9.3 Subject discussion
- 9.4 Importance and uses of Computer
- 9.5 Basic terms related to Computer
- 9.6 MS Word
- 9.7 MS EXCEL
- 9.8 Use of Internet
- 9.9 Summary
- 9.10 Check your progress/exercise
- 9.11 Answers to the self learning questions
- 9.12 Technical words and their meaning
- 9.13 Task
- 9.14 References for further study

9.1 OBJECTIVES

By the end of this unit you will be able to:

- Understand Importance and uses of Computer
- Know the Basic terms related to Computer
- Learn MS Word
- Discuss MS EXCEL
- Understand Use of Internet

9.2 INTRODUCTION

In this ninth chapter we are going to learn Importance and uses of Computer at first. After knowing what a computer is we will learn about the Basic terms related to Computer. We will also learn MS Word and MS EXCEL. The Use of Internet will be discussed in the latter part of this unit.

9.3 SUBJECT-DISCUSSION

Computer is the wonderful and mastermind gift of the science to the humankind. The term computer has been derived from the Latin term '*computare*', which means to calculate. Computer is an electronic device that is designed to work with Information. It is a programmable machine and thus cannot do anything without a Program. The two principal characteristics of a computer are (a) it responds to a specific set of instructions in a well-defined manner and (b) it can execute a prerecorded list of instructions i.e. a program. It represents the decimal numbers through a string of binary digits. The Word 'Computer' usually refers to the Center Processor Unit plus Internal memory. The first mechanical computer designed by Charles Babbage is known as Analytical Engine. It uses read-only memory in the form of punch cards. Charles Babbage is called the "Grand Father" of the computer.

We should remember one thing not to associate a personal computer with the phrase computer. A personal computer or PC is a small and relatively inexpensive computer. It is based on the microprocessor technology and designed for an individual use. Personal computers at home can be used for a number of different applications including games, word processing, accounting and other tasks. Besides PC there is Workstation which is a powerful, single-user computer. Minicomputer is a multi-user computer capable of supporting from 10 to hundreds of users simultaneously while Mainframe is a powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously. An extremely fast computer that can perform hundreds of millions of instructions per second is known as Supercomputer. Computers are used in many fields in our daily life.

9.4 IMPORTANCE AND USES OF COMPUTER

A computer is an electronic device that manipulates information, or data. It has the ability to store, retrieve, and process data. Computer can be used to type documents, send email, play games, and browse the Web Computer can also be used to edit or create spreadsheets, presentations, and even videos.

In the 1950's, when computers were first developed, the computer was used for performing long, complex calculation at high speed and with great accuracy. At that time, the computers were used only for engineering, military and scientific purpose. Today computers have become an essential part of modern human life. Computers are used in variety of fields. From Engineers to Doctors,

to Teachers, Students, and Government Organizations they all use computers. Computers have made our lives simpler and easier.

At **home**, computers are used to manage home budgets and also for entertainment.

In the field of **education**, computers are used for computers aided learning, distance learning and also for conducting online examinations. Researchers have massive usage of computers in their work from the starting to till the end of their scholarly work.

In **business**, computers are used for marketing, retailing, banking and stock trading.

Computers are being used by the **financial institutions** like banks for different purposes. The foremost important thing is to store information about different account holders in a database to be available at any time.

Computers have immense use in **medical** field as well. They are used to maintain patient history, patient monitoring, life support system and many others.

There are many uses of computers in **defense**. Computers are used to control UAV or unmanned air-crafts, to help the missile to get to the target, to track incoming missiles, to design and test new systems and many more. Computer builds the links between the soldiers and commanders through the satellite. Construction of weapons and controlling their function is not possible without the aid of computers.

In today's technologically growing society, computers are being used in **sports** as well. For recording information, analyzing movements of the athletics and maintaining score boards computers are used.

Computers have its dominant use in the **education** field which can significantly enhance performance in learning. Even distance learning is made productive and effective through internet and video-based classes.

Electronic mail is the revolutionary service offered by the computes. **Video Conferencing** is also another major advantage. **Electronic shopping** through online shopping added favor to purchaser and merchants. **Electronic banking** is now at our hands where every bank has online support for transaction of monetary issues.

9.5 BASIC TERMS RELATED TO COMPUTER

1. **Central Processing Unit** - The central processing unit or CPU, also known as the microprocessor or processor is the brain of the computer.
2. **Hardware** - A generic term used to describe any component of a computer system with a physical presence and which can, therefore, be seen and touched.
3. **Software** – Software is a program application; which provides the computer with step-by-step instructions to perform a specific task. A computer cannot function without software.
4. **Operating System** – Windows – The operating system (OS) is the software that communicates with the computer hardware. No software can be run on the computer without the operating system
5. **Input devices** are hardware devices which take information from the user of the computer system, convert it into electrical signals and transmit it to the processor.
6. **Output devices** take data from the computer system and convert it to a form that can be interpreted by humans.
7. **Monitor** - The computer monitors computer screen or display unit.
8. **Desktop** – It is the display on the monitor/screen
9. **Icon**- An icon is a small, clickable picture that opens programs on a computer.
10. **Mouse** – It is a hand held device that helps you control the pointer on the desktop/screen.
11. **Keyboard**– It is the device used in typing in the words, numbers and to perform tasks.
12. **File** –A file is a block of information includes word documents, pictures, music, etc. Each file is differentiated with the help of a unique file name.
13. **Folder** - The folder is a system that helps in organizing the files, programs and projects on the computer.
14. **Hard drive**: This is known as storage. All programs and data are stored in the hard drive.
15. **Processing devices** are the components responsible for the processing of information within the computer system. This includes devices such as the CPU, memory and motherboard.
16. **Storage devices** are components which allow data to be stored within a computer system. This includes devices such as hard disk drives and compact disk drives.

17. **Internet** - The Internet is a worldwide network that helps connect millions of users around the world to share and exchange data, information, opinions, etc.
18. **Word Document** - In its simplest form, a word document is a sequence of characters that exist in a computer's memory. Using word, a document can be edited, added to, and given a variety of layouts. Once the document has been created, a large number of actions can be carried out, such as saving, printing or sending the document as an email.
19. **Virus** - A computer virus is a program that is designed to harm the computer.
20. **Reboot** - To restart the computer.
21. **Crash** - A serious computer failure; the computer itself stops working or that a program aborts unexpectedly.

9.6 MICROSOFT WORD

Microsoft Word or **MS-WORD** (often called **Word**) is a graphical **word** processing program that users can type with. It is made by the computer company **Microsoft**. Its purpose is to allow users to type and save documents. Similar to other **word** processors, it has helpful tools to make documents.

- **Important Features of Ms-Word**

Ms-Word not only supports word processing features but also DTP features. Some of the important features of Ms-Word are listed below:

1. Using word we can create the document and edit them later, as and when required, by adding more text, modifying the existing text, deleting/moving some part of it.
2. Changing the size of the margins can reformat complete document or part of text.
3. Font size and type of fonts can also be changed.
4. Page numbers and Header and Footer can be included.
5. Spelling can be checked and correction can be made automatically in the entire document. Word count and other statistics can be generated.
6. Text can be formatted in columnar style as we see in the newspaper. Text boxes can be made.
7. Tables can be made and included in the text.

8. Word also allows the user to mix the graphical pictures with the text. Graphical pictures can either be created in word itself or can be imported from outside like from Clip Art Gallery.
9. Word also provides the mail-merge facility.
10. Word also has the facility of macros. Macros can be either attached to some function/special keys or to a tool bar or to a menu.
11. It also provides online help of any option.

9.7 MICROSOFT EXCEL

Microsoft Excel is a general-purpose electronic spreadsheet used to organize, calculate, and analyze data. The task which we can complete with Excel ranges from preparing a simple family budget, preparing a purchase order, create an elaborate 3-Dchart, or managing a complex accounting ledger for a medium size business.

An **Excel worksheet** is a single **spreadsheet** that contains cells organized by rows and columns. A **worksheet** begins with row number one and column A. Each cell can contain a number, text or formula. A cell can also reference another cell in the same **worksheet**, the same **workbook** or a different **workbook**.

- **Excel Features**

There are a number of features that are available in Excel to make the task easier. Some of the main features are:

1. **Auto Format** lets to choose many preset table formatting options.
2. **Auto Sum** helps to add the contents of a cluster of adjacent cells.
3. **List AutoFill** automatically extends cell formatting when a new item is added to the end of a list.
4. **Auto Fill** feature allows to quickly fill cells with repetitive or sequential data such as chronological dates or numbers, and repeated text. AutoFill can also be used to copy functions.
5. **Auto Shapes** toolbar will allows drawing a number of geometrical shapes, arrows, flowchart elements, stars and more. With these shapes you can draw your own graphs.
6. **Drag and Drop** feature helps to reposition the data and text by simply dragging the data with the help of mouse.
7. **Charts** features helps in presenting a graphical representation of the data in the form of Pie, Bar, Line charts and more.

8. PivotTable flips and sums data in seconds and allows performing data analysis and generating reports like periodic financial statements, statistical reports, etc.

Storing spread sheet data is only the beginning as far as Excel is concerned. The wide range of feature it contains lets us manipulate and present a data in almost any way chosen. Excel can be accounts program; it can be used as a sophisticated calculator. It is capable of utilizing complex mathematical formulas. It can also be diary, a scheduler, and many more.

Other areas of their application are cost accounting depreciation analysis, tax assessment, financial accounting, production planning, order processing/ invoicing, quality control, preparation of product report, personal management, marketing payroll etc.

Used in combination with Microsoft word, excels database features make creating mailing lists and personalized letters very easy. Excels presentation facilities use colour, border and different fonts to emphasis data. A variety of charts are available, which can be selected to suit the kind of data being presented for storing, manipulating, and presenting data, Microsoft excel offers an unrivaled range of possibilities.

9.8 USE OF INTERNET

Internet is defined as an information super highway, to access information over the web. However, it can be defined in many ways as follows:

- Internet is a worldwide global system of interconnected computer networks.
- Internet uses the standard internet protocol (TCP / IP)
- Every computer in internet is identified by a unique IP address.
- IP address is a unique set of numbers such as 110.22.33.114 which identifies a computers location.
- Internet is accessible to every user all over the world.

The concept of internet was originated in 1969 and has undergone several technological and infrastructural changes as discussed below.

- The origin of internet design from the concept of advanced research project agency.

- Arpanet was developed by United States department of defense. Basic purpose of Arpanet was to provide was to provide communication among the various bodies of government.
- Initially, there were only 4 nodes, formally called hosts.
- In 1972, the Arpanet spread over the globe with 23 nodes, located at different countries and thus became known as internet.
- By the time, with invention of new technologies such as TCP / IP protocols, DNS, WWW, browsers, internet provider a medium to publish and access information over the web.

Internet concerns almost every aspect of life, one can think of. There are large numbers of things that can be done using the internet and so it is very important.

At the moment the easiest thing that can be done using the internet is that we can **communicate** with the people living far away from us with extreme ease. Internet allows us to communicate with the people sitting at the remote locations. Communication is the most important gift that the internet has given to the common man. **Research** has also benefitted from evolution of internet. There are a number of books, reference books, online help centers, expert's views and other study oriented material on the internet that has made the learning process very easy as well as a fun learning experience. There are lots and lots of websites which are related to different topics and can be referred. A part from communication the source of information, it also serves the medium for the entertainment. Following are modes of **entertainment**.

1. Online television
2. Songs
3. Social networking
4. Online games
5. Videos

Internet allows us to use many **services** like:

1. Internet banking
2. Matrimonial services
3. Online shopping
4. Online ticket booking
5. Online bill payment
6. Data sharing
7. Email

Internet provides concepts of electronic communication that allows the business deal to be conducted on electronic systems.

There are various applications available on the web that uses internet as a medium for communicating. One can find various social networking sites such as:

1. Face book
2. Twitter
3. Yahoo
4. Flicker
5. Orkut

One can surf for any kind of information over the internet. Various information regarding, technology, health and services, social studies, IT, products etc. can be surfed with the help of search engine.

However, internet has provided to be a powerful source of information in almost every field but there are many disadvantages as well.

- There are always chances to loose personal information such as name, address, credit card number. Therefore, one should be very careful sharing information. One should use credit card only though authenticated sites.
- Another disadvantage is the spamming. Spamming corresponds to the unwanted emails in bulk. Emails serve no purpose and leads to obstruction of entire system.
- Virus can easily be spread to the computer connected to internet. Such virus attacks many cause your system to crash or your important data may get deleted.
- Also the biggest threat on internet is pornography. There are many pornographic sites that can be found, letting children to use internet which indirectly affects the children health mental life.
- There are various websites that do not provide the authenticated information. This leads to misconception among many people.

9.9 SUMMARY

Computer is one of the most important inventions of our age. It performs various functions faster and more accurately than human beings. It can be used to do any kind of work. Computer is a big dictionary. We can save any type and any amount of data like information, study materials, images, video, audio, songs, clips, games, etc. in computers. The first mechanical computer was designed by Charles Babbage.

Computers are used in various fields, at home, in office, in educational institutions etc. An important use of computers at home is to manage home budget. Moreover computers at home are used to play games. So computers are there for our entertainment too. Working from home is possible through computer. Internet, a means of connecting a computer to any other computer anywhere in the world via dedicated routers and servers, plays an important role almost in every aspect of life. Any type of information on the internet is available through computer. Educational and informative websites are available to download books, tutorials etc. In this way kids can improve their knowledge and learn new things. Computers have immense use in medical field as well for it maintains patient history. In defense there are multiple uses of computers, most important of which is that it builds the links between the soldiers and commanders through satellites. Computers play equally important role in the fields of sports and education also. E-mail is a revolutionary service offered by the computers. Through this messages can be distributed from one computer user to one or more recipients via a network. Microsoft Word or MS-WORD, made by the computer company Microsoft, is a graphical word processing program that users can type with. It is unique because it supports DTP features too. On the other hand Microsoft Excel is a general-purpose electronic spreadsheet used to organize, calculate, and analyze data. With so many important features computer has made our life and work very smooth and easy. To conclude it may be said that computer, a marvellous invention of the modern technology, has greatly increased our efficiency to do various tasks.

9.9 CHECK YOUR PROGRESS/ EXERCISE

1. True False

- a. The first mechanical computer designed by Charles Babbage is known as Analytical Horse.
- b. A computer is an electronic device that manipulates information, or data.
- c. In defense Computer builds links between soldiers and commanders through the satellite.
- d. The operating system (OS) is the hardware that communicates with the computer software.
- e. An Internet is a small, clickable picture that opens programs on a computer.

2. Fill in the blanks

- a. In a computer all programs and data are stored in the _____ drive.

- b. _____ means to restart the computer.
- c. _____ is a general-purpose electronic spreadsheet used to organize, calculate, and analyze data.
- d. Every computer in internet is identified by a unique _____ address.
- e. The _____ or CPU, also known as the microprocessor or processor is the brain of the computer.

3. Multiple choice question

- a. In a computer, Mouse
 - i. is a hand held device that helps you control the pointer on the desktop/screen.
 - ii. is the device used in typing in the words, numbers and to perform tasks.
 - iii. is a system that helps in organizing the files, programs and projects on the computer.
- b. Software is
 - i. a generic term used to describe any component of a computer system with a physical presence and which can, therefore, be seen and touched.
 - ii. the brain of the computer.
 - iii. a program application; which provides the computer with step-by-step instructions to perform a specific task.
- c. Using Ms-Word we can
 - i. add the contents of a cluster of adjacent cells.
 - ii. create the document and edit them later, as and when required.
 - iii. present a graphical representation of the data in the form of Pie, Bar, Line charts and more.
- d. Computers are being used by the financial institutions like banks for
 - i. productive distance learning is made possible through internet and video-based classes.
 - ii. it can store information about different account holders in a database to be available at any time.

- iii. it is capable of maintaining patient history, patient monitoring etc.
- e. Drag and Drop feature helps
 - i. in drawing a number of geometrical shapes, arrows, flowchart elements, stars and more.
 - ii. in cell formatting when a new item is added to the end of a list.
 - iii. to reposition the data and text by simply dragging the data with the help of mouse.

4. Answers the following Questions

1. Define a computer and state its importance and uses.
2. What is Microsoft Word? Elaborate your answer stating the important features of Ms-Word.
3. What is Microsoft Excel? What are the number of features that are available in Excel?
4. Define Internet. State the Uses of Internet.
5. Write short notes on:
 - a) Desktop
 - b) Icon
 - c) Mouse
 - d) Keyboard
 - e) Monitor
 - f) Central Processing Unit
 - g) Hardware
 - h) Operating System
 - i) Input devices

9.10 ANSWERS TO THE SELF LEARNING QUESTIONS

- 1.a. false, Analytical Engine
- 1.b. true
- 1.c. true
- 1.d. false, The operating system (OS) is the software that communicates with the computer hardware.
- 1.e. false, An icon is a small, clickable picture that opens programs on a computer.
- 2.a. hard
- 2.b. Reboot
- 2.c. Microsoft Excel

- 2.d. IP address
- 2.e. central processing unit
- 3.a.i.
- 3.b.iii.
- 3.c.ii.
- 3.d.ii.
- 3.e.iii.

9.11 TECHNICAL WORDS:

1. **Charles Babbage** – an English polymath. A mathematician, philosopher, inventor and mechanical engineer, Babbage is best remembered for originating the concept of a digital programmable computer.
2. **Computer-** is an electronic device that stores and manipulates information. Unlike a calculator, it is able to store a program and retrieve information from its memory.
3. **Spreadsheet-**an electronic document in which data is arranged in the rows and columns of a grid and can be manipulated and used in calculations.
4. **Presentation-**a speech or talk in which a new product, idea, or piece of work is shown and explained to an audience.
5. **Microsoft** – is a Technology corporation that focuses on the development and implementation of software used on computers and on the World Wide Web. The company's Microsoft Windows operating system is the most widely used operating system in the world.
6. **DTP-**Desktop publishing is abbreviated as DTP. In DTP of documents are created using page layout skills on a personal computer primarily for print.
7. **Worksheet-** a sheet of paper on which is printed a series of columns and into which tentative figures are entered as a preliminary step in preparing the adjusted or final statement.
8. **AutoFormat-** is a software feature commonly found in word processor programs such as Microsoft Word that automatically changes the formatting or appearance of text. For example, if a user types "1st", AutoFormat would change this to "1st."

- 9. Pivot table-** is a program tool that allows us to reorganize and summarize selected columns and rows of data in a spreadsheet or database table to obtain a desired report.
- 10. Monitor** -In computers, a monitor is a computer display and related parts packaged in a physical unit that is separate from other parts of the computer.

9.12 TASK

1. In a chart draw a computer and write down the basic terms related to it.
2. In a chart write down the main features of Microsoft Excel.

9.13 REFERENCES FOR FURTHER STUDY

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- Microsoft Excel 2013: Comprehensive by Mary Anne Poatsy
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- How Computers Work (Our Digital Planet)-by Ben Hubbard



SURVEYING

Unit Structure :

- 10.0 Concept
- 10.1 Introduction
- 10.2 Plane Table survey
- 10.3 Prismatic compass survey
- 10.4 Abney level

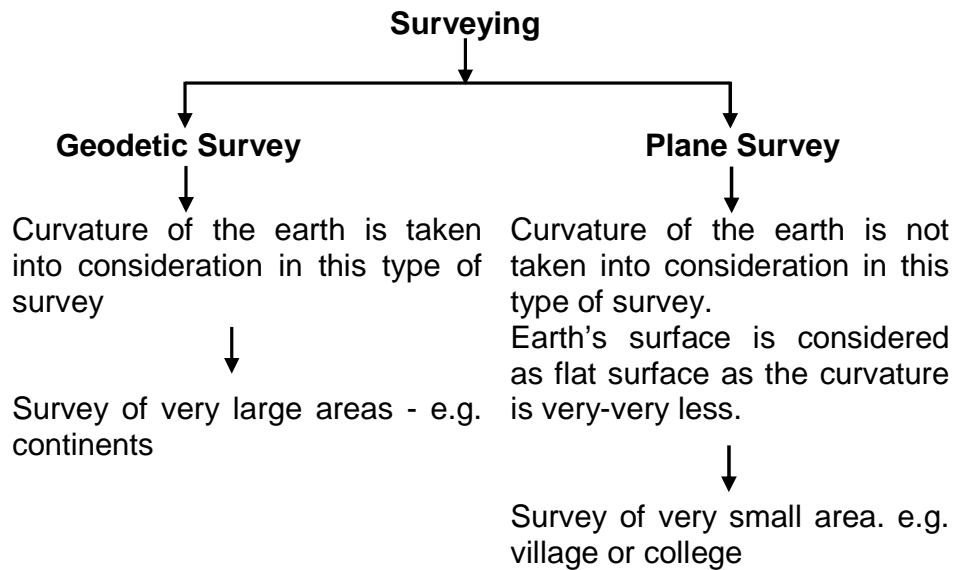
10.0 CONCEPT

- To understand concept of surveying.
- To study plane table survey
- To understand concept of bearing & prismatic compass survey.
- To study Abney level & measurement of heights & depths.

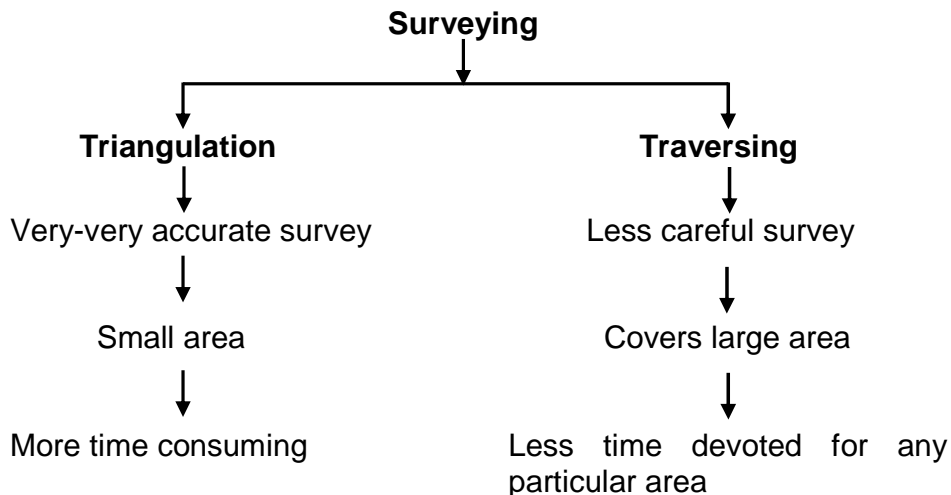
10.1 INTRODUCTION

Surveying is an art and science related to observation measurement and preparation of plans or maps of the earth's surface or part of it. Due to development in technology using GPS one can plot boundaries of an agricultural field and prepare map within 30 min. With the help of traditional surveying methods it may take one full day to do surveying & to plot the details for the preparation of plan of the same agricultural field.

Depending on the area covered in surveying it can be classified into two groups.



Based on accuracy surveying can also be classified into two groups.



There are various types of surveys used in various fields. e.g. Geological survey, Topographical survey, Cadastral survey, military survey etc.

10.2 PLANE TABLE SURVEY

- 1) Plane table is used in this type of survey so it is termed as plane table survey. Greatest advantage of plane table survey is that the plan of the area is prepared on the plane table in the ground while doing survey.
- 2) Equipments required for plane table survey.
 - 1) The Plane table with tripod stand.
 - 2) An Alidade
 - 3) A plumb bob

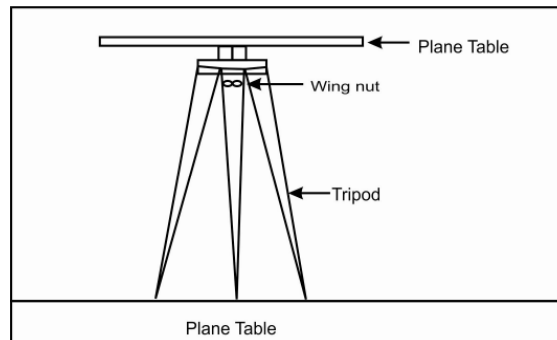
- 4) A spirit level
- 5) A trough compass
- 6) Ranging rods
- 7) Measure tape
- 8) Drawing paper
- 9) Pins & drawing pins / clips
- 10) Pencil, eraser, sharpeners etc.

1) The plane table -

Normally pinewood is used for preparation of the plane table.

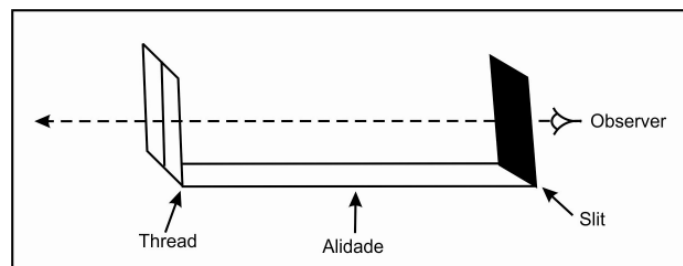
The size is $30'' \times 24'' \left(2\frac{1}{2} \text{ ft} \times 2 \text{ ft} \right)$. This plane table board is

supported by the wooden tripod stand. Wing nut-bolt keep board attached to the tripod. Plane table can be kept in the level condition with the help of three legs of the tripod.

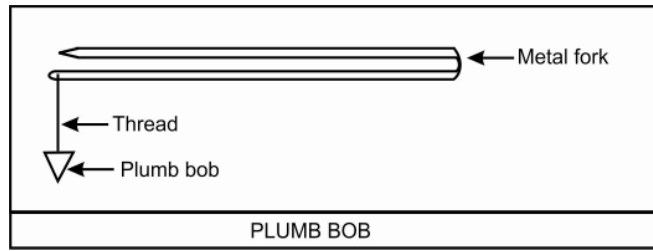


2) Alidade - It is also known as sighting rule. It is a strong flat metal ruler with perfectly straight and parallel edges. There are flap sites at both ends of Alidade.

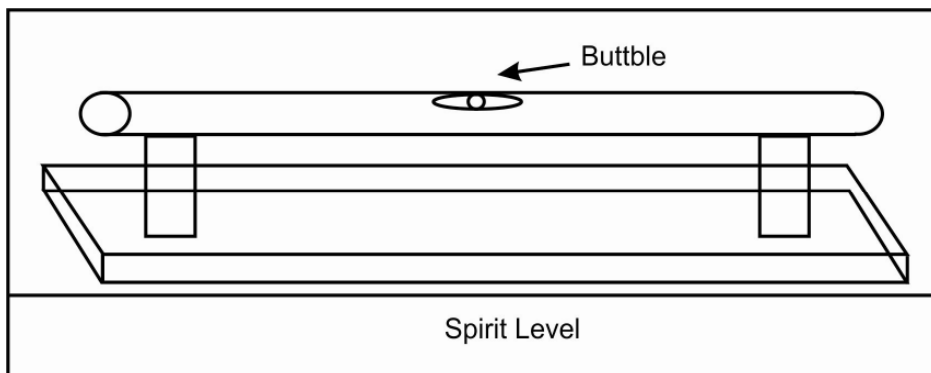
These can be folded down when not in use. One of the flaps has a slit in the centre and the other has a vertical thread. During survey observer (surveyor) looks through the slit and considers point (ranging rod), with vertical thread. As this line is perfectly parallel to the edge of Alidade he can draw line on the drawing paper fixed on the plane table for marking position of the point.



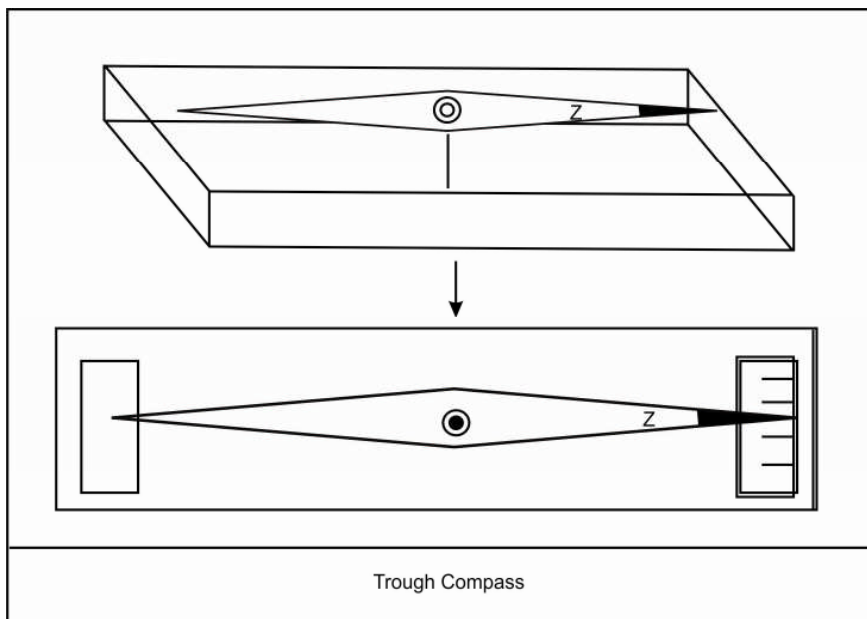
3) Plumb bob - It is a plumbers bob attached to a metal fork with the help of thread. It is used to centre the plane table over the station on the ground.



4) Spirit level - It is used for leveling of the plane table before doing survey. The accuracy of plane table survey depends on leveling.

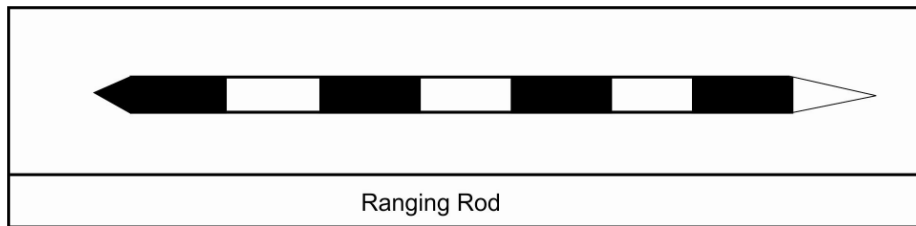


5) Trough compass - Trough compass is a magnetic compass used to mark north direction on the drawing paper fixed on the plane table.

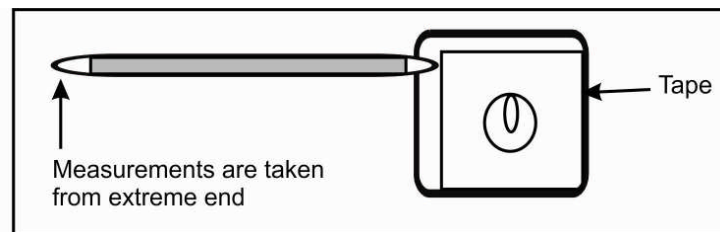


6) Ranging rods - These are wooden or metal rods used for locating points in the field survey. These rods are of 6ft (2m)

length. These are painted in red, black & white colour so that they can be used in any type of environment.



7) Measure tape - Measure tape of 15m or 30m length are used in the survey. Measurements are always taken from the extreme end of the tape.



Setting of plane table in the field -

Following steps are followed before doing plane table survey.

- 1) Fix plane table properly on the tripod in the field.
- 2) Attach drawing paper to the plane table with the help of drawing pins.
- 3) Check level of the plane table with the help of spirit level.
- 4) Fix long pin on the drawing paper at proper location.
- 5) Use plumb bob to adjust your location on the paper with the base station on the ground.
- 6) Mark north direction using trough compass.
- 7) Use Alidade for siting various survey points & drawing lines from the pin to these points on the drawing paper.
- 8) Take measurement of survey point from base station using tape. (Someone should hold ranging rod at the survey point while using alidade & taking measurement).

Transfer this measurement on the line as per the scale. Mark position of survey point on the line (on drawing paper)

- 9) Mark positions of all survey points on the paper & join them together to complete plan of the area.

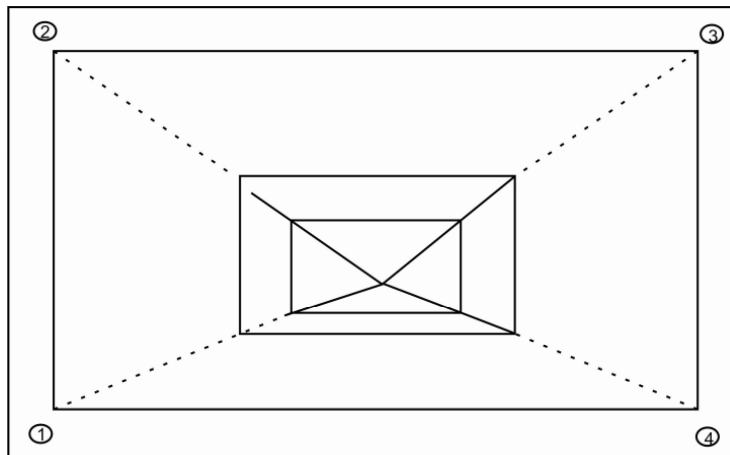
Methods used in the Plane Table survey -

Two methods are used in the plane table survey.

- 1) Radiation method
- 2) Intersection method

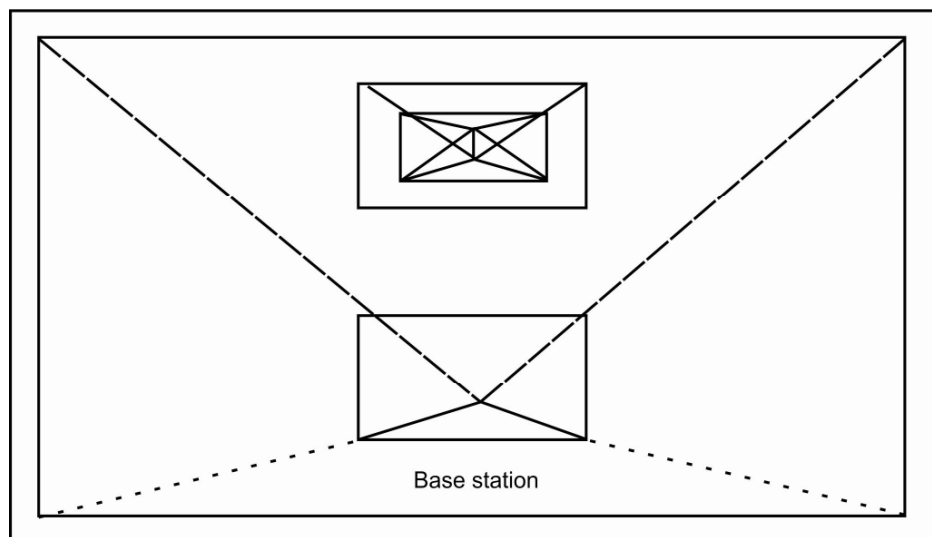
1) Radiation method -

Only one base station is required in radiation method rays (lines) are drawn from central pin towards survey points in all directions. Measurements are taken for all these points & their positions are marked on the drawing paper as per the scale. Plan is prepared by joining these points.



2) Intersection Method -

Two base stations are required for this method. Measurement is taken along the base line connecting two base stations. Lines for all points are drawn from both stations. Intersections of lines give us final location of point.



Intersection Method

Advantages of Plane Table Survey -

- 1) Final plan is prepared during survey in the field.
- 2) It is a quick method & fairly accurate.
- 3) Position of the unknown point can be plotted with the help of resection method.
- 4) Checking of plan is possible during the process of survey.

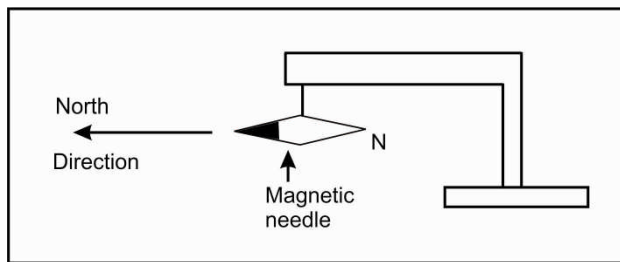
Disadvantages -

- 1) Plane table being heavy is difficult to carry.
- 2) Plane table survey is not possible during rainy season.

10.3 PRISMATIC COMPASS SURVEY

It is a magnetic compass having prism on one side (for viewing numbers) & so this instrument is known as the prismatic compass.

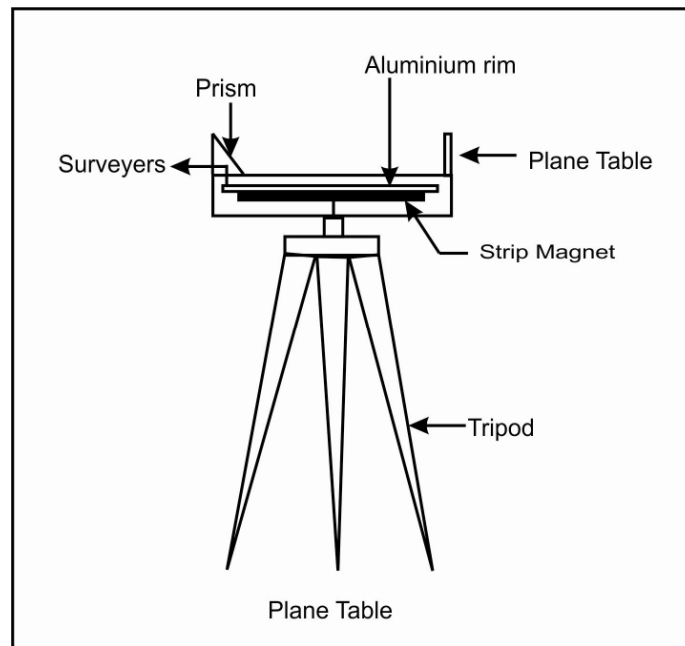
Magnetic needle always remains in the north-south direction, this principle is used in this survey instrument.



The concept of bearing is used in this instrument. Bearing is an angle measures from the north in clockwise directions.

<p>N 90°</p>	<p>N 120°</p>	<p>N 270°</p>	<p>N 300°</p>
Bearing 90°	Bearing 120°	Bearing 270°	Bearing 300°

In prismatic compass small strip magnet is fitted to a circular aluminium rim and is balanced at the centre on a pointed pivot. Bearings (numbers) are engraved on the aluminium rim. These numbers are viewed by the surveyor during field survey.

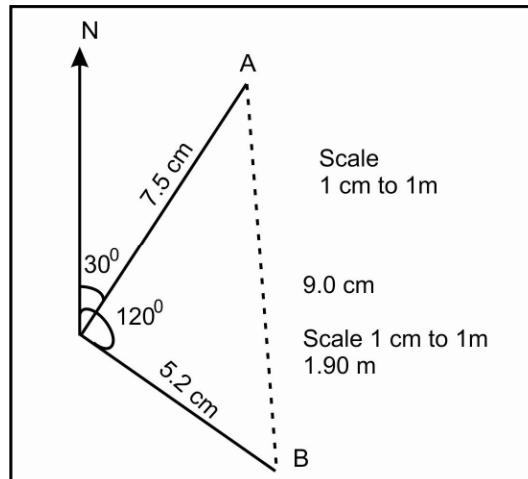


Prismatic Compass

Prismatic compass is used with the tripod. Other instruments required for the prismatic compass survey are Ranging rods, tape, field book etc. Instrument is fixed on the tripod in level condition. Survey points are selected and recorded / plotted in the field book. Someone will hold ranging rod at the survey point & the surveyor takes reading of bearing with the help of prismatic compass.

There is a small slit at the top portion of the prismatic compass. Surveyor looks through this slit and rotate prismatic compass in such a manner that central wire of the site vane coincides with the ranging rod. At this stage observer / surveyor looks in the downward direction through prism to get the bearing of this point, which is recorded in the field book. Distance is measured between the survey point & the base station (Prismatic compass Bearings & distances taken during prismatic compass survey are shown below. Find out distance between A & with the help of these measurements.

From	To	Bearing	Distance (in m)
X	A	30°	7.5
X	B	120°	5.2



Distance between A to B is 9.0 cm scale is 1cm to 1 m hence distance is 9.0 m.

Advantages of Prismatic Compass -

- 1) It is light weight survey instrument & hence can be taken to any place easily.
- 2) It can be used in very congested area where other survey instruments are difficult to use.

Disadvantages -

- 1) Iron objects like iron pipes, electric poles, steel structure etc. can deviate magnetic needle & thus give wrong reading.
- 2) Slight variations in the measurement of angle are found with different instruments.

Check you Progress :

Following readings were obtained in the prismatic compass survey. Find out distance between A & B.

1)

From	To	Bearing	Distance (in m)
X	A	40 ⁰	7.8 m
X	B	200 ⁰	6.4 m

2)

From	To	Bearing	Distance (in m)
X	A	300 ⁰	4.7 m
X	B	190 ⁰	5.3 m

3)

From	To	Bearing	Distance (in m)
X	A	100°	5.7 m
X	B	200°	8.6 m

4)

From	To	Bearing	Distance (in m)
X	A	45°	3.5 m
X	B	210°	6.2 m

5)

From	To	Bearing	Distance (in m)
X	A	0°	5.2 m
X	B	150°	4.2 m

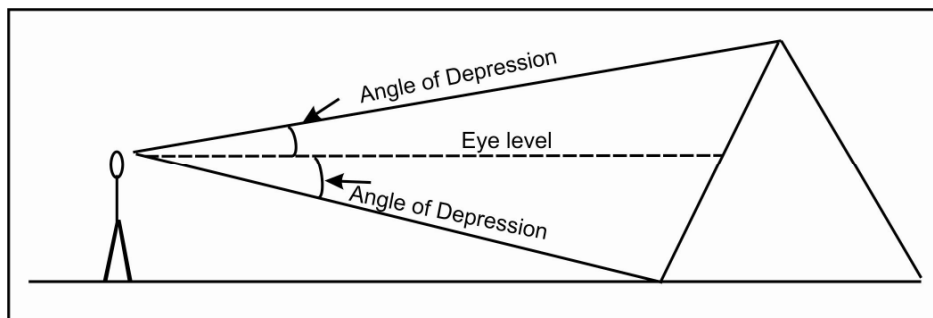
10.4 ABNEY LEVEL

Abney level is a survey instrument used for the measurement of height or depth. It contains spirit level which helps us to keep the instrument in the horizontal direction parallel to the horizontal plane. Protractor is a part of this instrument which helps us to measure the angle above or below our eye level.

Eye Level - It is straight horizontal line at the height of our eye.

Angle of elevation - Angle measured above eye level is termed as an angle of elevation.

Angle of Depression - Angle measurement below eye level is termed as an angle of depression.

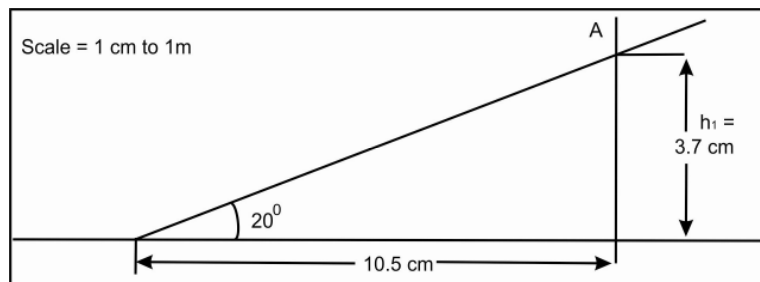


Procedure for taking measurement with the help of Abney level.

- 1) Hold Abney Level in your left hand.
- 2) Look through hole. You will see horizontal line & mirror surface inside the instrument.
- 3) Coincide horizontal line (wire, with the point whose height or depth is required.
- 4) Rotate knob of the instrument with you right hand in such a manner that you will be able to see image of bubble in the mirror. Coincide bubble with the wire.
- 5) Measure angle of elevation or depression on the protractor.
- 6) Measure your eye level. i.e. height of your eye from your feet.
- 7) Measure distance between your position and the point.
- 8) Take proper scale 1 cm to 1m and plot details. We can get height or depth by graphical method.

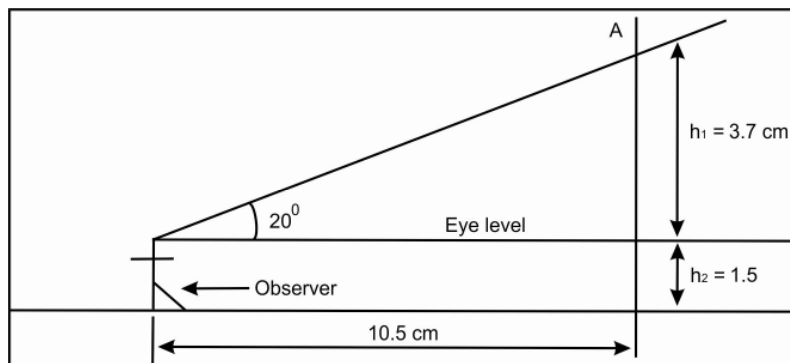
Q.1 Following details were obtained in Abney level survey. Find out height of point A.

- 1) Angle of elevation = 20°
- 2) Distance = 10.5m
- 3) Eye level = 1.5 m



$$\begin{aligned} \text{Height} &= h_1 + h_2 \\ &= 3.7\text{cm} + 1.5\text{m} \\ &= 5.2\text{cm} \end{aligned}$$

Scale is 1cm to 1m. hence 5.2cm means 5.2m.
Height of point 'A' is 5.2m



Formula for angle of Elevation -

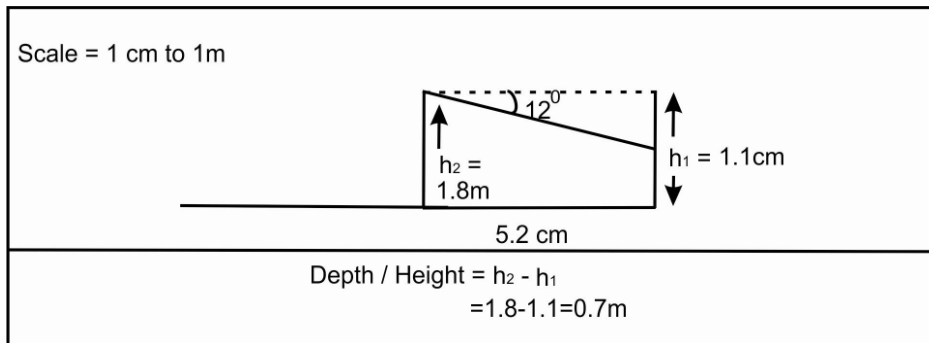
Height (H) = $h_1 + h_2$ (Eye level).

Formula for angle of Depression

Depth (D) = h_2 (Eye level) - h_1

Q.2 Find out height of the object with the help of following readings.

- 1) Eye level = 1.8m.
- 2) Distance = 5.2m.
- 3) Angle of depression = 12°



Height of the object is 0.7m. Calculate height / depth in the following examples.

Sr. No.	Eye level (1m)	Distance (m)	Angle of Elevation	Angle of Depression
1	1.2	10.6	15°	--
2	1.8	1.9	--	8°
3	1.3	8.7	22°	--
4	1.5	6.8	25°	--
5	1.8	2.5	--	10°
6	1.6	3.2	--	11°
7	1.5	11.0	18°	--

