

REPRESENTATION OF DATA

Besides the tabular form, the data may also be presented in some graphic or diagrammatic form.

“The transformation of data through visual methods like graphs, diagrams, maps and charts is called representation of data.”

The need of representing data graphically:

Graphics, such as maps, graphs and diagrams, are used to represent large volume of data. They are necessary:

- If the information is presented in tabular form or in a descriptive record, it becomes difficult to draw results.
- Graphical form makes it possible to easily draw visual impressions of data.
- The graphic method of the representation of data enhances our understanding.
- It makes the comparisons easy.
- Besides, such methods create an imprint on mind for a longer time.
- It is a time consuming task to draw inferences about whatever is being presented in non-graphical form.
- It presents characteristics in a simplified way.
- These makes it easy to understand the patterns of population growth, distribution and the density, sex ratio, age-sex composition, occupational structure, etc.

General Rules for Drawing Graphs, Diagrams and Maps

1. Selection of a Suitable Graphical Method

Each characteristic of the data can only be suitably represented by an appropriate graphical method. For example,

- To show the data related to the temperature or growth of population between different periods in time line graph are used.
- Similarly, bar diagrams are used for showing rainfall or the production of commodities.
- The population distribution, both human and livestock, or the distribution of the crop producing areas are shown by dot maps.
- The population density can be shown by choropleth maps.

Thus, it is necessary and important to select suitable graphical method to represent data.

2. Selection of Suitable Scale

Each diagram or map is drawn to a scale which is used to measure the data. The scale must cover the entire data that is to be represented. The scale should neither be too large nor too small.

3. Design

The diagram or map should have following design:

- Title: The title of the diagram/map must be clear and include -
 - The name of the area,
 - Reference year of the data used and
 - The caption of the diagram.

These are written with different font sizes and thickness. The title, subtitle and the corresponding year is shown in the centre at the top of the map/diagram.

- Legend or Index: The index must clearly explain the colours, shades, symbols and signs used in the map and diagram. A legend is shown either at the lower left or lower right side of the map sheet.
- Direction The maps should show the direction North and properly placed on the top.

Types of Diagrams

The diagrams and the maps is of following types:

- One-dimensional diagrams such as line graph, poly graph, bar diagram, histogram, age, sex, pyramid, etc.;
- Two-dimensional diagram such as pie diagram and rectangular diagram;
- Three-dimensional diagrams such as cube and spherical diagrams.

The most commonly drawn diagrams and maps are:

- Line graphs
- Bar diagrams
- Pie diagram
- Wind rose and star diagram
- Flow Charts

1. Line Graph

The line graphs are usually drawn to represent the time series data related to the temperature, rainfall, population growth, birth rates and the death rates.

Construction of a Line Graph

1st step: Round the data to be shown up to the 1 digit of even numbers.

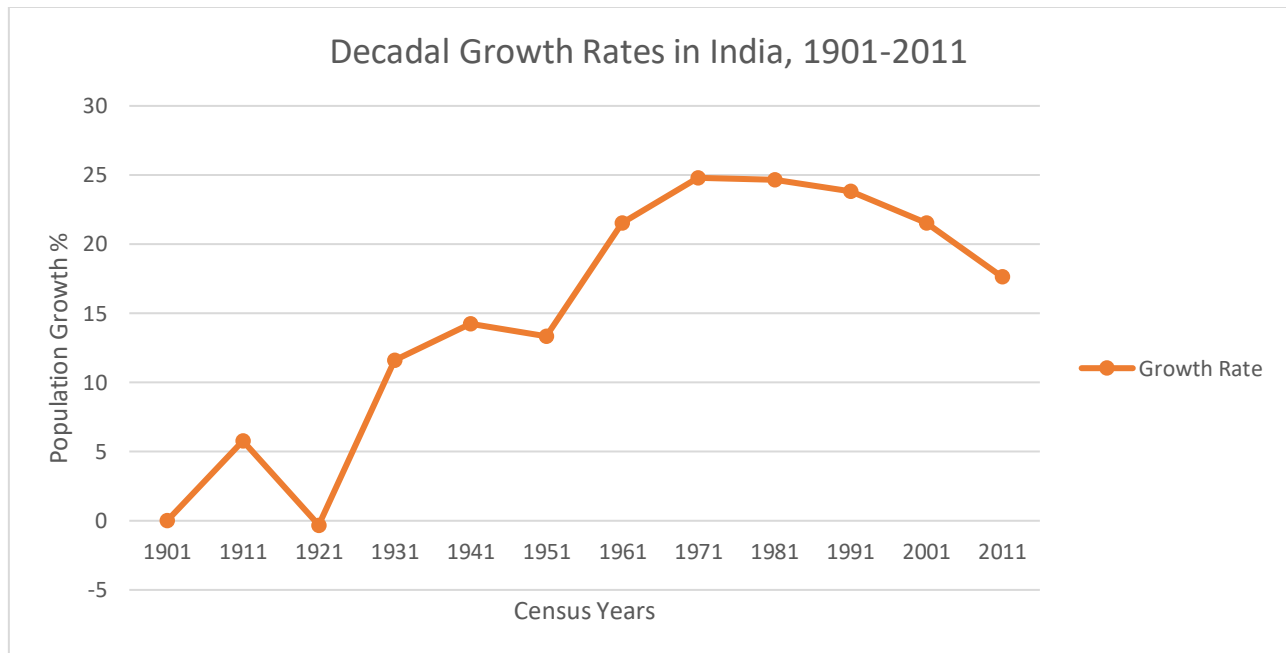
2nd step: Draw X and Y-axis. Mark the time series variables (years/months) on the X axis and the data quantity/value to be plotted on Y axis.

3rd step: Choose an appropriate scale to show data and label it on Y-axis. If the data involves a negative figure, then the selected scale should also show it.

4th step: Plot the data to depict year/month-wise values according to the selected scale on Y-axis, mark the location of the plotted values by a dot and join these dots by a free hand drawn line.

Example 1: Construct a line graph – take example from table 1.1 pg.5 of India book

	Decadal Growth Rates in India, 1901-2011											
Census Years	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001	2011
Growth Rate	NA	5.75	-0.31	11.6	14.22	13.31	21.51	24.8	24.66	23.85	21.54	17.64



2. Polygraph

Polygraph is a line graph in which two or more than two variables are shown on a same diagram by different lines. It helps in comparing the data. Examples which can be shown as polygraph are:

- The growth rate of different crops like rice, wheat, pulses in one diagram.
- The birth rates, death rates and life expectancy in one diagram.
- Sex ratio in different states or countries in one diagram.

Construction of a Polygraph

All steps of construction of polygraph are similar to that of line graph. But different lines are drawn to indicate different variables.

✎ **Example 2: Construct a polygraph take example from fig.11.1 pg.125 India book**

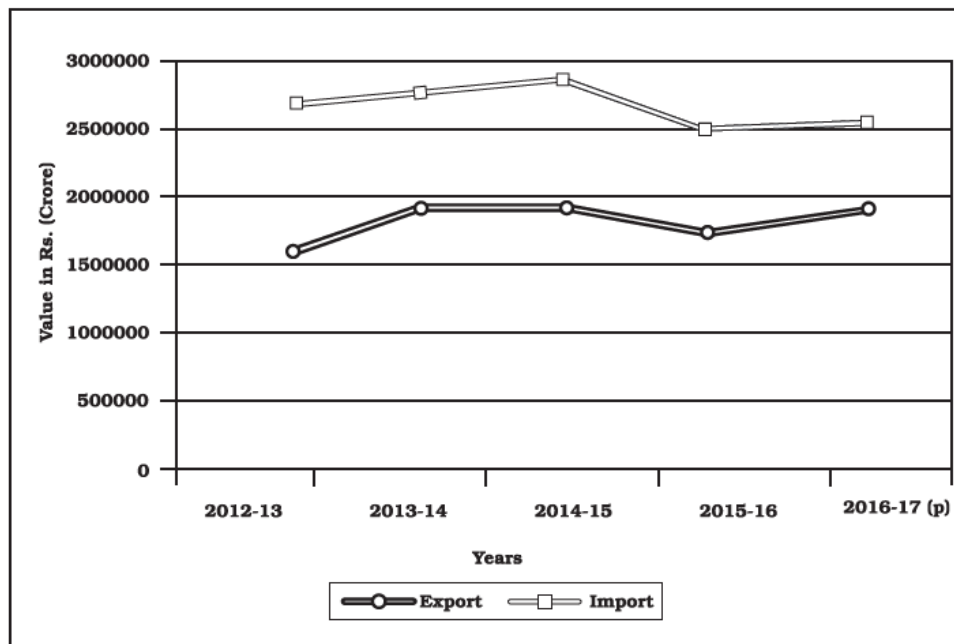
Table 11.1 India's Foreign Trade

Value in Rs. Crores

Year	Exports	Imports	Trade Balance
2004-05	3,75,340	5,01,065	-1,25,725
2009-10	8,45,534	13,63,736	-5,18,202
2013-14	19,05,011	27,15,434	-8,10,423
2016-17	18,52,340	25,77,422	-7,25,082

Source : <http://commerce.nic.in/publications/annual-report-2010-11> and Economic Survey 2016-17

Extent of gap between Exports and Imports in India's foreign trade During 2012-13 to 2016-17



Source : *Economic Survey, 2016-17*

3. Bar Diagram

It is also called a columnar diagram. The bar diagrams are drawn through columns of equal width. Following rules were observed while constructing a bar diagram:

- The width of all the bars or columns is similar.
- All the bars should be placed on equal intervals/distance.
- Bars are shaded with colours or patterns to make them distinct and attractive.

Three types of bar diagrams are used to represent different data sets:

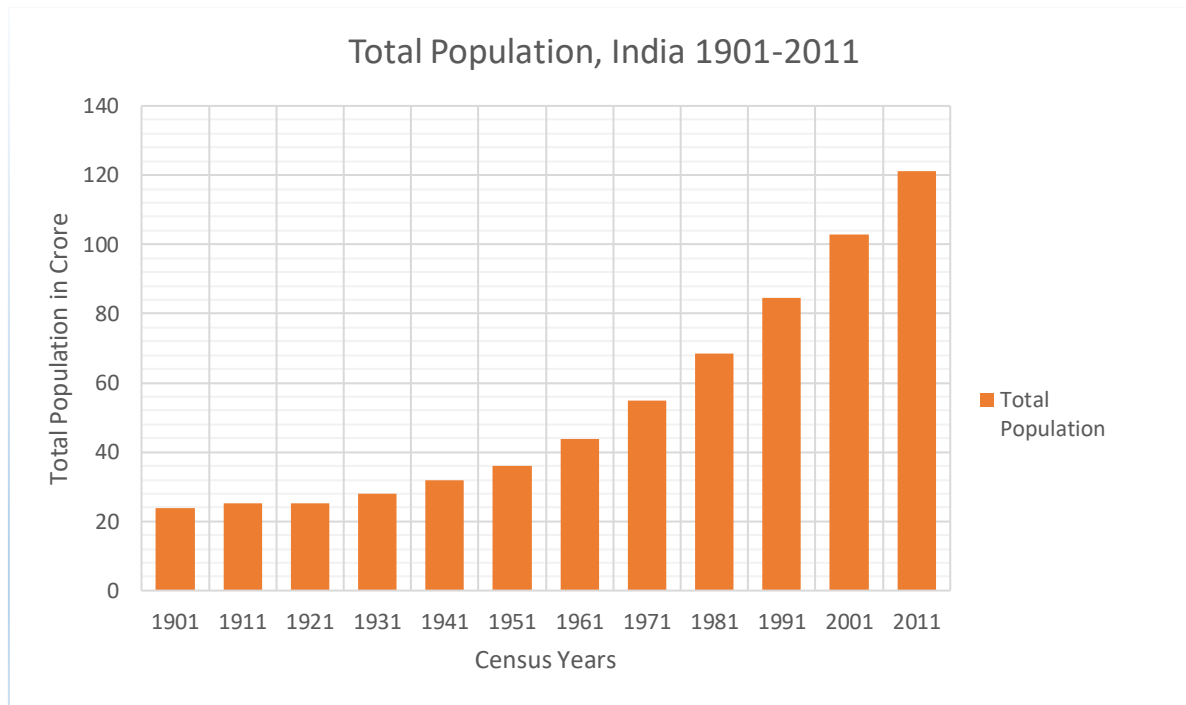
- The simple bar diagram
- Compound bar diagram
- Polybar diagram.

Simple Bar Diagram

A simple bar diagram is constructed for an immediate comparison. It is advisable to arrange the given data set in an ascending or descending order and plot the data variables accordingly. However, time series data are represented according to the sequencing of the time period.

Example 3: Construct a simple bar diagram.

		Total Population India, 1901 to 2011										
Census Years	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001	2011
Total Population	23.84	25.21	25.13	27.89	31.86	36.11	43.92	54.81	68.33	84.63	102.86	121.02

**Construction Steps:**

Draw X and Y-axes on a graph paper. Take an interval and mark it on Y-axis to plot data. Divide X-axis into equal parts to draw bars. The actual values will be plotted according to the selected scale.

4. Line and Bar Graph

The line and bar graphs as drawn separately may also be combined to depict the data related to some of the closely associated characteristics such as the climatic data of mean monthly temperatures and rainfall.

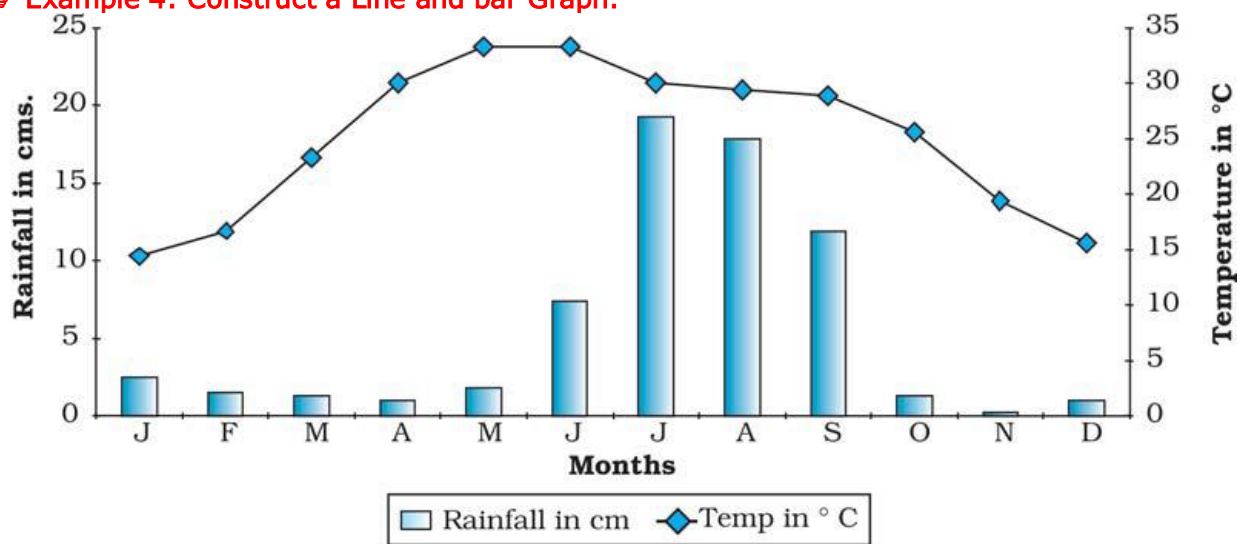
Example 4: Construct a Line and bar Graph.

Table 3.4 : Average monthly Temperature and Rainfall in Delhi

Months	Temp. in °C	Rainfall in cm.
Jan.	14.4	2.5
Feb.	16.7	1.5
Mar.	23.30	1.3
Apr.	30.0	1.0
May	33.3	1.8
June	33.3	7.4
Jul.	30.0	19.3
Aug.	29.4	17.8
Sep.	28.9	11.9
Oct.	25.6	1.3
Nov.	19.4	0.2
Dec.	15.6	1.0

Construction:

- Draw X and Y-axes of a suitable length and divide X-axis into parts to show months in a year.
- Select a suitable scale with equal intervals on the Y-axis and label it at its right side.
- Similarly, select a suitable scale with equal intervals on the Y-axis and label at its left side.
- Plot data using line graph and columnar diagram.

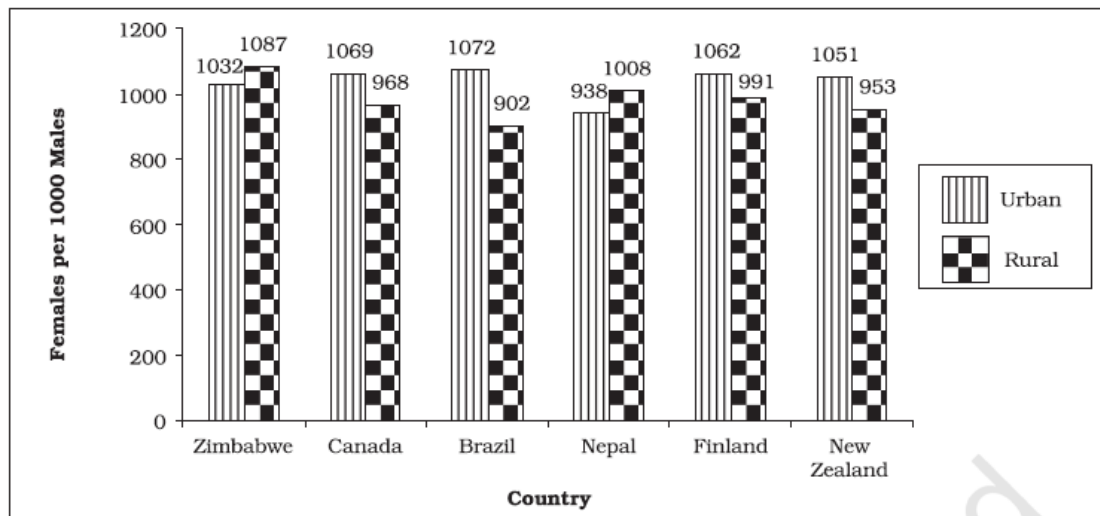
5. Multiple Bar Diagram

Multiple bar diagrams are constructed to represent two or more than two variables for the purpose of comparison. For example, a multiple bar diagram may be constructed to show proportion of males and females in the total, rural and urban population or the share of canal, tube well and well irrigation in the total irrigated area in different states.

Construction

- Mark time series data on X-axis and variable data on Y-axis as per the selected scale.
- Plot the data in closed columns.

Example 5: Construct a Multiple bar Diagram fig 3.4 pg.20 Fundamental book.



Source: Demographic Year Book, 2015

Fig. 3.4: Rural Urban Sex Composition (Selected Countries)

Mention Table also.

6. Compound Bar Diagram

When different components are grouped in one set of variable or different variables of one component are put together, their representation is made by a compound bar diagram. In this method, different variables are shown in a single bar with different rectangles.

Construction

- Arrange the data in ascending or descending order.
- A single bar will depict the set of variables by dividing the total length of the bar as per percentage.

Example 6: Construct a Compound Bar Diagram

Table 3.6 : Gross Generation of Electricity in India (in Billion KWh)

Year	Thermal	Hydro	Nuclear	Total
2008-09	616.2	110.1	14.9	741.2
2009-10	677.1	104.1	18.6	799.8
2010-11	704.3	114.2	26.3	844.8

Source: Economic Survey, 2011-12

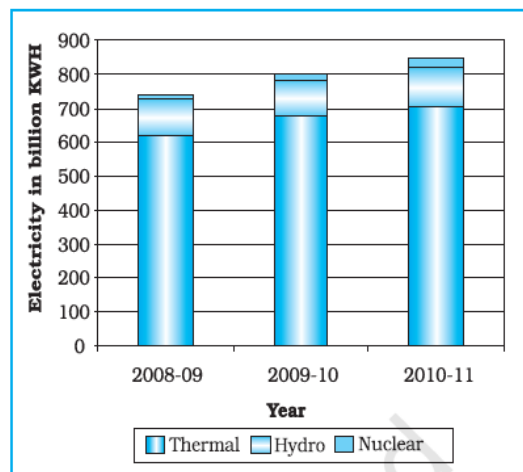


Fig. 3.7 : Gross Electricity Generation in India

7. Pie Diagram

Pie diagram is another graphical method of the representation of data. It is drawn to depict the total value of the given attribute using a circle. Dividing the circle into corresponding degrees of angle then represent the sub-sets of the data. Hence, it is also called as Divided Circle Diagram. The angle of each variable is calculated using the following formulae.

$$\frac{\text{Value of given State/Region} \times 360}{\text{Total Value of All States/Regions}}$$

If data is given in percentage form, the angles are calculated using the given formulae.

$$\frac{\text{Percentage of } x \times 360}{100}$$

Calculation of Angles

- Arrange the data on percentages in an ascending order.
- Calculate the degrees of angles for showing the given values
- It could be done by multiplying percentage with a constant of 3.6 as derived by dividing the total number of degrees in a circle by 100, i. e. $360/100$.
- Plot the data by dividing the circle into the required number of divisions to show the share different regions/countries

Construction

- Select a suitable radius for the circle to be drawn. A radius of 3, 4 or 5 cm may be chosen for the given data set.
- Draw a line from the centre of the circle to the arc as a radius.
- Measure the angles from the arc of the circle for each category of vehicles in an ascending order clock-wise, starting with smaller angle.
- Complete the diagram by adding the title, sub - title, and the legend. The legend mark be chosen for each variable/category and highlighted by distinct shades/colours.

Precautions

- The circle should neither be too big to fit in the space nor too small to be illegible.
- Starting with bigger angle will lead to accumulation of error leading to the plot of the smaller angle difficult.

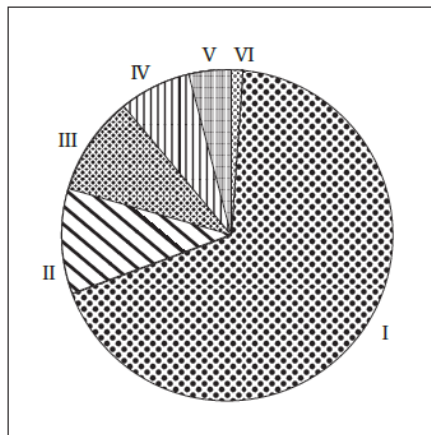
Example 7: Construct a Pie Diagram

Table 4.2 : India— Class-wise number of towns and cities and their population, 2011

Class	Population Size	Number of Cities	Total Urban Population	% of Total Urban Population
I	1,00,000 and more	468	2,27,899	60.45
II	50,000 - 99,999	474	41,328	10.96
III	20,000 - 49,999	1,373	58,174	15.43
IV	10,000 - 19,999	1,683	31,866	8.45
V	5,000 - 9,999	1,749	15,883	4.21
VI	Less than 5,000	424	1,956	0.51

*Source: Census of India - 2011 and India, 2017, Ministry of Information and Broadcasting, Government of India

Fig. 4.5 : India : Distribution of urban population (%), according to size class of urban centre - 2011



Thematic Maps

Varieties of maps are drawn to understand the patterns of the regional distributions or the characteristics of variations over space these maps are known as the distribution maps or thematic maps.

Requirements for Making a Thematic Map

- (a) State/District level data about the selected theme.
- (b) Outline map of the study area along with administrative boundaries.
- (c) Physical map of the region. For example, physiographic map for population distribution and relief and drainage map for constructing transportation map.

Rules for Making Thematic Maps

- (i) The drawing of the thematic maps must be carefully planned. The final map should properly reflect the following components:
 - a. Name of the area
 - b. Title of the subject-matter
 - c. Source of the data and year
 - d. Indication of symbols, signs, colours, shades, etc.
 - e. Scale
- (ii) The selection of a suitable method to be used for thematic mapping.

Classification of Thematic Maps based on Method of Construction

The thematic maps are generally, classified into quantitative and non-quantitative maps. The quantitative maps are drawn to show the variations within the data. For example, maps depicting areas receiving more than 200 cm, 100 to 200 cm, 50 to 100 cm and less than 50 cm of rainfall are referred as quantitative maps. These maps are also called as statistical maps.

The non-quantitative maps, on the other hand, depict the non-measurable characteristics in the distribution of given information such as a map showing high and low rainfall-receiving areas. These maps are also called as qualitative maps.

The construction of quantitative maps: There are three types of quantitative maps -

- (a) Dot maps
- (b) Choropleth maps
- (c) Isopleth maps

9. Dot Maps

The dot maps are drawn to show the distribution of phenomena such as population, cattle, types of crops, etc. The dots of same size as per the chosen scale are marked over the given administrative units to highlight the patterns of distributions.

Requirement

- (a) An administrative map of the given area showing state/district/block boundaries.
- (b) Statistical data on selected theme for the chosen administrative units, i.e., total population, cattle etc.
- (c) Selection of a scale to determine the value of a dot.

(d) Physiographic map of the region especially relief and drainage maps.

Precaution

- (a) The lines demarcating the boundaries of various administrative units should not be very thick and bold.
- (b) All dots should be of same size.

Construction

- (a) Select the size and value of a dot.
- (b) Determine the number of dots in each district using the given scale. For example –
(Leave three lines empty)
- (c) Place the dots in each district as per the determined number.
- (d) Consult the physiographic/relief map of India to identify mountainous, desert, and/or snow covered areas and mark lesser number of dots in such areas.

✎ **Example 9: Construct a Dot Map (will be done in class)**

10. Choropleth Map

The choropleth maps are also drawn to depict the data characteristics as they are related to the administrative units. These maps are used to represent the density of population, literacy/growth rates, sex-ratio, etc.

Requirement for drawing Choropleth Map

- (a) A map of the area depicting different administrative units.
- (b) Appropriate statistical data according to administrative units.

Steps to be followed

- (a) Arrange the data in ascending or descending order.
- (b) Group the data into 5 categories to represent very high, high, medium, low and very low concentrations.
- (c) The interval between the categories may be identified on the following formulae i.e.
 $\text{Range}/5$ and $\text{Range} = \text{maximum value} - \text{minimum value}$.
- (d) Patterns, shades or colour to be used to depict the chosen categories should be marked in an increasing or decreasing order.

Construction

- (a) Arrange the data in ascending order as shown above.
- (b) Identify the range within the data.
(Leave 12 lines empty)

✎ **Example 10: Construct a Choropleth Map. (will be done in class)**

11. Isopleth Map

Variations in the degrees of slope, temperature, occurrence of rainfall, may be represented by drawing the lines of equal values on a map. All such maps are termed as Isopleth Map. The word Isopleth is derived from Iso meaning equal and pleth means lines. Thus, an imaginary line, which joins the places of equal values, is referred as Isopleth. The more frequently drawn isopleths include Isotherm (equal temperature), Isobar (equal pressure), Isohyets (equal

rainfall), Isonephs (equal cloudiness), Isohels (equal sunshine), contours (equal heights), Isobaths (equal depths), Isohaline (equal salinity), etc.

Requirement

- Base line map depicting point location of different places.
- Appropriate data of temperature, pressure, rainfall, etc. over a definite period of time.
- Drawing instrument specially French Curve, etc.

Rules to be observed

- An equal interval of values be selected.
- Interval of 5, 10, or 20 is supposed to be ideal.
- The value of Isopleth should be written along the line on either side or in the middle by breaking the line.

Interpolation

Interpolation is used to find the intermediate values between the observed values of at two stations/locations. Generally, drawing of isopleths joining the places of same value is also termed as interpolation.

Method of Interpolation: For interpolation, follow the following steps:

- Firstly, determine the minimum and maximum values given on the map.
- Calculate the range of value i.e. Range = maximum value – minimum value.
- Based on range, determine the interval in a whole number like 5, 10, 15, etc.

The exact point of drawing an Isopleth is determined by using the following formulae.

$$\text{Point of Isopleth} = \frac{\text{Distance between two points in cm}}{\text{Difference between the two values of corresponding points}} \times \text{Interval}$$

The interval is the difference between the actual value on the map and interpolated value. For example, in an Isotherm map of two places show 28° C and 33° C and you want to draw 30° C isotherm, measure the distance between the two points. Suppose the distance is 1cm or 10 mm and the difference between 28 and 33 is 5, thus, exact point of 30 will be plotted 4mm away from 28°C or 6mm ahead of 33°C.

 **Example 11: Construct an Isopleth Map. (will be done in class)**