# UNIT-II

# Formation of Frequency Distribution

Frequency distribution is a series when a number of observations with similar or closely related values are put in separate bunches or groups, each group being in order of magnitude in a series. It is simply a table in which the data are grouped into classes and the number of cases which fall in each class are recorded. It shows the frequency of occurrence of different values of a single Phenomenon.

A frequency distribution is constructed for three main reasons:

- ✓ To facilitate the analysis of data.
- ✓ To estimate frequencies of the unknown population distribution from the distributionof sample data and
- ✓ To facilitate the computation of various statistical measures

### Raw data:

The statistical data collected are generally raw data or ungrouped data. Let us consider the daily wages (in Rs ) of 30 labours in a factory.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 80 | 70 | 55 | 50 | 60 | 65 | 40 | 30 | 80 | 90 |
| 75 | 45 | 35 | 65 | 70 | 80 | 82 | 55 | 65 | 80 |
| 60 | 55 | 38 | 65 | 75 | 85 | 90 | 65 | 45 | 75 |

The above figures are nothing-but raw or ungrouped data and they are recorded as they occur without any pre consideration. This representation of data does not furnish any useful information and is rather confusing to mind. A better way to express the figures in an ascending or descending order of magnitude and is commonly known as array. But this does not reduce the bulk of the data. The above data when formed into an array is in the following form:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30 | 35 | 38 | 40 | 45 | 45 | 50 | 55 | 55 | 55 |
| 60 | 60 | 65 | 65 | 65 | 65 | 65 | 65 | 70 | 70 |
| 75 | 75 | 75 | 80 | 80 | 80 | 80 | 85 | 90 | 90 |

The array helps us to see at once the maximum and minimum values. It also gives a rough idea of the distribution of the items over the range . When we have a large number of items, the formation of an array is very difficult, tedious and cumbersome. The Condensation should be directed for better understanding and may be done in two ways, depending on the nature of the data.

### A. Discrete (or) Ungrouped frequency distribution:

In this form of distribution, the frequency refers to discrete value. Here the data are presented in a way that exact measurement of units are clearly indicated.

There are definite difference between the variables of different groups of items. Each class is distinct and separate from the other class. Non-continuity from one class to another class exist. Data as such facts like the number of rooms in a house, the number of companies registered in a country, the number of children in a family, etc.

The process of preparing this type of distribution is very simple. We have just to count the number of times a particular value is repeated, which is called the frequency of that class. In order to facilitate counting prepare a column of tallies.

In another column, place all possible values of variable from the lowest to the highest. Then put a bar (Vertical line) opposite the particular value to which it relates.

To facilitate counting, blocks of five bars ~~||||~~ are prepared and some space is left in between each block. We finally count the number of bars and get frequency.

**Example:**

In a survey of 40 families in a village, the number of children per family was recorded and the following data obtained.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 3 | 2 | 1 | 5 | 6 | 2 |
| 2 | 1 | 0 | 3 | 4 | 2 | 1 | 6 |
| 3 | 2 | 1 | 5 | 3 | 3 | 2 | 4 |
| 2 | 2 | 3 | 0 | 2 | 1 | 4 | 5 |
| 3 | 3 | 4 | 4 | 1 | 2 | 4 | 5 |

Represent the data in the form of a discrete frequency distribution.

**Solution:**

Frequency distribution of the number of children

| Number of Children | Tally Marks | Frequency |
|---|---|---|
| 0 | \|\|\| | 3 |
| 1 | ~~\|\|\|\|~~ \|\| | 7 |
| 2 | ~~\|\|\|\|~~ ~~\|\|\|\|~~ | 10 |
| 3 | ~~\|\|\|\|~~ \|\|\| | 8 |
| 4 | ~~\|\|\|\|~~ \| | 6 |
| 5 | \|\|\|\| | 4 |
| 6 | \|\| | 2 |
| | Total | 40 |

## B. Continuous frequency distribution:

In this form of distribution refers to groups of values. This becomes necessary in the case of some variables which can take any fractional value and in which case an exact measurement is not possible. Hence a discrete variable can be presented in the form of a continuous frequency distribution.

Wage distribution of 100 employees

| Weekly wages (Rs) | Number of employees |
|---|---|
| 50-100 | 4 |
| 100-150 | 12 |
| 150-200 | 22 |
| 200-250 | 33 |
| 250-300 | 16 |
| 300-350 | 8 |
| 350-400 | 5 |
| Total | 100 |

**Nature of class:**

The following are some basic technical terms when a continuous frequency distribution is formed or data are classified according to class intervals.

**a) Class limits:**

The class limits are the lowest and the highest values that can be included in the class. For example, take the class 30-40. The lowest value of the class is 30 and highest class is 40. The two boundaries of class are known as the lower limits and the upper limit of the class. The lower limit of a class is the value below which there can be no item in the class. The upper limit of a class is the value above which there can be no item to that class. Of the class 60-79, 60 is the lower limit and 79 is the upper limit, i.e. in the case there can be no value which is less than 60 or more than 79. The way in which class limits are stated depends upon the nature of the data. In statistical calculations, lower class limit is denoted by L and upper class limit by U.

**b) Class Interval:**

The class interval may be defined as the size of each grouping of data. For example, 50-75, 75-100, 100-125… are class intervals. Each grouping begins with the lower limit of a class interval and ends at the lower limit of the next succeeding class interval

**c) Width or size of the class interval:**

The difference between the lower and upper class limits is called Width or size of class interval and is denoted by ‘ C’ .

**d) Range:**

The difference between largest and smallest value of the observation is called The Range and is denoted by ‘ R’ ie

R = Largest value – Smallest value

R = L - S

**e) Mid-value or mid-point:**

The central point of a class interval is called the mid value or mid-point. It is found out by adding the upper and lower limits of a class and dividing the sum by 2.

(i.e.) Mid value = $\frac{L+U}{2}$

For example, if the class interval is 20-30 then the mid-value is

$\frac{20+30}{2} = 25$

**f) Frequency:**

Number of observations falling within a particular class interval is called **frequency** of that class. Let us consider the frequency distribution of weights of persons working in a company.

| Weight (in Kgs) | Number of persons |
|---|---|
| 30-40 | 25 |
| 40-50 | 53 |
| 50-60 | 77 |
| 60-70 | 95 |
| 70-80 | 80 |
| 80-90 | 60 |
| 90-100 | 30 |
| Total | 420 |

In the above example, the class frequencies are 25,53,77,95,80,60,30. The total frequency is equal to 420. The total frequency indicates the total number of observations considered in a frequency distribution.

**g) Number of class intervals:**

The number of class interval in a frequency is matter of importance. The number of class interval should not be too many. For an ideal frequency distribution, the number of class intervals can vary from 5 to 15. To decide the number of class intervals for the frequency distributive in the whole data, we choose the lowest and the highest of the values. The difference between them will enable us to decide the class intervals.

Thus the number of class intervals can be fixed arbitrarily keeping in view the nature of problem under study or it can be decided with the help of Sturges' Rule. According to him, the number of classes can be determined by the formula

$K = 1 + 3.322 \log_{10} N$

where N = Total number of observations

log = logarithm of the number

K = Number of class intervals.

Thus, if the number of observation is 10,

then the number of class intervals is $K = 1 + 3.322 \log 10 = 4.322 \cong 4$

If 100 observations are being studied,

the number of class interval is $K = 1 + 3.322 \log 100 = 7.644 \cong 8$ and so on.

**h) Size of the class interval:**

Since the size of the class interval is inversely proportional to the number of class interval in a given distribution. The approximate value of the size (or width or magnitude) of the class interval ' C' is obtained by using sturges rule as

$$\text{Size of class interval} = C = \frac{\text{Range}}{\text{Number of class interval}}$$

$$= \text{Range} / (1 + 3.322 \log_{10} N)$$

where Range = Largest Value – smallest value in the distribution.

**Types of class intervals:**

There are three methods of classifying the data according to class intervals namely

a) Exclusive method

b) Inclusive method

c) Open-end classes

**a) Exclusive method:**

When the class intervals are so fixed that the upper limit of one class is the lower limitof the next class; it is known as the exclusive method of classification. The following data are classified on this basis.

| Expenditure (Rs.) | No. of families |
|---|---|
| 0-5000 | 60 |
| 5000-10000 | 95 |
| 10000-15000 | 122 |
| 15000-20000 | 83 |
| 20000-25000 | 40 |
| Total | 400 |

The exclusive method ensures continuity of data as much as the upper limit of one class is the lower limit of the next class. In the above example, there are so familieswhose expenditure is between Rs.0 and Rs.4999.99. A family whose expenditure is Rs.5000 would be included in the class interval 5000-10000. This method is widely used in practice.

**b) Inclusive method:**

In this method, the overlapping of the class intervals is avoided. Both the lower and upper limits are included in the class interval. This type of classification may be used for a grouped frequency distribution for discrete variable like members in a family, number of workers in a factory etc., where the variable may take only integral values. It cannot be used with fractional values like age, height, weight etc.

This method may be illustrated as follows:

| **Class interval** | **Frequency** |
|---|---|
| 5-9 | 7 |
| 10-14 | 12 |
| 15-19 | 15 |
| 20-29 | 21 |
| 30-34 | 10 |
| 35-39 | 5 |
| Total | 70 |

Thus, to decide whether to use the inclusive method or the exclusive method, it is important to determine whether the variable under observation in a continuous or discrete one. In case of continuous variables, the exclusive method must be used. The inclusive method should be used in case of discrete variable.

**c) Open end classes:**

A class limit is missing either at the lower end of the first class interval or at the upper end of the last class interval or both are not specified. The necessity of open end classes arises in a number of practical situations, particularly relating to economic and medical data when there are few very high values or few very low values which are far apart from the majority of observations.

The example for the open-end classes as follows:

| Salary Range | No. of workers |
|---|---|
| Below 2000 | 7 |
| 2000-4000 | 5 |
| 4000-6000 | 6 |
| 6000-8000 | 4 |
| 8000 and above | 3 |

## Formation or Construction of the frequency table:

Constructing or forming a frequency distribution depends on the nature of the given data. Hence, the following general consideration may be borne in mind for ensuring meaningful classification of data:

(i) The number of classes should preferably be between 5 and 20. However there is no rigidityabout it.
(ii) As far as possible one should avoid values of class intervals as 3,7,11,26….etc. preferably.
(iii) One should have class intervals of either five or multiples of 5 like 10,20,25,100 etc.
(iv) The starting point i.e., the lower limit of the first class, should either be zero or 5 or multiple of 5.
(v) To ensure continuity and to get correct class interval we should adopt **exclusive** method.
(vi) Wherever possible, it is desirable to use class interval of equal sizes.

## Preparation of frequency table:

The premise of data in the form of frequency distribution describes the basic pattern which the data assumes in the mass. Frequency distribution gives a better picture of the pattern of data if the number of items is large. If the identity of the individuals about whom a particular information is taken, is not relevant then the first step of condensation is to divide the observed range of variable into a suitable number of class-intervals and to record the number of observations in each class. Let us consider the weights in kg of 50 college students.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 42 | 62 | 46 | 54 | 41 | 37 | 54 | 44 | 32 | 45 |
| 47 | 50 | 58 | 49 | 51 | 42 | 46 | 37 | 42 | 39 |
| 54 | 39 | 51 | 58 | 47 | 64 | 43 | 48 | 49 | 48 |
| 49 | 61 | 41 | 40 | 58 | 49 | 59 | 57 | 57 | 34 |
| 56 | 38 | 45 | 52 | 46 | 40 | 63 | 41 | 51 | 41 |

Here the size of the class interval as per Sturges rule is obtained as follows

$$\text{Size of class interval} = C = \frac{\text{Range}}{1 + 3.322 \log N}$$

$$= \frac{64 - 32}{1 + 3.322 \log(50)} = \frac{32}{6.64} \approx 5$$

Thus, the number of class interval is 7 and size of each class is 5. The required size of each class is 5. The required frequency distribution is prepared using tally marks as given below:

| Class Interval | Tally Marks | Frequency |
|---|---|---|
| 30-35 | 𝍷𝍷 | 2 |
| 35-40 | 𝍸 𝍷 | 6 |
| 40-45 | 𝍸 𝍸 𝍷𝍷 | 12 |
| 45-50 | 𝍸 𝍸 𝍷𝍷𝍷𝍷 | 14 |
| 50-55 | 𝍸 𝍷 | 6 |
| 55-60 | 𝍸 𝍷 | 6 |
| 60-65 | 𝍷𝍷𝍷𝍷 | 4 |
| Total | | 50 |

**Example:**

Given below are the number of tools produced by workers in a factory.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 43 | 18 | 25 | 18 | 39 | 44 | 19 | 20 | 20 | 26 |
| 40 | 45 | 38 | 25 | 13 | 14 | 27 | 41 | 42 | 17 |
| 34 | 31 | 32 | 27 | 33 | 37 | 25 | 26 | 32 | 25 |
| 33 | 34 | 35 | 46 | 29 | 34 | 31 | 34 | 35 | 24 |
| 28 | 30 | 41 | 32 | 29 | 28 | 30 | 31 | 30 | 34 |
| 31 | 35 | 36 | 29 | 26 | 32 | 36 | 35 | 36 | 37 |
| 32 | 23 | 22 | 29 | 33 | 37 | 33 | 27 | 24 | 36 |
| 23 | 42 | 29 | 37 | 29 | 23 | 44 | 41 | 45 | 39 |
| 21 | 21 | 42 | 22 | 28 | 22 | 15 | 16 | 17 | 28 |
| 22 | 29 | 35 | 31 | 27 | 40 | 23 | 32 | 40 | 37 |

Construct frequency distribution with inclusive type of class interval. Also find.
a. How many workers produced more than 38 tools?
b. How many workers produced less than 23 tools?

**Solution:**

Using Sturges formula for determining the number of class intervals, we have

Number of class intervals $= 1 + 3.322 \log_{10} N$

$= 1 + 3.322 \log_{10} 100$

$= 7.6$

$$\text{Sizes of class interval} = \frac{\text{Range}}{\text{Number of class interval}}$$

$$= \frac{46-13}{7.6}$$
$$\approx 5$$

Hence taking the magnitude of class intervals as 5, we have 7 classes 13-17, 18-22… 43-47 are the classes by inclusive type. Using tally marks, the required frequency distribution is obtain in the following table

| Class Interval | Tally Marks | Number of tools produced (Frequency) |
|---|---|---|
| 13-17 | 𝍸 \| | 6 |
| 18-22 | 𝍸 𝍸 \| | 11 |
| 23-27 | 𝍸 𝍸 𝍸 \|\|\| | 18 |
| 28-32 | 𝍸 𝍸 𝍸 𝍸 𝍸 | 25 |
| 33-37 | 𝍸 𝍸 𝍸 𝍸 \|\| | 22 |
| 38-42 | 𝍸 𝍸 \| | 11 |
| 43-47 | 𝍸 \|\| | 7 |
| Total | | 100 |

## 2.1 Presentation of data:

The techniques of classification and tabulation that help in summarizing the collected data and presenting them in a systematic manner. However, these forms of presentation do not always prove to be interesting to the common man.One of the most convincing and appealing ways in which statistical results may be presentedis through diagrams and graphs. Just one diagram is enough to represent a given data more effectively than thousand words.

Moreover, even a layman who has nothing to do with numbers can also understands diagrams. Evidence of this can be found in newspapers, magazines, journals, advertisement, etc.

There are five types of representation an they are

a) Textual presentation b) Tabular presentation
c) Diagrammatic representation d) Graphical Representaion

**Diagrammatic Representation of data:**

A diagram is a visual from for presentation of statistical data, highlighting their basic facts and relationship. If we draw diagrams on the basis of the data collected they will easily be understood and appreciated by all. It is readily intelligible and save a considerable amount of time and energy.

## Significance of Diagrams and Graphs:

Diagrams and graphs are extremely useful because of the following reasons.

i. They are attractive and impressive.
ii. They make data simple and intelligible.
iii. They make comparison possible
iv. They save time and labour.
v. They have universal utility.
vi. They give more information.
vii. They have a great memorizing effect.

**General rules for constructing diagrams:**

The construction of diagrams is an art, which can be acquired through practice.However, observance of some general guidelines can help in making them more attractive andeffective. The diagrammatic presentation of statistical facts will be advantageous provided the following rules are observed in drawing diagrams:

(i) A diagram should be neatly drawn and attractive.
(ii) The measurements of geometrical figures used in diagram should be accurate and proportional.
(iii)The size of the diagrams should match the size of the paper.
(iv) Every diagram must have a suitable but short heading.
(v) The scale should be mentioned in the diagram.
(vi) Diagrams should be neatly as well as accurately drawn with the help of drawing instruments.
(vii) Index must be given for identification so that the reader can easily make out the meaning of the diagram.
(viii)Footnote must be given at the bottom of the diagram.
(ix) Economy in cost and energy should be exercised in drawing diagram.

**Types of diagrams:**

In practice, a very large variety of diagrams are in use and new ones are constantly being added. For the sake of convenience and simplicity, they may be divided under the following heads:

A.One-dimensional diagrams
B.Two-dimensional diagrams
C.Three-dimensional diagrams
D.Pictograms and Cartograms

**A. One-dimensional diagrams:**

In such diagrams, only one-dimensional measurement, i.e height is used and the width is not considered. These diagrams are in the form of bar or line charts and can be classified as

(i) Line Diagram
(ii) Simple Diagram
(iii) Multiple Bar Diagram
(iv) Sub-divided Bar Diagram
(v) Percentage Bar Diagram

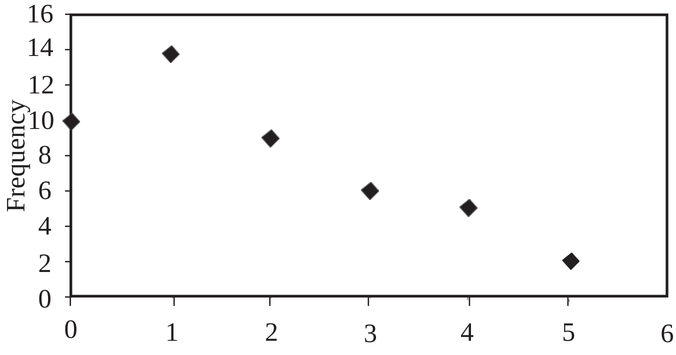
**Line Diagram:**

Line diagram is used in case where there are many items to be shown and there is not much of difference in their values. Such diagram is prepared by drawing a vertical line for each item according to the scale. The distance between lines is kept uniform. Line diagram makes comparison easy, but it is less attractive.

**Example:** Show the following data by a line chart:

| No. of children | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Frequency | 10 | 14 | 9 | 6 | 4 | 2 |

Line Diagram




**Simple Bar Diagram:**

Simple bar diagram can be drawn either on horizontal or vertical base, but bars on horizontal base more common. Bars must be uniform width and intervening space between bars must be equal. While constructing a simple bar diagram, the scale is determined on the basis of the highest value in the series.

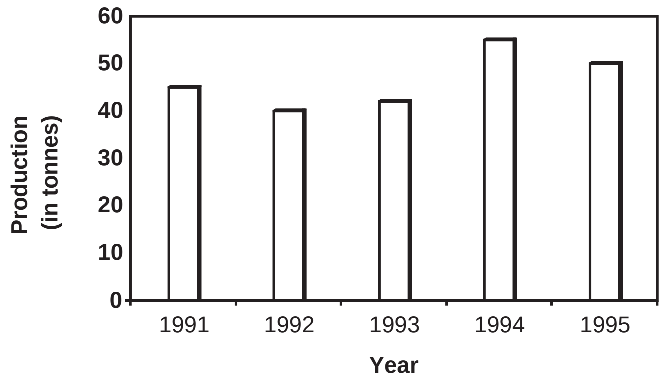
To make the diagram attractive, the bars can be coloured. Bar diagram are used in business and economics. However, an important limitation of such diagrams is that they can present only one classification or one category of data. For example, while presenting the population for the last five decades, one can only depict the total population in the simple bar diagrams, and not its sex-wise distribution.

**Example:** Represent the following data by a bar diagram.

| Year | Production (in tones) |
|---|---|
| 1991 | 45 |
| 1992 | 40 |
| 1993 | 42 |
| 1994 | 55 |
| 1995 | 50 |

**Solution :**

**Simple Bar Diagram**



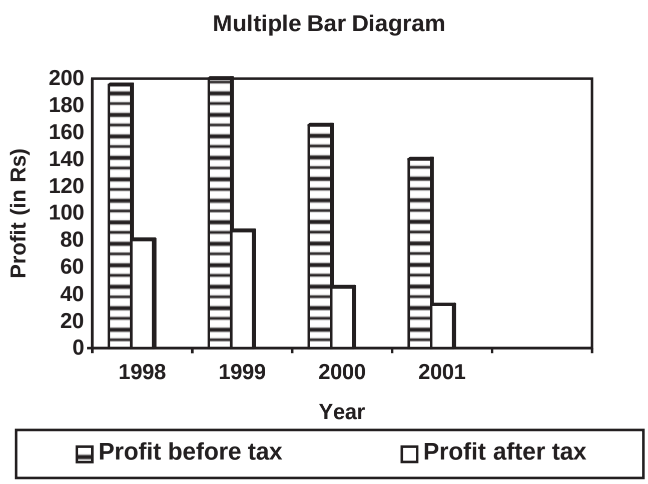

## Multiple Bar Diagram:

Multiple bar diagram is used for comparing two or more sets of statistical data. Bars are constructed side by side to represent the set of values for comparison. In order to distinguish bars, they may be either differently coloured or there should be different types of crossings or dotting, etc. An index is also prepared to identify the meaning of different colours or dottings.

**Example:** Draw a multiple bar diagram for the following data.

| Year | Profit before tax (in lakhs of rupees) | Profit after tax (in lakhs of rupees) |
|---|---|---|
| 1998 | 195 | 80 |
| 1999 | 200 | 87 |
| 2000 | 165 | 45 |
| 2001 | 140 | 32 |

**Solution :**



**Sub-divided Bar Diagram:**

In a sub-divided bar diagram, the bar is sub-divided into various parts in proportion to the values given in the data and the whole bar represent the total. Such diagrams are also called Component Bar diagrams. The sub divisions are distinguished by different colours or crossings or dottings.

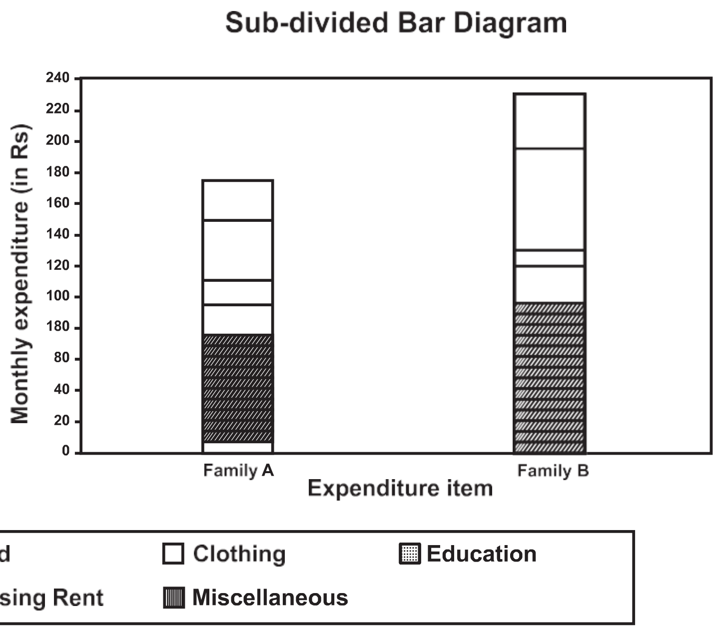
The main defect of such a diagram is that all the parts do not have a common base to enable one to compare accurately the various components of the data.

**Example:**

Represent the following data by a sub-divided bar diagram.

| Expenditure items | Monthly expenditure (in Rs.) | |
|---|---|---|
| | Family A | Family B |
| Food | 75 | 95 |
| Clothing | 20 | 25 |
| Education | 15 | 10 |
| Housing Rent | 40 | 65 |
| Miscellaneous | 25 | 35 |

**Solution :**




**Percentage bar diagram:**

This is another form of component bar diagram. Here the components are not the actual values but percentages of the whole. The main difference between the sub-divided bar diagram and percentage bar diagram is that in the former the bars are of different heights since their totals may be different whereas in the latter the bars are of equal height since each bar represents 100 percent. In the case of data having sub-division, percentage bar diagram will be more appealing than sub-divided bar diagram.

**Example:** Represent the following data by a percentage bar diagram.

| Particular | Factory X | Factory Y |
|---|---|---|
| Selling Price | 400 | 650 |
| Quantity Sold | 240 | 365 |
| Wages | 3500 | 5000 |
| Materials | 2100 | 3500 |
| Miscellaneous | 1400 | 2100 |

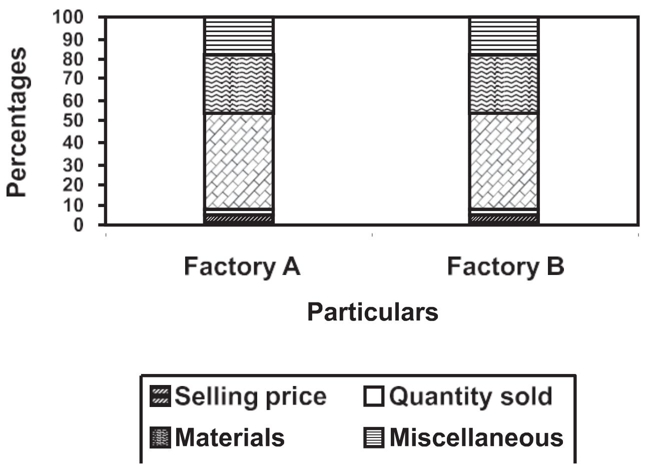
**Solution:**

Convert the given values into percentages as follows:

| Particulars | Factory A | | Factory B | |
|---|---|---|---|---|
| | Rs. | % | Rs. | % |
| Selling Price | 400 | 5 | 650 | 6 |
| Quantity Sold | 240 | 3 | 365 | 3 |
| Wages | 3500 | 46 | 5000 | 43 |
| Materials | 2100 | 28 | 3500 | 30 |
| Miscellaneous | 1400 | 18 | 2100 | 18 |
| Total | 7640 | 100 | 11615 | 100 |

**Solution :**

**Sub-divided Percentage Bar Diagram**




## B. Two-dimensional Diagrams:

In one-dimensional diagrams, only length 9 is considered. But, in two-dimensional diagrams, the area represent the data and so the length and breadth have both to be taken into account. Such diagrams are also called area diagrams or surface diagrams. The important types of area diagrams are:

a) Rectangles b) Squares c) Circles or Pie-diagrams

**Rectangles:**

Rectangles are used to represent the relative magnitude of two or more values. The area of the rectangles are kept in proportion to the values. Rectangles are placed side by side for comparison. When two sets of figures are to be represented by rectangles, either of the two methods may be adopted.

We may represent the figures as they are given or may convert them to percentages and then subdivide the length into various components. Thus the percentage sub-divided rectangular diagram is more popular than sub-divided rectangular since it enables comparison to be made on a percentage basis.

**Example:**

Represent the following data by sub-divided percentage rectangular diagram.

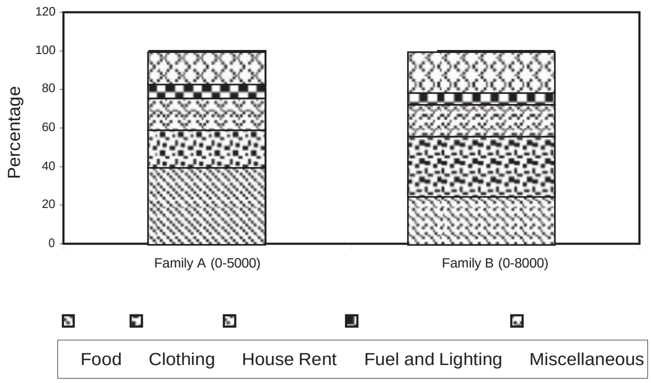
| Items of Expenditure | Family A (Income Rs. 5000) | Family B (income Rs. 8000) |
|---|---|---|
| Food | 2000 | 2500 |
| Clothing | 1000 | 2000 |
| House Rent | 800 | 1000 |
| Fuel and lighting | 400 | 500 |
| Miscellaneous | 800 | 2000 |
| Total | 5000 | 8000 |

**Solution:**

The items of expenditure will be converted into percentage as shown below:

| Items of Expenditure | Family A | | Family B | |
|---|---|---|---|---|
| | Rs. | Y | Rs. | Y |
| Food | 2000 | 40 | 2500 | 31 |
| Clothing | 1000 | 20 | 2000 | 25 |
| House Rent | 800 | 16 | 1000 | 13 |
| Fuel and lighting | 400 | 8 | 500 | 6 |
| Miscellaneous | 800 | 16 | 2000 | 25 |
| Total | 5000 | 100 | 8000 | 100 |

## Sub-divided Percentage Rectangular Diagram




### Squares:

The rectangular method of diagrammatic presentation is difficult to use where the values of items vary widely. The method of drawing a square diagram is very simple. One has to take the square root of the values of various item that are to be shown in the diagrams and then select a suitable scale to draw the squares.

**Example:**

Yield of rice in Kgs. per acre of five countries are

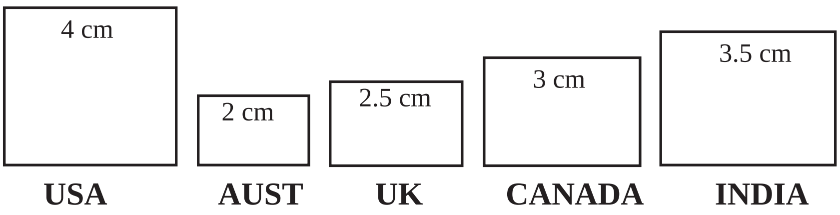
| Country | U.S.A. | Australia | U.K | Canada | India |
|---|---|---|---|---|---|
| Yield of rice in Kgs per acre | 6400 | 1600 | 2500 | 3600 | 4900 |

**Represent the above data by Square diagram.**

**Solution:**

To draw the square diagram we calculate as follows:

| Country | Yield | Square root | Side of the square in cm |
|---|---|---|---|
| U.S.A | 6400 | 80 | 4 |
| Australia | 1600 | 40 | 2 |
| U.K. | 2500 | 50 | 2.5 |
| Canada | 3600 | 60 | 3 |
| India | 4900 | 70 | 3.5 |



**Pie Diagram or Circular Diagram:**

Another way of preparing a two-dimensional diagram is in the form of circles. In such diagrams, both the total and the component parts or sectors can be shown. The area of a circle is proportional to the square of its radius.

While making comparisons, pie diagrams should be used on a percentage basis and not on an absolute basis. In constructing a pie diagram the first step is to prepare the data so that various components values can be transposed into corresponding degrees on the circle.

The second step is to draw a circle of appropriate size with a compass. The size of the radius depends upon the available space and other factors of presentation. The third step is to measure points on the circle and representing the size of each sector with the help of a protractor.

**Example:** Draw a Pie diagram for the following data of production of sugar in quintals of various countries.

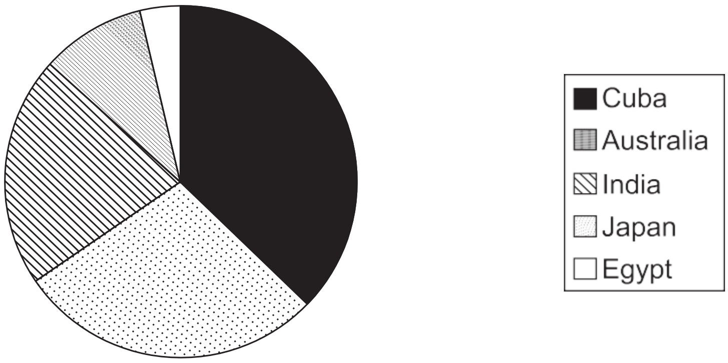
| Country | Production of Sugar (in quintals) |
|---|---|
| Cuba | 62 |
| Australia | 47 |
| India | 35 |
| Japan | 16 |
| Egypt | 6 |

**Solution:**

The values are expressed in terms of degree as follows.

| Country | Production of Sugar | |
|---|---|---|
| | In Quintals | In Degrees |
| Cuba | 62 | 134 |
| Australia | 47 | 102 |
| India | 35 | 76 |
| Japan | 16 | 35 |
| Egypt | 6 | 13 |
| Total | 166 | 360 |

**Pie Diagram**




## C. Three-dimensional diagrams:

Three-dimensional diagrams, also known as volume diagram, consist of cubes, cylinders, spheres, etc. In such diagrams three things, namely length, width and height have to be taken into account. Of all the figures, making of cubes is easy. Side of a cube is drawn in proportion to the cube root of the magnitude of data. Cubes of figures can be ascertained with the help of logarithms. The logarithm of the figures can be divided by 3 and the antilog of that value will be the cube-root.

**Example:**

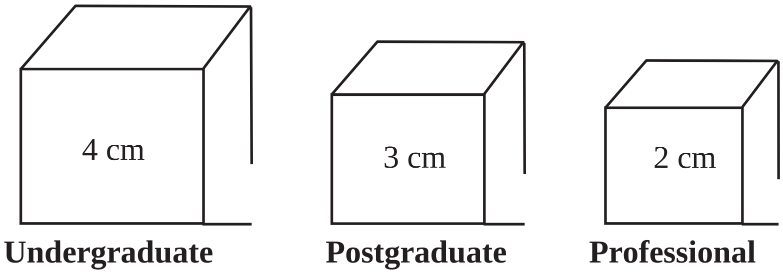
Represent the following data by volume diagram.

| Category | Number of Students |
|---|---|
| Under-graduate | 64000 |
| Post-graduate | 27000 |
| Professionals | 8000 |

**Solution:**

The sides of cubes can be determined as follows

| Category | Number of Students | Cube root | Side of cube |
|---|---|---|---|
| Under-graduate | 64000 | 40 | 4 cm |
| Post-graduate | 27000 | 30 | 3 cm |
| Professionals | 8000 | 20 | 2 cm |



**D. Pictograms and Cartograms:**

Pictograms are not abstract presentation such as lines or bars but really depict the kind of data we are dealing with. Pictures are attractive and easy to comprehend and as such this method is particularly useful in presenting statistics to the layman. When Pictograms are used, data are represented through a pictorial symbol that is carefully selected.

Cartograms or statistical maps are used to give quantitative information as a geographical basis. They are used to represent spatial distributions. The quantities on the map can be shown in many ways such as through shades or colours or dots or placing pictogram in each geographical unit.

## 2.2 Graphical representation of data:

A histogram is a bar chart or graph showing the frequency of occurrence of each value of the variable being analysed. In histogram, data are plotted as a series of rectangles. Class intervals are shown on the 'X-axis' and the frequencies on the 'Y-axis' .

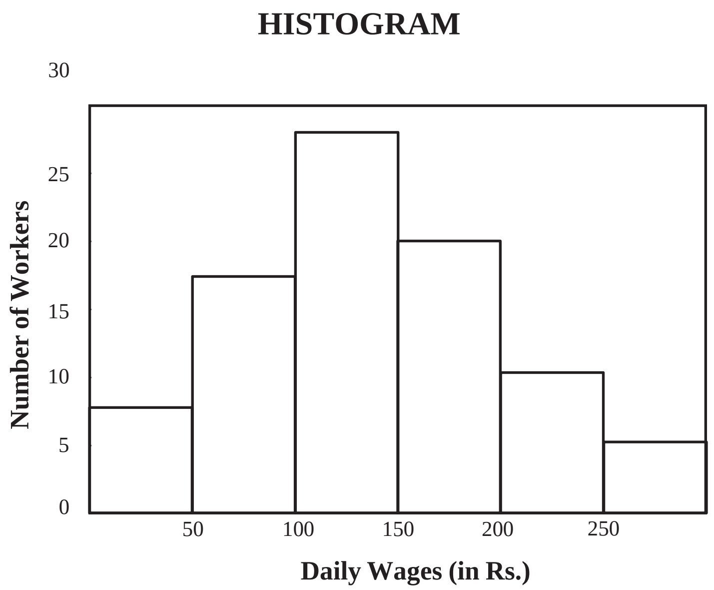
The height of each rectangle represents the frequency of the class interval. Each rectangle is formed with the other so as to give a continuous picture. Such a graph is also called staircase or block diagram.

However, we cannot construct a histogram for distribution with open-end classes. It is also quite misleading if the distribution has unequal intervals and suitable adjustments in frequencies are not made.

**Example:** Draw a histogram for the following data.

| Daily Wages | Number of Workers |
|---|---|
| 0-50 | 8 |
| 50-100 | 16 |
| 100-150 | 27 |
| 150-200 | 19 |
| 200-250 | 10 |
| 250-300 | 6 |

**Solution :**



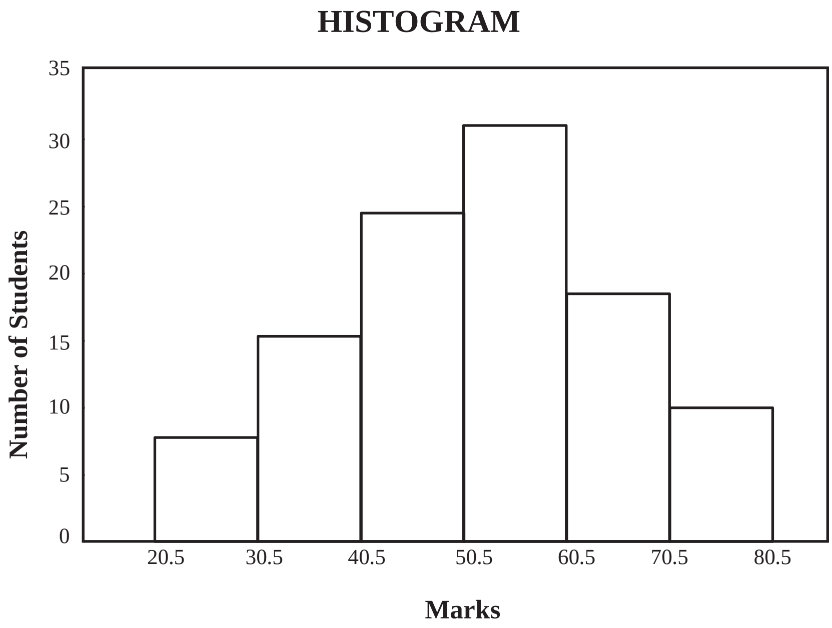

**Example:** For the following data, draw a histogram.

| Marks | Number of Students |
|---|---|
| 21-30 | 6 |
| 31-40 | 15 |
| 41-50 | 22 |
| 51-60 | 31 |
| 61-70 | 17 |
| 71-80 | 9 |

**Solution:**

For drawing a histogram, the frequency distribution should be continuous. If it is not continuous, then first make it continuous as follows.

| Marks | Number of Students |
|---|---|
| 20.5-30.5 | 6 |
| 30.5-40.5 | 15 |
| 40.5-50.5 | 22 |
| 50.5-60.5 | 31 |
| 60.5-70.5 | 17 |
| 70.5-80.5 | 9 |




**Example:** Draw a histogram for the following data.

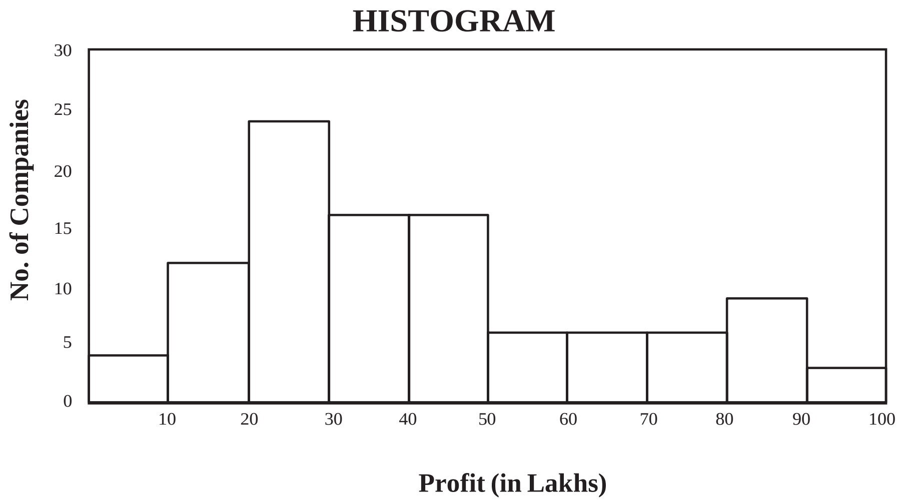
| Profits (in lakhs) | Number of Companies |
|---|---|
| 0-10 | 4 |
| 10-20 | 12 |
| 20-30 | 24 |
| 30-50 | 32 |
| 50-80 | 18 |
| 80-90 | 9 |
| 90-100 | 3 |

**Solution:**

When the class intervals are unequal, a correction for unequal class intervals must be made. The frequencies are adjusted as follows: The frequency of the class 30-50 shall be divided by two since the class interval is in double. Similarly, the class interval 50- 80 can be divided by 3. Then draw the histogram.

Now we rewrite the frequency table as follows.

| Profits (in lakhs) | Number of Companies |
|---|---|
| 0-10 | 4 |
| 10-20 | 12 |
| 20-30 | 24 |
| 30-40 | 16 |
| 40-50 | 16 |
| 50-60 | 6 |
| 60-70 | 6 |
| 70-80 | 6 |
| 80-90 | 9 |
| 90-100 | 3 |

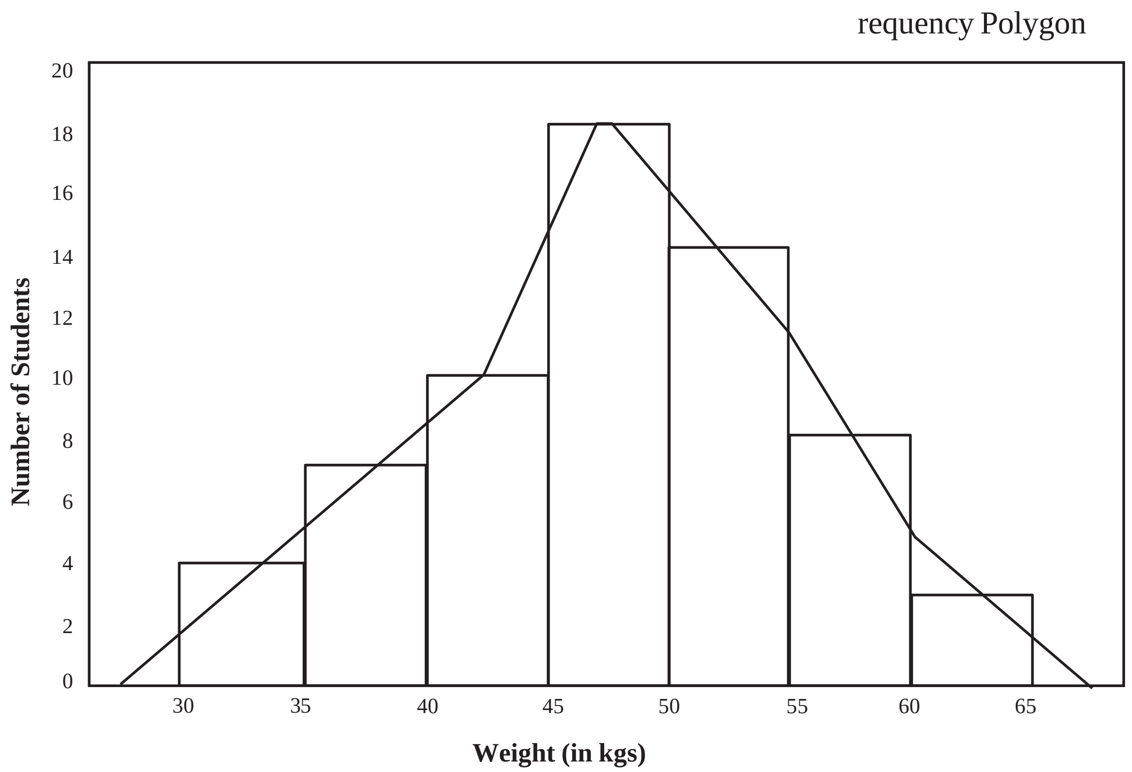


**Frequency Polygon:**

If we mark the midpoints of the top horizontal sides of the rectangles in a histogram and join them by a straight line, the figure so formed is called a Frequency Polygon. This is done under the assumption that the frequencies in a class interval are evenly distributed throughout the class. The area of the polygon is equal to the area of the histogram, because the area left outside is just equal to the area included in it.

**Example:** Draw a frequency polygon for the following data.

| Weight (in kg) | Number of Students |
|---|---|
| 30-35 | 4 |
| 35-40 | 7 |
| 40-45 | 10 |
| 45-50 | 18 |
| 50-55 | 14 |
| 55-60 | 8 |
| 60-65 | 3 |



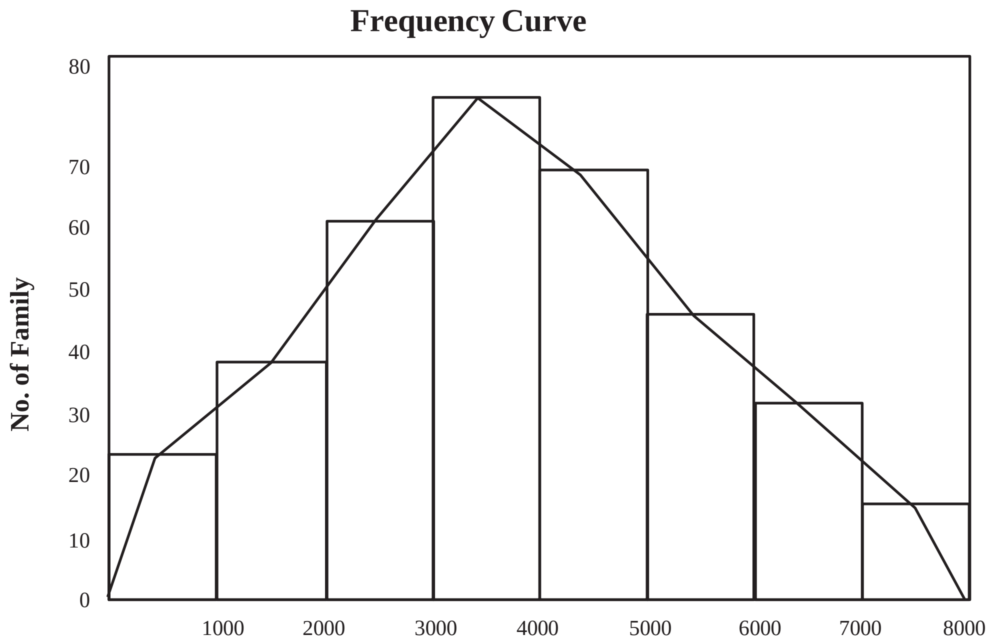

**Frequency Curve:**

If the middle point of the upper boundaries of the rectangles of a histogram is corrected by a smooth freehand curve, then that diagram is called frequency curve. The curve should begin and end at the base line.

**Example:** Draw a frequency curve for the following data.

| Monthly Wages (in Rs.) | No. of family |
|---|---|
| 0-1000 | 21 |
| 1000-2000 | 35 |
| 2000-3000 | 56 |
| 3000-4000 | 74 |
| 4000-5000 | 63 |
| 5000-6000 | 40 |
| 6000-7000 | 29 |
| 7000-8000 | 14 |

**Solution:**



**Monthly Wages in Rs.**

# Ogive curves

## Cumulative frequency table:

Cumulative frequency distribution has a running total of the values. It is constructedby adding the frequency of the first class interval to the frequency of the second class interval.Again add that total to the frequency in the third class interval continuing until the final total appearing opposite to the last class interval will be the total of all frequencies. The cumulativefrequency may be downward or upward.

A downward cumulation results in a list presenting the number of frequencies "less than" any given amount as revealed by the lower limit of succeeding class interval and the upward cumulative results in a list presenting the number of frequencies "more than" and given amount is revealed by the upper limit of a preceding class interval.

**Example:**

| Age group (in years) | Number of women | Less than Cumulative frequency | More than cumulative frequency |
|---|---|---|---|
| 15-20 | 3 | 3 | 64 |
| 20-25 | 7 | 10 | 61 |
| 25-30 | 15 | 25 | 54 |
| 30-35 | 21 | 46 | 39 |
| 35-40 | 12 | 58 | 18 |
| 40-45 | 6 | 64 | 6 |

**(a) Less than cumulative frequency distribution table**

| End values upper limit | Less than Cumulative frequency |
|---|---|
| Less than 20 | 3 |
| Less than 25 | 10 |
| Less than 30 | 25 |
| Less than 35 | 46 |
| Less than 40 | 58 |
| Less than 45 | 64 |

**(b) More than cumulative frequency distribution table**

| End values lower limit | Cumulative frequency more than |
|---|---|
| 15 and above | 64 |
| 20 and above | 61 |
| 25 and above | 54 |
| 30 and above | 39 |
| 35 and above | 18 |
| 40 and above | 6 |

**Ogive Curves:**

For a set of observations, we know how to construct a frequency distribution. In some cases we may require the number of observations less than a given value or more than a givenvalue. This is obtained by a accumulating (adding) the frequencies upto

These cumulative frequencies are then listed in a table is called cumulative frequency table. The curve table is obtained by plotting cumulative frequencies is called a cumulative frequency curve or an ogive.

There are two methods of constructing ogive namely:

- ✓ The ‘ less than ogive’ method
- ✓ The ‘more than ogive’ method.

In less than ogive method we start with the upper limits of the classes and go adding the frequencies. When these frequencies are plotted, we get a rising curve. In more than ogive method, we start with the lower limits of the classes and from the total frequencies we subtract the frequency of each class. When these frequencies are plotted we get a declining curve.

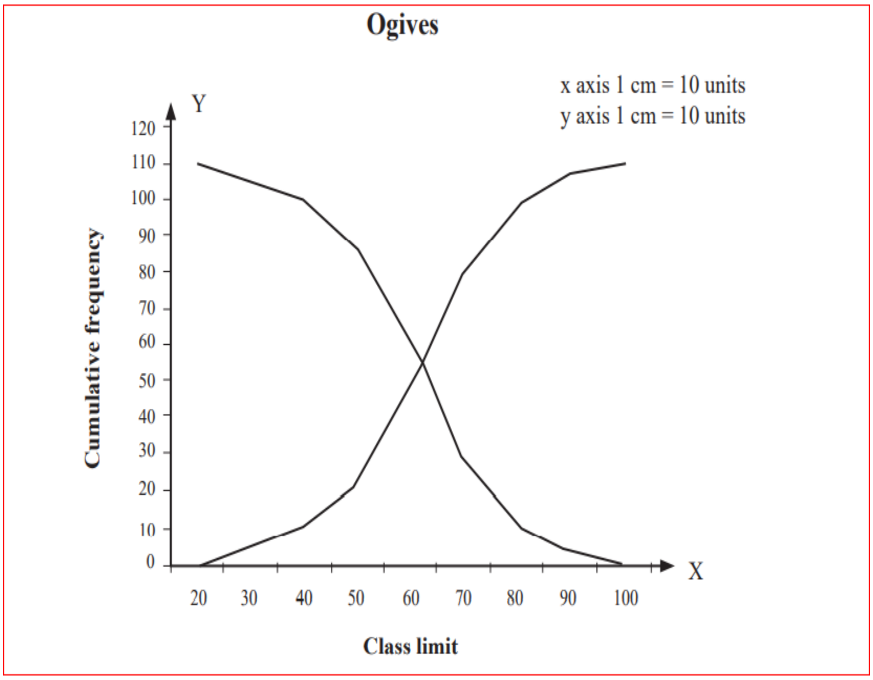
**Example:**

Draw the Ogives for the following data.

| Class interval | Frequency |
|---|---|
| 20-30 | 4 |
| 30-40 | 6 |
| 40-50 | 13 |
| 50-60 | 25 |
| 60-70 | 32 |
| 70-80 | 19 |
| 80-90 | 8 |
| 90-100 | 3 |

**Solution :**

| Class limit | Less than ogive | More than ogive |
|---|---|---|
| 20 | 0 | 110 |
| 30 | 4 | 106 |
| 40 | 10 | 100 |
| 50 | 23 | 87 |
| 60 | 48 | 62 |
| 70 | 80 | 30 |
| 80 | 99 | 11 |
| 90 | 107 | 3 |
| 100 | 110 | 0 |




@@@ End of **UNIT-II** @@@