Graphical Representation of Data

Once the data are summarized in the form of a frequency table, a graphical representation can be given.
In this section we will introduce some ways commonly used to graphically represent both qualitative and quantitative data.

Graphical representation of qualitative data
Bar graph

A graph of bars whose heights represent the frequencies (or relative frequencies) of respective categories is called a bar graph.

A bar graph displays graphically the information concerning qualitative data that a frequency distribution shows in tabular form. The graph is composed of bars whose heights are the respective frequencies of the different categories and are of uniform width on the horizontal axis.

The bars should be separated by spaces.

Example
Make a bar graph of the data shown earlier in Table 2.1.

Fig. 2.1
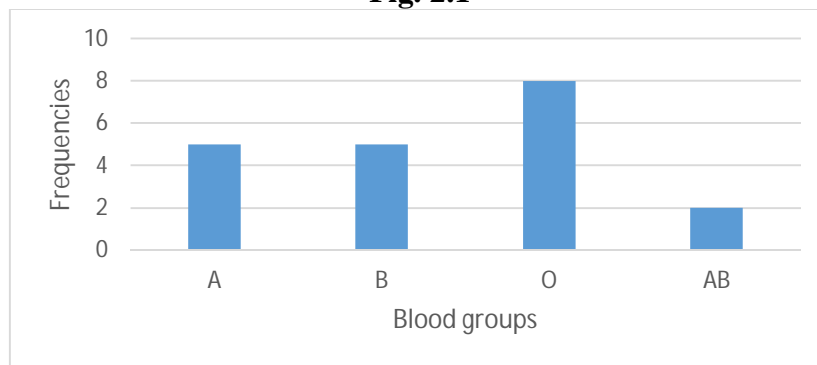
PIE CHART
A pie chart, is used to graphically display qualitative data, it is a circle that is divided into sectors that represent the relative frequencies or percentages belonging to different categories.

A pie chart is made by representing the relative frequency or percentage of a category by an angle of a circle determined by the following rule:

<mark>**Angle of a category = Relative frequency(percentage) of the category * 360**</mark>
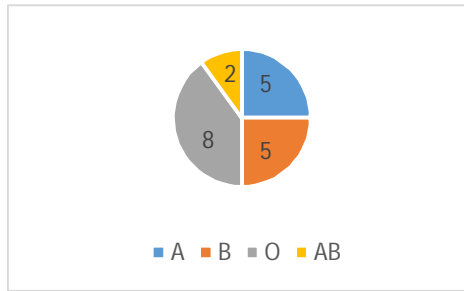
Example
Construct a pie chart for the frequency distribution in Table 2.1

To construct the pie chart, we have to find angle sizes for each category, as shown in the table below

blood groups (x_i)	Relative frequency (f_i)	Angle size
A	0.25	0.25*360 = 90°
B	0.25	0.25*360 = 90°
O	0.4	0.4*360 = 144°
AB	0.1	0.1*360 = 36%

Fig. 2.2

Graphical representation of quantitative data
**Graphical representation of a discrete quantitative variable**
Simple bar graph
The distribution of a discrete quantitative variable can be represented by a simple bar diagram.
The simple bar diagram is similar to a bar graph. However, a simple bar diagram is represented by lines whose heights are proportional to the number of frequencies, while a bar graph is represented by rectangles.

Example
Construct a simple bar graph for the frequency distribution in Table 2.3

Fig. 2.3
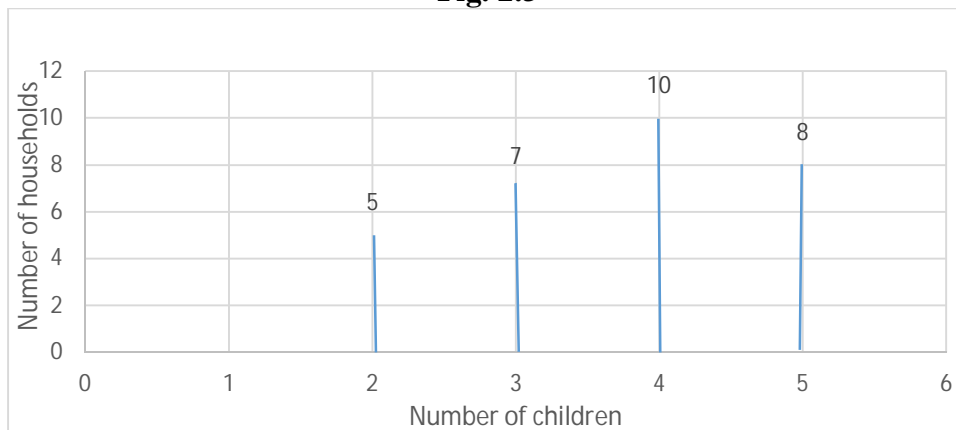
Histogram: The most common form of graphical presentation of continuous data is histogram or frequency histogram. A histogram is a bar (rectangles) diagram where a bar against a class represents frequency of the class. Bars must begin and end at class boundaries, so bars are drawn adjacent to each other without any gaps.
A histogram displays the classes on the horizontal axis and the frequencies of the classes on the vertical axis

When making a histogram, it is essential to distinguish two cases.

1. If the class widths are equal, the height of the rectangles will correspond to the frequencies of classes.

2. If the class widths are different, in order to constitute the histogram, it is necessary to:
– Calculate, for each class, the class width L_i;
– Calculate the density $d_i = n_i / L_i$ for a frequency histogram, and $d_i = f_i / L_i$ for a relative frequency histogram;
– Give to each rectangle a height proportional to the density di of the correspondent class.
– Let $min(L_i)$ be the minimum class width; the height is then called "**Corrected frequency**" and noted as $n_i^* = d_i \times min(L_i)$ (corrected relative frequency $f_i^* = di \times min(L_i)$).
A histogram is correct as long as the numbers (or the corrected frequencies) are proportional to the densities.

Example (a): Class widths are equal
Display the data shown in Table 2.4 using a frequency histogram
Since the class widths are equal, the height of the rectangles corresponds to the frequencies of the classes.
We draw bars over each class, with heights being the frequencies on the following chart:

Fig. 2.4
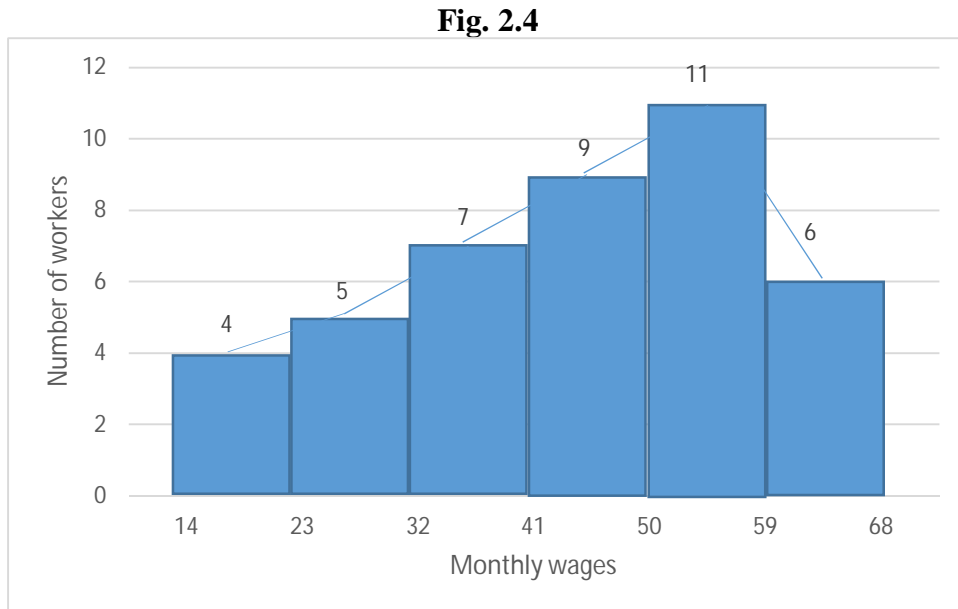
Example (b): Class widths are different
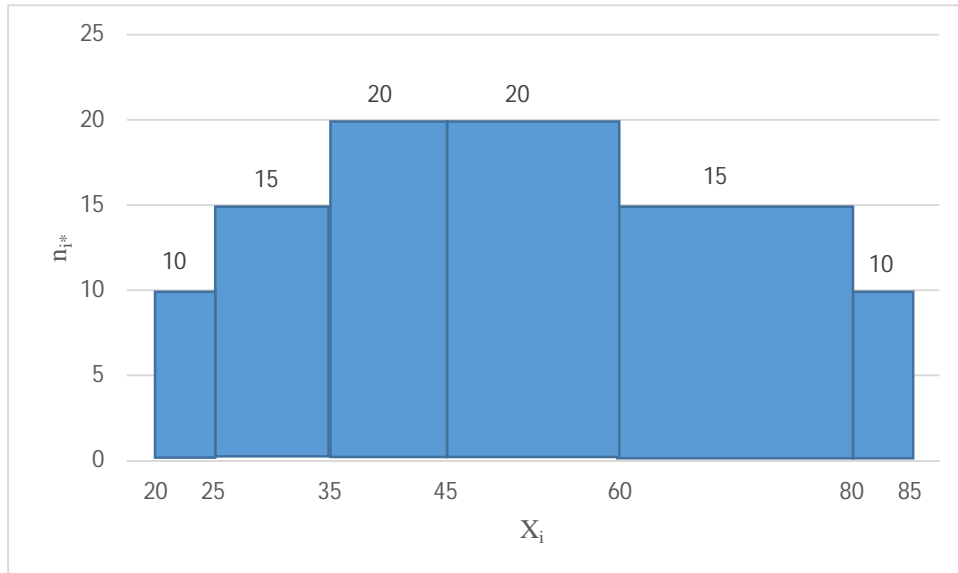Make a frequency histogram for the data shown in Table below.

x_i	[20 25[	[25 35[	[35 45[	[45 60[	[60 80[	[80 85[
n_i	10	30	40	60	60	10

Since the class widths are different, we have to calculate the corrected frequencies (n_i*).

Table 2.5

x_i	n_i	L_i	d_i	n_i*
[20 25[	10	5	2	2 * 5 = 10
[25 35[	30	10	3	3 * 5 = 15
[35 45[	40	10	4	4 * 5 = 20
[45 60[	60	15	4	4 * 5 = 20
[60 80[	60	20	3	3 * 5 = 15
[80 85[	10	5	2	2 * 5 = 10
Sum	210	/	/	

Fig. 2.5

The histogram is plotted by using the corrected frequencies of each class.
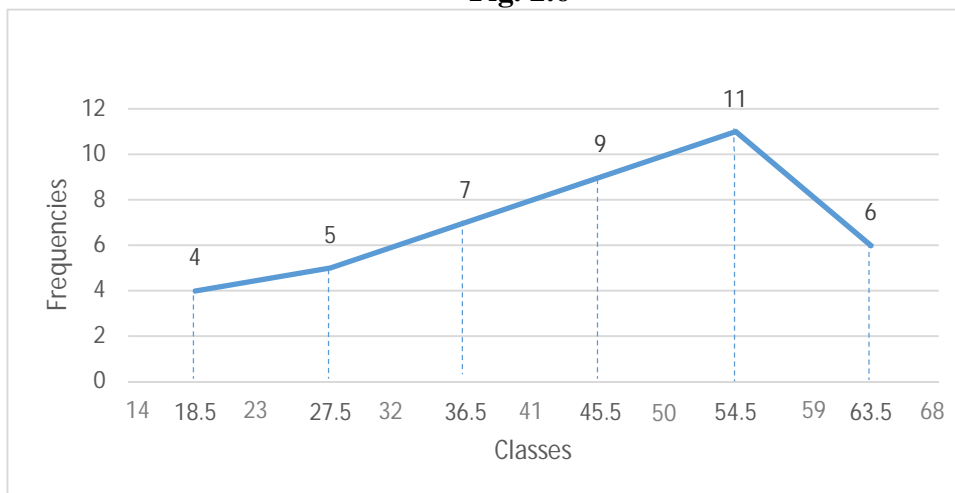
frequency polygon
A frequency polygon is a line graph of the class frequencies plotted against class marks. It can be obtained by connecting the midpoints of the tops of the rectangles in the histogram.
A frequency polygon emphasizes the continuous change in frequencies.

Example
Make a frequency polygon for the frequency distribution in Table 2.4

To construct the frequency polygon, we plot points that represent the midpoint and frequency of each class and connect the points. We can also make the frequency polygon by connecting the midpoints of the tops of the rectangles in the histogram, as mentioned above (Fig. 2.4).

Fig. 2.6

Ogive or Cumulative frequency polygon:
A graph showing the cumulative frequency less than any upper class boundary plotted against the upper class boundary or the cumulative frequency distribution of all values greater than or equal to the lower class boundary of each class interval. Ogives can also be constructed for a cumulative relative frequency distribution as well as a cumulative percentage distribution.

Example
Draw an ogive for the cumulative frequencies in Table 2.4.

We draw ogive for (less than) cumulative frequencies by connecting the plotted points that represent the upper class boundaries against their corresponding cumulative frequencies, and we do the same thing with (or more) cumulative frequencies using the appropriate manner as explained above.