

Statistics and Collection of Data

- **Statistics:** The branch of mathematics which deals with the extraction of meaningful information from the numerical figures collected for a definite purpose is known as statistics.
- **Data:** Facts or figures related to various aspects of life, which are numerical or otherwise, collected with a definite purpose are called data.
- **Primary data:** When the information is collected by the investigator himself or herself for a definite purpose or plan, the data obtained is called primary data, e.g. Heights of 30 students in a class.
- **Secondary data:** When the information is collected from a source which already has the information stored, the data obtained is called secondary data, e.g. Maximum and minimum temperature of various cities.

Presentation of Data, Frequency of an Observation and Class Interval

- **Presentation of data:** The way or arrangement to condense and organise the collection of data in order to study their salient features is called presentation of data.
- **Raw or ungrouped data:** The data obtained in original form is called raw data or ungrouped data. For example, the marks obtained by 30 students of a class in a mathematics test.
- **Array or arrayed data:** Raw data arranged in ascending or descending order to get better information about the achievement of the particular group is called an array or arrayed data.
- **Variable or variate quantity:** The quantity which is being measured in an experiment is called a variable or variate quantity.
- **Frequency:** The number of times an observation occurs in the given data is called frequency of that observation.
- **Frequency table:** The table in which numerical data of a particular variate with their frequency is shown is called frequency table.
- **Class intervals/classes:** To present a large amount of data more meaningful, we divide it into various groups with minimum and maximum values. Such groups are called classes or class intervals, e.g. 16–25, 26–35, etc.
- **Lower class limit:** The least number of the class is called lower class limit, e.g. for the class 50–59, the lower class limit = 50.
- **Upper class limit:** The greatest number of a class is called upper class limit, e.g. for the class 50–59, the upper class limit = 59.
- **Range:** The difference between the highest and lowest values of the data is called range of the data.
- **Class-size or class width:** The difference between the upper limit and the lower limit of a class is called its class-size or class width. For example, for the classes for ungrouped data 20–29, 30–39, 40–49, etc., class size is 10. For grouped data, i.e. for class 15.5–25.5, 25.5–35.5....., class size is 10. In this case, $25.5 - 15.5 = 10$. Here, upper limit is included while calculating the class size.

- **Class mark:** The mid value of a class is called the class mark of class.

$$\text{Class mark of a class} = \frac{\text{Upper limit} + \text{Lower limit}}{2}$$

- **Grouped frequency distribution table:** The simplified and condensed data in the form of groups and their frequency, that enables us to analyse and observe important facts is called grouped frequency distribution table.

Note: To make the class intervals continuous, if necessary, follow the following steps:

- Find the gaps in between the upper and lower class limits of two consecutive classes.
- Add half of this difference to each of the upper limits and subtract the same from each of the lower limits of each class interval.

For example, consider the class intervals 20 – 29 and 30 – 39.

Here, lower limit of class 30 – 39 = 30 and upper limit of class 20 – 29 = 29. Difference = 30 – 29 = 1. So, add half of the difference, i.e. 0.5 to the upper limit and subtract the same, i.e. 0.5 from lower limits. Thus, new class interval of the class 20 – 29 = (20 – 0.5) – (29 + 0.5) = 20.5 – 29.5.

Similarly, new class interval of 30 – 39 is (30 – 0.5) – (39 + 0.5) = 29.5 – 39.5 and so on.

➤ SOLVED QUESTIONS BASED ON EXERCISES 14.1 AND 14.2

Very Short Answer Type Questions [1 Mark]

- Which is more reliable: primary data or secondary data and why?

Sol. Primary data is more reliable and relevant because the investigator himself collected the data according to his plan and objective in view.

- Why do we group data?

Sol. If the number of observations in the data is large and the difference between maximum and minimum value of observation is more, then we condense the data into classes or groups to make the presentation of data in a more meaningful way.

- Which table gives a better picture of data: frequency distribution table for ungrouped data or frequency distribution table for grouped data?

Sol. Frequency distribution table for grouped data.

- State any two characteristics of statistics.

Sol. (i) The data for statistics should be collected with a definite purpose in view.
(ii) Statistics in an experiment should be comparable.

- Find the upper limit of the first class interval of the following:

8 – 11, 12 – 15, 16 – 19,

[CBSE 2015]

Sol. Upper limit of 8 – 11 is 11.

- Find the range of the given data: 25.7, 16.3, 2.8, 21.7, 24.3, 22.7 and 24.9.

Sol. Range of the data = Highest value – Lowest value = 25.7 – 2.8 = 22.9

Short Answer Type Questions I [2 Marks]

- The marks obtained by 20 students of class IX in an examination are given below:

18, 8, 12, 6, 9, 16, 13, 5, 23, 22, 10, 20, 14, 9, 7, 16, 15, 3, 1, 13.

Present the data in the form of a frequency distribution table using the equal class interval, one such class being 15 – 20.

[CBSE 2014]

Sol. Required frequency distribution table is shown below:

Marks obtained by students	Tally Marks	Frequency (Number of students)
0 – 5		2
5 – 10		6
10 – 15		5
15 – 20		4
20 – 25		3
Total		20

8. The weights (in kilograms) of 25 students are given as follows:

35, 38, 36, 37, 38, 35, 37, 36, 35, 38, 36, 36, 37, 37, 35, 38, 36, 35, 36, 37, 37, 38, 36, 38, 37.

Complete the following frequency table:

Weights	35	36	37	38
Frequency	—	—	—	—

Sol.

Weights (in kg)	35	36	37	38
Frequency	5	7	7	6

9. Given below the ages (in years) of 30 students of a class VIIIth in a school. Prepare a discrete frequency distribution table.

15, 16, 16, 14, 17, 17, 18, 16, 20, 22, 17, 14, 15, 18, 20, 22, 16, 15, 16, 20, 22, 17, 14, 15, 18, 20, 22, 15, 14, 16.

Sol.

Age of students (in years)	Tally Marks	Frequency (Number of students)
14		4
15		5
16		6
17		4
18		3
20		4
22		4
Total		30

Short Answer Type Questions II [3 Marks]

10. Make a frequency distribution table of the following marks scored by 20 students of a class, where class intervals are 4 – 7, 8 – 11 and so on: 5, 11, 6, 8, 10, 20, 23, 14, 19, 22, 7, 11, 10, 9, 12, 26, 24, 14, 7, 8.

Sol.

Marks scored	Tally Marks	Frequency (Number of students)
4 – 7		4
8 – 11		7
12 – 15		3
16 – 19		1
20 – 23		3
24 – 27		2
Total		20

11. The electricity bill (in rupees) of 25 hours in a locality are given below construct a frequency distribution table with a class size of 75.

170, 212, 252, 225, 310, 712, 415, 430, 320, 328, 194, 197, 235, 318, 412, 535, 604, 726, 375, 410, 318, 405, 469, 373, 414.

Sol. The minimum and maximum value on the data is 170 and 726.

$$\therefore \text{Range} = 726 - 170 = 556$$

$$\text{Class size} = 75$$

$$\therefore \text{Number of classes} = \frac{556}{75} = 7.4 \approx 8$$

The classes, therefore, are 150 – 225, 225 – 300, 300 – 375 and so on

We, therefore, construct the frequency distribution table as follows:

Electricity bill (in rupees)	Tally Marks	Frequency
150 – 225		4
225 – 300		3
300 – 375		6
375 – 450		7
450 – 525		1
525 – 600		1
600 – 675		1
675 – 750		2
Total		25

12. The marks obtained by 40 students of class IX in a mathematics test are given below:

18, 55, 68, 79, 85, 43, 29, 68, 54, 73, 47, 35, 72, 64, 95, 44, 50, 77, 64, 35, 79, 52, 45, 54, 70, 83, 62, 64, 72, 92, 84, 76, 63, 43, 54, 38, 73, 68, 52, 54.

Prepare a frequency distribution table with class size of 10 marks.

[CBSE 2012]

Sol. The minimum and maximum marks in the given data are 18 and 95.

$$\therefore \text{Range} = 95 - 18 = 77$$

It is given that class size is 10. So,

$$\text{Number of classes} = \frac{\text{Range}}{\text{Class size}} = \frac{77}{10} = 7.7 = 8$$

So, we should have 7 classes each of size 10. According to minimum and maximum value, the classes should be 18 – 28, 28 – 38, 38 – 48 and so on. We, therefore, construct the frequency distribution table as follows:

Marks obtained	Tally Marks	Frequency (Number of students)
18 – 28		1
28 – 38		2
38 – 48		6
48 – 58		8
58 – 68		5
68 – 78		10
78 – 88		6
88 – 98		2
Total		40



PRACTICE QUESTIONS BASED ON EXERCISES 14.1 AND 14.2

1. 30 children were asked about the number of hours they watched TV programmes last week. The result is recorded as under:

No. of hours	0 – 5	5 – 10	10 – 15	15 – 20
Frequency	8	16	4	2

Can we say that the number of children who watched TV for 10 or more hours a week is 22? Justify your answer. [HOTS]

2. A curious 12th class student wants to know and collect the data regarding the percentage of students who got grade A1 in Mathematics during the last 10 years in Board Examinations. Name the type of this collected data.
3. The marks obtained by 30 students in a section of Class IX in a class test of 100 marks are as follows: 75, 35, 41, 41, 16, 28, 75, 45, 55, 25, 41, 45, 37, 28, 75, 82, 55, 61, 75, 19, 75, 61, 19, 28, 19, 61, 28, 25, 16, 16
- (i) Name the data present in the above form.
(ii) Arrange the above data in arrayed form.
4. Construct the frequency distribution table for ungrouped data given in question 3.
5. Construct the frequency distribution table for grouped data for the data given in question 3. Write the true lower limits and true upper limits of various classes.
6. The weights (in grams) of 30 apples, picked at random from a basket of apples are given below: 45, 55, 30, 108, 75, 100, 40, 60, 65, 40, 100, 75, 70, 60, 70, 70, 60, 95, 85, 80, 35, 45, 40, 50, 60, 55, 65, 30, 45, 90.

Construct the frequency distribution table for the above data with equal class intervals, one of them being 30 – 40.

7. The weights of the newly born babies (in kg) in a hospital of a particular day are as follows: 2.1, 2.6, 2.9, 3.2, 2.7, 2.4, 2.8, 3.2, 2.5, 2.7, 3.1, 2.8, 3.2, 3.2, 2.6
- (i) Rearrange the data in ascending order.
(ii) Determine the range of the data.
(iii) Determine how many babies weigh
- (a) more than 2.7 kg
(b) equal to 2.7 kg
(c) less than 2.7 kg

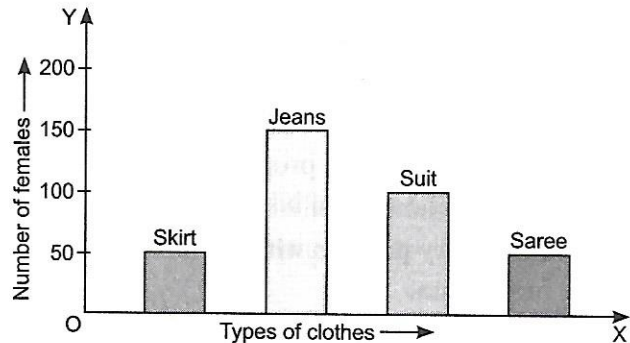
8. Construct a frequency distribution table for the following marks obtained by 40 students in a test using equal class intervals, one of them being 4 – 8 (8 not included).

3, 6, 20, 12, 19, 1, 23, 17, 8, 24, 21, 5, 13, 14, 15, 12, 6, 4, 2, 3, 7, 9, 26, 21, 22, 19, 15, 16, 2, 4, 12, 14, 16, 5, 9, 8, 6, 15, 18, 25. [CBSE 2016]

9. The marks obtained (out of 100 marks) by 30 students of class IX of a certain school in a science test are presented in the table given below:

Marks obtained	10	20	36	40	50	56	60	70	72	80	88	92	95
Number of students	1	1	3	4	3	2	4	4	1	1	2	3	1

- (i) Convert the above frequency distribution table for ungrouped data into a grouped frequency distribution table with suitable class intervals of width 15.
- (ii) If the passing marks is 40, then how many students are failed in the test?
- (iii) Find the number of students who scores 80 or more than 80 marks.
10. The types of clothes preferred by the females in the age group of 22 – 35 years are shown in the following graph:



Find the ratio of females preferring jeans to the females preferring suits. [CBSE 2016]

11. The class marks of a distribution are 47, 52, 57, 62, 67, 72, 77, 82. Determine the (i) class size, (ii) class limits; (iii) true class limits.
12. The electricity bills (in rupees) of 41 houses in a locality are given below. Construct a frequency distribution table with a class size of 10.
- 30, 35, 37, 28, 32, 34, 40, 50, 47, 46, 55, 52, 44, 43, 44, 45, 61, 60, 59, 25, 26, 27, 48, 49, 50, 41, 42, 43, 57, 58, 56, 55, 60, 70, 72, 69, 88, 89, 101, 103, 99.

Graphical Representation of Data

- The graphical representation of data is eye-catching and easier to understand than the actual data. In this section, we study the following three graphical ways by which the data can be represented:

- (i) Bar graph
- (ii) Histograms of uniform width and of varying widths
- (iii) Frequency polygons

Bar Graphs: A bar graph or a bar chart provides a visual display for comparing quantities in different categories.

It may run horizontally or vertically.

- (i) Vertical bar graph is useful when presenting a data over time.
- (ii) x -axis represents the categories.
- (iii) y -axis represents the value for those categories.
- (iv) heights of the bars depend on the values of variable. It is equal to quantity within that category.
- (v) All the drawn bars should be of uniform width with equal spacing between them.

Histogram: A histogram is the graphical representation of a frequency distribution.

- (i) Represent the class boundaries along the x -axis to avoid the gaps in the construction of a histogram.
- (ii) Represent class frequency along y -axis.
- (iii) Construct rectangles with bases along x -axis and heights along y -axis. Note that the area of each rectangle should be proportional to the respective class frequency. A histogram varying width of the rectangles does not give the correct representation of the data.

- **Frequency Polygon:** It is the curve drawn when the data is continuous and very large. It is useful for comparing the performance of two different sections of the same class.

- (i) **Frequency polygon with histogram:** It is obtained by joining the mid-points of the respective tops of rectangles in histogram.

To complete the polygon, the mid-points of each end are joined to the immediately lower or higher mid-points of preceding and succeeding class (as the case may be) at zero frequency.

Thus, by using the properties of congruent triangles, we find that the area of frequency polygon is the same as the area of histogram.

- (ii) **Frequency polygon without histogram:** For this, we require the mid-points of the class intervals used in the data.

Class mark: The mid-points of the class intervals are called class-marks.

$$\text{Class-mark} = \frac{\text{Upper limit} + \text{Lower limit}}{2}$$

Class size = Difference between the class marks of two successive classes.

$$\text{Lower class limit} = \text{Class mark} - \frac{1}{2} \times \text{class size}$$

$$\text{Upper class limit} = \text{Class mark} + \frac{1}{2} \times \text{Class size}$$

To draw the frequency polygon only, first represent the class-marks on the x -axis and corresponding frequency on the y -axis. Then, plot the corresponding points and join them by the line segment.

Measures of Central Tendency

- **Mean:** Mean (or average) of a number of observations is the sum of the values of all observations divided by the total number of observations. Let $x_1, x_2, x_3, \dots, x_n$ be n observations.

$$\begin{aligned} \text{Therefore, mean } (\bar{x}) &= \frac{\text{Sum of all observations}}{\text{Total number of observations}} \\ &= \frac{x_1 + x_2 + x_3 + \dots + x_n}{n} = \frac{1}{n} \sum_{i=1}^n x_i \end{aligned}$$

- (i) If N -observations in the raw data consist of only k distinct values $x_1, x_2, x_3, \dots, x_k$ of the variable x occurring with frequencies $f_1, f_2, f_3, \dots, f_k$ respectively, then

$$\bar{x} = \frac{f_1x_1 + f_2x_2 + \dots + f_kx_k}{f_1 + f_2 + \dots + f_k} = \frac{\sum_{i=1}^k f_ix_i}{\sum_{i=1}^k f_i} = \frac{1}{N} \sum_{i=1}^k f_ix_i$$

where $N = \sum_{i=1}^k f_i$ denotes total frequency.

- (ii) Let \bar{x} be the mean of n numbers.

If k is added to each number, then new mean $= \bar{x} + k$.

If k is subtracted from each number, then new mean $= \bar{x} - k$

If each number is multiplied by k , then new mean $= k\bar{x}$

If each number is divided by k , then new mean $= \frac{\bar{x}}{k}$.

- (iii) Sum of observations = Number of observations \times Mean

- (iv) The algebraic sum of the deviations of a set of values from their arithmetic mean is zero.

i.e.,
$$\sum_{i=1}^k f_i (x_i - \bar{x}) = 0.$$

- **Median from ungrouped Data:** Median is the value of the middle most item when arranged in a definite order (ascending or descending) calculation of median involves the following steps:

- (i) Arrange the values in ascending or descending order.

- (ii) If the number of observations n is odd, then median $= \left(\frac{n+1}{2}\right)$ th term.

- (iii) If the number of observations n is even, then median is the arithmetic mean of $\frac{n}{2}$ th term and $\left(\frac{n}{2} + 1\right)$ th term of series.

- **Mode of ungrouped data:** Mode is the value of observation which occurs greatest number of times or with greatest frequency.

- The relation between mode, median and mean.

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



SOLVED QUESTIONS BASED ON EXERCISES 14.3 AND 14.4

Very Short Answer Type Questions [1 Mark]

1. The mid-value of a class interval is 42. If the class-size is 10, find the upper and lower limits of the class.

[HOTS]

Sol. Mid-value of class interval is known as class-mark.

Given, class-mark = 42 and class size = 10

So,

$$\begin{aligned} \text{Lower class limit} &= \text{Class-mark} - \frac{1}{2} \times \text{Class-size} \\ &= 42 - \frac{1}{2} \times 10 = 37 \end{aligned}$$

$$\begin{aligned} \text{Upper class limit} &= \text{Class-mark} + \frac{1}{2} \times \text{Class-size} \\ &= 42 + \frac{1}{2} \times 10 = 47 \end{aligned}$$

2. The mean of x_1 and x_2 is 6 and mean of x_1, x_2, x_3 is 7. Find the value of x_3 .

[CBSE 2010]

Sol. We know that

$$\text{Mean} = \frac{\text{Sum of all observations}}{\text{Total number of observations}}$$

Now,

$$6 = \frac{x_1 + x_2}{2} \Rightarrow x_1 + x_2 = 12$$

Also,

$$7 = \frac{x_1 + x_2 + x_3}{3}$$

\Rightarrow

$$7 = \frac{12 + x_3}{3}$$

[\because From (i), $x_1 + x_2 = 12$]

\Rightarrow

$$12 + x_3 = 21$$

\Rightarrow

$$x_3 = 21 - 12 = 9$$

3. Find the mean of the factors of 24.

[CBSE 2012]

Sol. Various factors of 24 = 1, 2, 3, 4, 6, 8, 12 and 24.

\therefore

$$\begin{aligned} \text{Mean, } \bar{x} &= \frac{\text{Sum of all observations}}{\text{Total number of observations}} \\ &= \frac{1 + 2 + 3 + 4 + 6 + 8 + 12 + 24}{8} \\ &= \frac{60}{8} = \frac{15}{2} = 7.5 \end{aligned}$$

4. Find the mean of first six odd numbers.

[CBSE 2016]

Sol. First six odd numbers are 1, 3, 5, 7, 9 and 11

\therefore

$$\text{Mean } (\bar{x}) = \frac{1 + 3 + 5 + 7 + 9 + 11}{6} = \frac{36}{6} = 6$$

5. Find the mean of prime numbers between 20 and 30.

[HOTS; CBSE 2015]

Sol. Prime numbers between 20 and 30 are 23 and 29 (only two)

\therefore

$$\text{Mean, } \bar{x} = \frac{23 + 29}{2} = \frac{52}{2} = 26$$

6. The mean of the set of numbers 6, 3, x , 4, 3, 5 and y is given as 5. What is the value of $x + y$? [CBSE 2016]

Sol. Total number of observations = 7

$$\text{Mean of the data, } \bar{x} = \frac{x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7}{7}$$

$$\Rightarrow 5 = \frac{6 + 3 + x + 4 + 3 + 5 + y}{7}$$

$$\Rightarrow 21 + x + y = 35$$

$$\Rightarrow x + y = 35 - 21 = 14$$

7. Calculate the median of the given data:

144, 145, 147, 148, 149, 150, 152, 155, 160

[CBSE 2015]

Sol. Here, number of observations (n) = 9 (odd).

$$\begin{aligned} \therefore \text{Median} &= \left(\frac{n+1}{2}\right)\text{th term} \\ &= \left(\frac{9+1}{2}\right)\text{th observation} \\ &= 5\text{th observation} = 149 \end{aligned}$$

8. If the median of the observations: $x, x + 3, x + 5, x + 7, x + 10$ is 9, find the last observation.

Sol. Total number of observations, $n = 5$ (an odd number)

$$\therefore \text{Median} = \left(\frac{n+1}{2}\right)\text{th observation}$$

$$\Rightarrow 9 = 3\text{rd observation} = x + 5$$

$$\Rightarrow x = 9 - 5 = 4$$

$$\text{So, the last observation} = x + 10 = 4 + 10 = 14$$

9. The age (in years) of 12 persons are given below:

42, 48, 48, 50, 56, 43, 47, 56, 60, 65, 56, 65

Find the mode.

[CBSE 2016]

Sol. On arranging the data in ascending order, we get

42, 43, 47, 48, 48, 50, 56, 56, 56, 60, 65, 65

Age 56 years occurs 3 times in the data and has maximum frequency amongs other.

$$\therefore \text{Mode of age} = 56 \text{ years}$$

10. Find the mode of the following data:

15, 14, 19, 20, 14, 15, 16, 14, 15, 18, 14, 19, 15, 17, 15.

Sol. Making a frequency table, we have

x_i	14	15	16	17	18	19	20
f_i	4	5	1	1	1	2	1

We find that observation 15 has the maximum frequency (5)

$$\therefore \text{Mode} = 15$$

Short Answer Type Questions I [2 Marks]

11. The class marks of the distribution are 37, 42, 47, 52 and 57. Determine the class-size and the class limits of the last class mark. [CBSE 2013]

Sol. Class size = Difference between class marks of two adjacent classes
 $= 42 - 37 = 5$

Therefore, we need classes of size 5 with class marks as 37, 42, 47, 52, 57.

$$\begin{aligned}\text{Now, lower class limit of the last class} &= 57 - \frac{1}{2} \times 5 \\ &= 57 - 2.5 = 54.5\end{aligned}$$

$$\text{upper class limit of the last class} = 57 + \frac{1}{2} \times 5 = 59.5$$

\therefore Class limits of the last class mark are 54.5 – 59.5.

12. The mean of the observations x , $2x + 1$, $2x + 5$ and $2x + 9$ is 30. What is the mean of first three observations?

Sol. $\text{Mean, } \bar{x} = \frac{x + (2x + 1) + (2x + 5) + (2x + 9)}{4} = 30$

$$\begin{aligned}\therefore 7x + 15 &= 120 \\ \Rightarrow 7x &= 120 - 15 = 105 \\ \Rightarrow x &= \frac{105}{7} = 15\end{aligned}$$

So, the first three observations are 15, 31 and 35.

$$\text{Therefore, their mean} = \frac{15 + 31 + 35}{3} = \frac{81}{3} = 27$$

13. Find the mean of the first 8 prime numbers.

[CBSE 2015]

Sol. First eight prime numbers are 2, 3, 5, 7, 11, 13, 17 and 19.

$$\begin{aligned}\therefore \text{Mean} &= \frac{2 + 3 + 5 + 7 + 11 + 13 + 17 + 19}{8} \\ &= \frac{77}{8} = 9.625\end{aligned}$$

14. The following observations have been arranged in ascending order. If the median of the data is 23.5, find the value of x .

12, 16, 17, 19, x , $x + 3$, 27, 37, 38, 40

[CBSE 2012]

Sol. Here number of observations (n) = 10 (even)

$$\begin{aligned}\text{Median} &= \frac{1}{2} \left[\left(\frac{n}{2} \right) \text{th term} + \left(\frac{n}{2} + 1 \right) \text{th term} \right] \\ &= \frac{1}{2} [5\text{th term} + 6\text{th term}]\end{aligned}$$

$$23.5 = \frac{1}{2} [x + x + 3]$$

$$\begin{aligned}\Rightarrow 2x + 3 &= 47 \\ \Rightarrow 2x &= 47 - 3 = 44 \\ \Rightarrow x &= 22\end{aligned}$$

15. Find the mode of the following marks (out of 10) obtained by 20 students.

10, 4, 6, 5, 9, 3, 2, 10, 7, 6, 5, 4, 9, 10, 10, 3, 4, 10, 6, 9.

Sol. Arranging the data in ascending order, we have 2, 3, 3, 4, 4, 4, 5, 5, 6, 6, 6, 7, 9, 9, 9, 10, 10, 10, 10, 10

Here, the observation 10 has the maximum frequency 5

$$\therefore \text{Mode} = 10$$

16. For what value of ' x ' the mode of the following data is 7?

3, 5, 6, 7, 5, 4, 7, 5, 6, ($x + 1$), 8, 7

[CBSE 2013]

Sol. Arranging the data in ascending order, we have 3, 4, 5, 5, 5, 6, 6, 7, 7, 7, ($x + 1$), 8

Since mode of the given data is 7, so it should have the maximum frequency. It means

$$x + 1 = 7 \Rightarrow x = 6$$

Short Answer Type Questions II [3 Marks]

17. Mean of 50 observations was found to be 80.4. But later on, it was discovered that 96 was misread as 69 at one place. Find the correct mean. If in each observation a constant value 'k' is added, how is the mean affected?

[CBSE 2012]

Sol. Given: Mean of 50 observations = 80.4
 \therefore Sum of 50 observations = $50 \times 80.4 = 4020$
 But later, it was discovered that 96 was misread as 69 at one place.

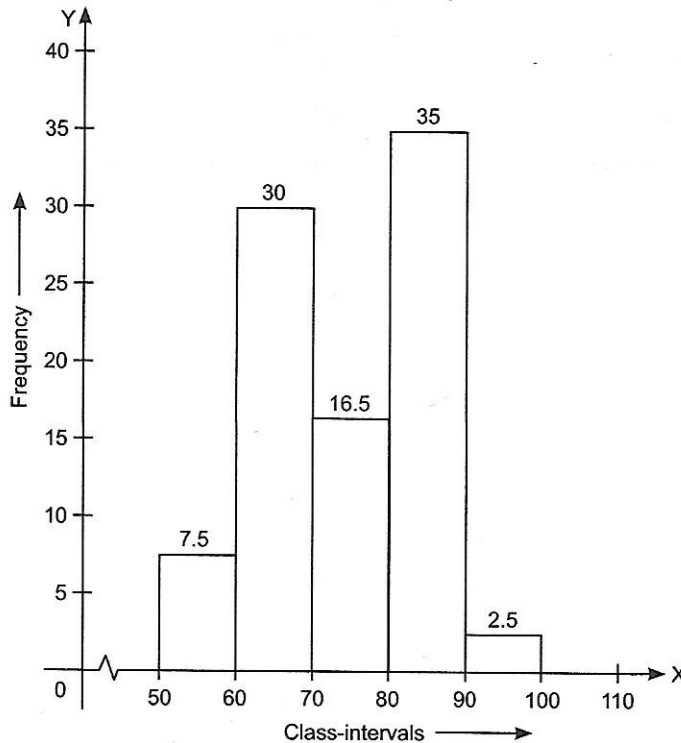
$$\therefore \text{Correct mean} = \frac{4020 - 69 + 96}{50} = \frac{4047}{50} = 80.94$$

Hence the correct mean = 80.94

* If 'k' is added to each observation, then new mean is $80.94 + k$.

18. Using the given histogram, prepare a grouped frequency distribution table.

[CBSE 2014]



Sol. The constructed grouped frequency distribution table is shown below:

Class interval	Frequency
50 - 60	7.5
60 - 70	30
70 - 80	16.5
80 - 90	35
90 - 100	2.5

19. The marks of 15 students in an examination out of 10 marks is as follows:

3, 9, 7, 5, 6, 3, 7, 6, 7, 4, 7, 7, 4, 8, 2.

Find the mean, mode and median.

Sol. Arranging the given data in ascending order, we have

2, 3, 3, 4, 4, 5, 6, 6, 7, 7, 7, 7, 7, 8, 9

Therefore

$$(i) \text{ Mean, } \bar{x} = \frac{1}{N} \sum x_i = \frac{1}{15} (\text{sum of all observations}) = \frac{1}{15} \times 85 = 5.67$$

(ii) Here, the observation 7 has maximum frequency 5.

$$\therefore \text{Mode} = 7$$

(iii) Here, number of observations (n) = 15 (odd)

$$\therefore \text{Median} = \left(\frac{n+1}{2}\right)\text{th observation} = 8\text{th observation} = 6$$

20. Draw a histogram for the following marks obtained (out of 100 marks) by class of 80 students. [CBSE 2016]

Marks	Number of students
10 – 20	18
20 – 30	10
30 – 50	15
50 – 60	7
60 – 80	4

Sol. We observed that the class size are varying in frequency distribution table with minimum class size = $20 - 10 = 10$

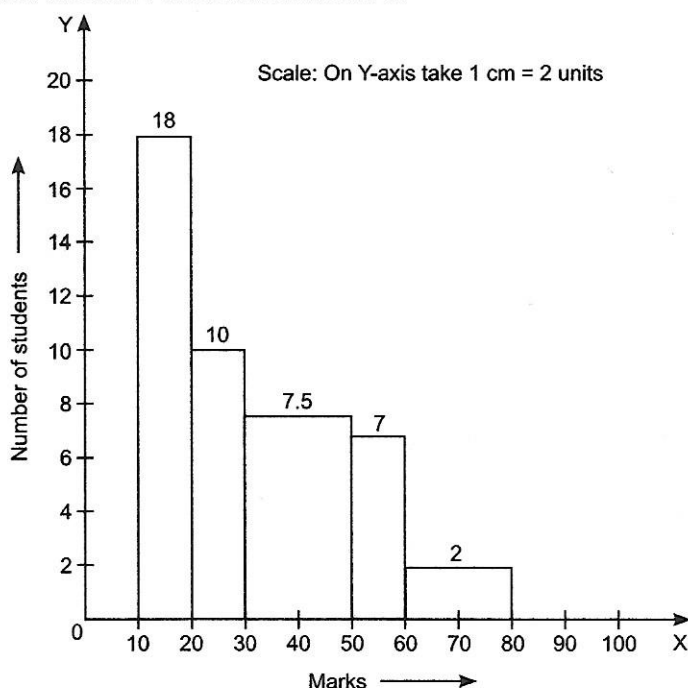
By using formula,

$$\text{Adjusted frequency of a class} = \frac{\text{Minimum class size}}{\text{Class size of this class}} \times \text{frequency}$$

Accordingly, the modified frequency distribution table is given below:

Marks	Number of students (frequency)	Width	Length of the rectangle (Adjusted frequency)
10 – 20	18	10	$\frac{10}{10} \times 18 = 18$
20 – 30	10	10	$\frac{10}{10} \times 10 = 10$
30 – 50	15	20	$\frac{10}{20} \times 15 = 7.5$
50 – 60	7	10	$\frac{10}{10} \times 7 = 7$
60 – 80	4	20	$\frac{10}{20} \times 4 = 2$

Therefore, histogram, for the above table is shown below:



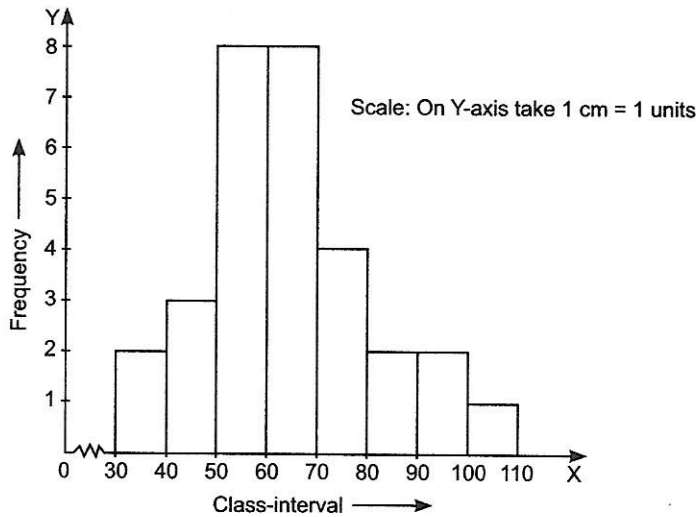
Long Answer Type Questions [4 Marks]

21. Below are the marks obtained by 30 students of a class in Maths test out of 100. Make a frequency distribution table for this data with class interval of size 10 and draw a histogram to represent the data.

55, 61, 46, 100, 75, 90, 77, 60, 48, 58, 64, 59, 60, 78, 55, 88, 60, 37, 58, 84, 62, 44, 52, 50, 56, 98, 67, 70, 39, 68.

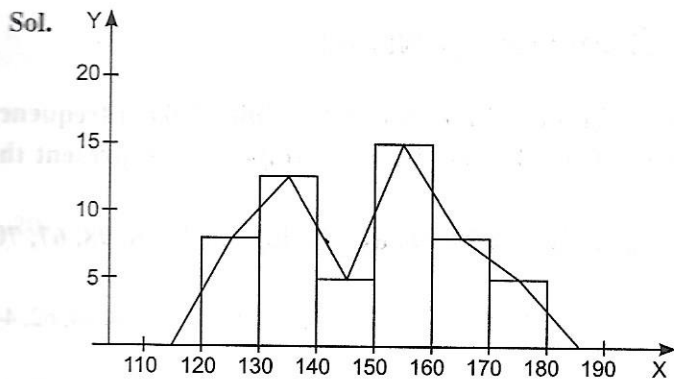
Sol. Marks obtained by 30 students are 55, 61, 46, 100, 75, 90, 77, 60, 48, 58, 64, 59, 60, 78, 55, 88, 60, 37, 58, 84, 62, 44, 52, 50, 56, 98, 67, 70, 39, 68.

Class interval	Tally marks	Frequency
30 – 40		2
40 – 50		3
50 – 60		8
60 – 70		8
70 – 80		4
80 – 90		2
90 – 100		2
100 – 110		1
Total		30



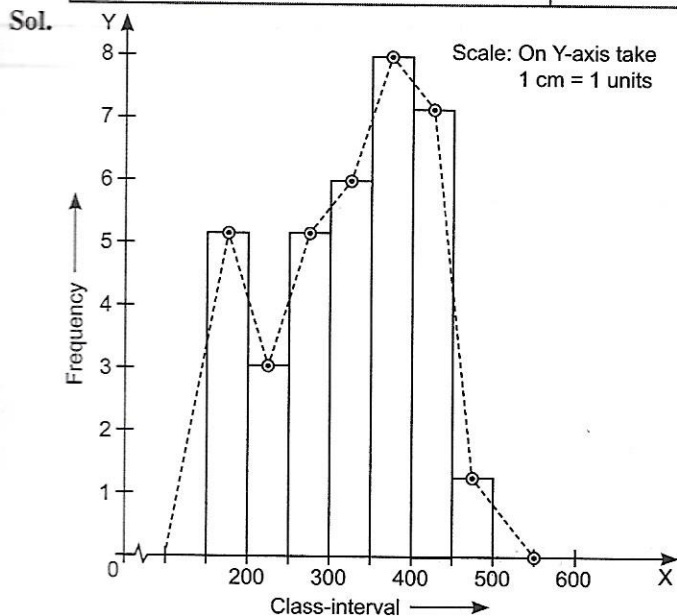
22. In a city, the following weekly instructions are made in a study on cost of living index. Draw a histogram and frequency polygon for the data.

Cost of living index	Number of weeks
120 – 130	8
130 – 140	12
140 – 150	4
150 – 160	16
160 – 170	8
170 – 180	4



23. Draw a histogram and frequency polygon on the same graph for the following data.

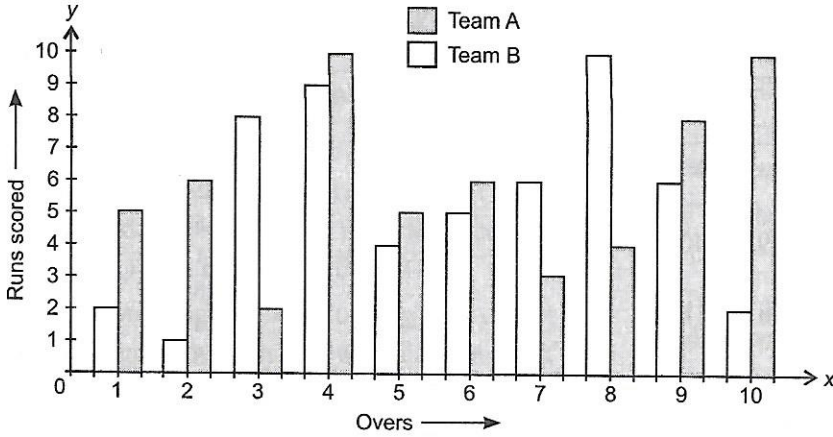
Class interval	Frequency
150 – 200	5
200 – 250	3
250 – 300	5
300 – 350	6
350 – 400	8
400 – 450	7
450 – 500	1



24. Following are the runs scored by two teams A and B in a 10 over match. Represent the data graphically on the same graph.

Over	Team A	Team B
1	2	5
2	1	6
3	8	2
4	9	10
5	4	5
6	5	6
7	6	3
8	10	4
9	6	8
10	2	10

Sol.



PRACTICE QUESTIONS BASED ON EXERCISES 14.3 AND 14.4

- The mean of 20 observations is 17. If 25 is added to the sum of the observations, find the new sum of the observations. [HOTS]
- If the mode of the data 15, 18, 14, 15, 15, 18, 14, 17, 18 and k is 15, then find the value of k . [CBSE 2016]
- The mean of 20 observation is 75. If each observation is divided by 3, find the new mean. [CBSE 2016]
- In a frequency distribution, the mid-value of a class-interval is 5 and the width of the class-interval is 6. Find the lower limit of the class-interval. [CBSE 2016]
- Find the median of the following data:
15, 35, 18, 26, 19, 25, 29, 20, 27.
- The mean of seven numbers is 42. If one number is excluded, their mean becomes 39. What is the excluded number? [HOTS; CBSE 2014]
- The class mark of a particular class is 6.5 and its class-size is 3. Write the next 3 classes, if they all continuous. [CBSE 2014]
- The points scored by a basket ball team in a series of matches are as follows:
17, 2, 7, 27, 25, 5, 14, 18, 10, 24, 48, 10, 8, 7, 10, 28.
Find the median and mode for the data.
- Find the value of p , if the mean of the following data is 40.4:

Variable (x)	10	20	30	40	50	60	70
Frequency (f)	3	8	12	5	p	7	5

- Find the missing frequencies in the following frequency distribution shown where the mean of the distribution is 1.46.

Number of accidents (x_i)	0	1	2	3	4	5	Total
Frequency (f_i)	46	f_1	f_2	25	10	5	200

- For the following information, construct a frequency polygon (without histogram):

Class Marks	5	15	25	35	45	55
Frequency	3	15	12	18	9	3

[CBSE 2014]

- Draw a histogram and a frequency polygon of the following:

Marks	Number of students
0 – 10	3
10 – 20	5
20 – 30	8
30 – 40	10
40 – 50	7
50 – 60	2

- The heights (in cm) of employees in an office are as follows:

Heights (in cm)	Number of employee
130 – 140	8
140 – 150	18
150 – 160	20
160 – 170	5
170 – 180	4
180 – 190	3

Draw the histogram and frequency polygon of the above table.

[CBSE 2014]

- A survey of the number of people of various age-groups visiting the Diwali mela on a particular day is given below. Draw a frequency polygon with histogram to represent the data.

Age (in years)	Number of people
0 – 10	14
10 – 20	28
20 – 30	35
30 – 40	21
40 – 50	14
50 – 60	7

15. Draw a histogram for the following data:

Marks	10 – 15	15 – 20	20 – 25	25 – 30	30 – 40	40 – 60	60 – 80
Number of candidates	7	9	8	5	12	12	8

16. To solve a problem, time (in minutes) taken by students is as follows:

37, 31, 27, 18, 59, 45, 54, 40, 32, 43, 39, 49, 45, 40, 59, 53, 52, 50, 40, 59, 60, 23, 21, 20, 22.

(a) Construct a frequency distribution table using interval of 10.

(b) Draw a histogram to represent the distribution.

17. The temperature of a patient admitted in a hospital with typhoid fever, taken at different times of the day is given below: Draw the temperature-time graph for the data.

Time (in hours)	7:00	9:00	11:00	13:00	15:00	17:00	19:00	21:00
Temperature (in °F)	100	101	104	102	100	99	100	98

(i) Find the temperature of the patient at

(a) 13:00 hours

(b) 15:00 hours

(ii) At what time is the temperature

(a) maximum?

(b) minimum?

18. Draw a histogram with a frequency polygon for the following data:

Class-interval	25 – 29	30 – 34	35 – 39	40 – 44	45 – 49	50 – 54
Frequency	5	15	23	20	10	7

19. The average score of the girls in an examination of class IX in a school is 67 and that of boys is 63. The average score for the whole class is 64.5. Find the percentage of girls and boys in the class.

20. Draw a histogram and a frequency polygon for the following data:

Class interval	Frequency
1 – 50	12
51 – 100	18
101 – 150	27
151 – 200	20
201 – 250	17
251 – 300	06

Value Based Questions

1. The following approximate data shows the Debt service payments project of India in US\$ billion from 2016–2026:

Year	Principal Repayments	Interest Payments
2016 – 2017	30.4	4.8
2017 – 2018	21.5	4.3
2018 – 2019	24.4	3.7
2019 – 2020	22.5	3.1
2020 – 2021	23.5	2.5
2021 – 2022	16.1	2.0
2022 – 2023	12.8	1.6
2023 – 2024	9.4	1.3
2024 – 2025	10.8	1.2
2025 – 2026	9.3	0.8

(i) Draw the bar graph of the above data.

(ii) What conclusion will derive from above data?

2. 25 plants each were planted in 25 schools during the fest organised by the State government for 'Save Earth Save Atmosphere'.

16	10	15	17	20
20	12	22	9	15
23	7	11	4	18
10	9	13	10	18
6	15	21	12	22

(i) Prepare a frequency distribution table of the above data using one of class intervals as 0 – 5.

(ii) What values are represented through this activity?

3. The following data represents the number of school going girls in a town (out of 5000 population):

Age group	Number of girls
0–5	900
5–10	800
10–15	200
15–20	20
Total	1920

(i) Draw a histogram for the same.

(ii) What does this data represents?

4. A group of 10 students visited to a blind school. They donate ₹ 1000, ₹ 1200, ₹ 500, ₹ 750, ₹ 1000, ₹ 1500, ₹ 1000, ₹ 750, ₹ 850, ₹ 1250.

(i) Find the mean, mode, median of this data.

(ii) What impression will you receive through this activity?

INTEGRATED EXERCISE

Very Short Answer Type Questions [1 Mark]

1. A student is asked to collect the information about the number of students enrolled in his school in last five years and is allowed to see the school records. Which type of data is collected by him?
2. An educational society wants to know and collect the percentage of students statewise selected in IIT competition during the last 10 years. Which type of data is collected by them? Give reasons.
3. In the given data, some variables are given with particular values. We want to represent it pictorially for better understanding of the results. Which method of graphical representation of frequency distribution will be suitable to represent the data?
4. How is the histogram different from bar graph?
5. In a diagnostic test in mathematics given to the students, the following marks (out of 100) are recorded: 46, 52, 48, 11, 41, 62, 54, 53, 96, 40, 98 and 44. Which average will be a good representative of the above data and why? [NCERT Exemplar]
6. In which class interval out of class intervals 5 – 10, 10 – 15; the number 10 will be included?
7. Find the class mark of the class interval 60 – 80.
8. Find the range of the data 25, 18, 20, 22, 16, 6, 17, 15, 12, 30, 32, 10, 19, 8, 11 and 20. [NCERT Exemplar]
9. If m is the mid-point and l is the upper class limit of a class in a continuous frequency distribution, find its lower class limit.

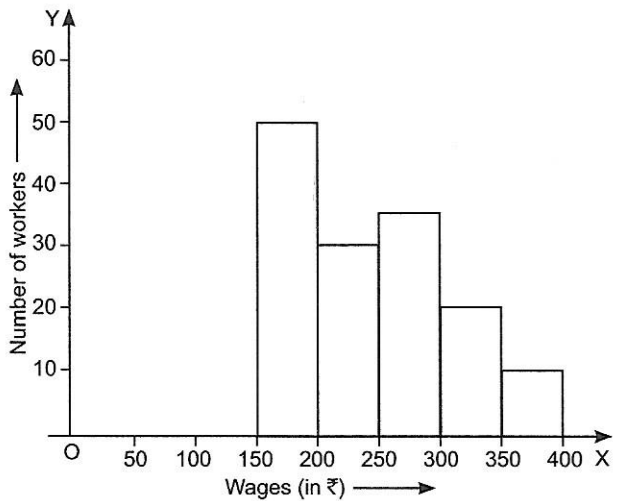
Short Answer Type Questions I [2 Marks]

10. The mean of observations $x, x + 3, x + 5, x + 7$ and $x + 10$ is 9. What will be the mean of last three observations?
11. The mean of 10, 12, 16, 20, p and 26 is 17. Find the value of p .
12. The daily sale of flour of a flourmill is given below:

Day	Mon.	Tue.	Wed.	Thurs.	Fri.	Sat.
Sale of flour (in kg)	120	110	70	80	40	210

Determine the average daily sale of flour of a flourmill.

13. The following data have been arranged in ascending order of magnitudes: 59, 62, 65, $x, x + 2, 72, 85, 94$. If the median of the data is 69, find the value of x .
14. Find the mode of the following data:
14, 25, 14, 28, 18, 17, 18, 14, 23, 22, 14, 18
15. In the given figure, there is a histogram depicting daily wages of workers in a factory. Construct the frequency distribution table. [NCERT Exemplar]



16. Following table shows the weights of 20 students:

Weights (in kg)	59	60	62	65	64
Number of students	5	4	6	3	2

Find the mean weight. [CBSE 2010]

Short Answer Type Questions II [3 Marks]

17. A football player scored the following number of goals in the 10 matches:
1, 3, 2, 5, 8, 6, 1, 4, 7, 9
Since the number of matches is 10 (an even number), therefore, the median
$$= \frac{5^{\text{th}} \text{ observation} + 6^{\text{th}} \text{ observation}}{2} = \frac{8 + 6}{2} = 7$$

Is it the correct? If not and why? [NCERT Exemplar]
18. The scores (out of 100) obtained by 33 students in a mathematics test are as follows:
69, 48, 84, 58, 48, 73, 83, 48, 66, 58, 84
66, 64, 71, 64, 66, 69, 66, 83, 66, 69, 71
81, 71, 73, 69, 66, 66, 64, 58, 64, 69, 69
Represent this data in the form of a frequency distribution. [NCERT Exemplar]

19. Prepare a continuous grouped frequency distribution from the following data:

Mid-point	Frequency
5	4
15	8
25	13
35	12
45	6

Also, find the size of class intervals. [NCERT Exemplar]

20. The expenditure of a family on different heads in a month is given below:

Heads	Expenditure (in ₹)
Food	4000
Education	2500
Clothing	1000
House rent	3500
Others	2500
Savings	1500

Draw a bar graph to represent the above data.

[NCERT Exemplar]

21. If the mean of the following data is 20.2, find the value of p .

x	10	15	20	25	30
f	6	8	p	10	6

[NCERT Exemplar]

22. Ten observations 6, 14, 15, 17, $x + 1$, $2x - 13$, 30, 32, 34, 43 are written in an ascending order. The median of the data is 24. Find the value of x . [NCERT Exemplar]
23. The mean of 1, 7, 5, 3, 4 and 4 is m . The observations 3, 2, 4, 2, 3, 3 and p have mean $(m - 1)$ and median q . Find p and q .

Long Answer Type Questions [4 Marks]

24. The marks obtained (out of 100) by a class of 80 students are given below

Marks	Number of students
10–20	6
20–30	17
30–50	15
50–70	16
70–100	26

Construct a histogram to represent the data above.

25. Following table shows a frequency distribution for the speed of cars passing through at a particular spot on a high way

Class interval (km/h)	Frequency
30–40	3
40–50	6
50–60	25
60–70	65
70–80	50
80–90	28
90–100	14

Draw a histogram and frequency polygon representing the data above.

26. The mean of the following distribution is 50.

x	10	30	50	70	90
f	17	$5a + 3$	32	$7a - 11$	19

Find the value of a and hence the frequencies of 30 and 70.

27. The mean marks (out of 100) of boys and girls in an examination are 70 and 73, respectively. If the mean marks of all the students in that examination is 71, find the ratio of the number of boys to the number of girls.
28. For a particular year, following is the frequency distribution table of ages (in years) of primary school teachers in a district:

Age (in years)	Number of teachers
15 – 20	10
20 – 25	30
25 – 30	50
30 – 35	50
35 – 40	30
40 – 45	6
45 – 50	4

- (i) Write the lower limit of the first class interval.
- (ii) Determine the class limits of the fourth class interval.
- (iii) Find the class mark of the class 45 – 50.
- (iv) Determine the class size.

ASSESS YOURSELF

- Find the class mark of class interval 70–80.
- A child says that the median of 3, 14, 18, 20 and 5 is 18. What doesn't the child understand about finding the median?
- The blood groups of 30 students are recorded as follows:
A, B, O, A, AB, O, A, O, B, A, O, B, A, AB, B, A, AB, B, A, A, O, A, AB, B, A, O, B, A, B, A.
Prepare a frequency distribution table for the data.

- Find the mean and median of first 12 odd composite numbers.
- Explain the reasons behind grouping raw data. What advantages do we get by grouping the data?
- Find the mean of the following data:

Marks	10	30	50	70	89
Frequency	7	8	10	15	10

- The expenditure of a company under different heads (in thousand of rupees) is given below:

Heads	Expenditure (in thousand of rupees)
Salary of employee	400
Travelling allowance	100
Medical facilities	250
House rent	200
Others	300

Draw a bar chart to depict the above data.

- In a city, the following weekly observations were made in a study on cost of living index:

Cost of living index	Number of weeks
140 – 150	5
150 – 160	10
160 – 170	20
170 – 180	9
180 – 190	6
190 – 200	2

Draw the frequency polygon for the above data without histogram.

- Find the mean, median and mode of the following data: 24, 17, 13, 24, 26, 20, 26, 30, 8, 41, 24
If one 24 is replaced by 26, find the new median and mode.

- Draw a histogram and frequency polygon to represent the following grouped frequency distribution table:

Age (in years)	Number of teachers
20 – 24	10
25 – 29	28
30 – 34	32
35 – 39	48
40 – 44	50
45 – 49	35
50 – 54	12