EXERCISE 14.1

Write the correct answer in each of the following:

1. The class mark of the class 90–120 is:

    (*a*) 90   (*b*) 105   (*c*) 115   (*d*) 120

Sol. Class mark $= \dfrac{90+120}{2} = \dfrac{210}{2} = 105$

Hence, (*b*) is the correct answer.

2. The range of the data:

25, 18, 20, 22, 16, 6, 17, 15, 12, 30, 32, 10, 19, 8, 11, 20 is

    (*a*) 10   (*b*) 15   (*c*) 18   (*d*) 26

Sol. Maximum value of the variate $= 32$

and the minimum value of the variate $= 6$

Range = Maximum value of the variate – Minimum value of the variate

$= 32 - 6 = 26$

Hence, (*d*) is the correct answer.

3. In a frequency distribution, the mid value of a class is 10 and the width of the class is 6. The lower limit of the class is:

    (*a*) 6   (*b*) 7   (*c*) 8   (*d*) 12

Sol. Lower limit of the class $= 10 - \left(\dfrac{6}{2}\right) = 10 - 3 = 7$

Hence, (*b*) is the correct answer.

4. The width of each of the five continuous classes in a frequency distribution is 5 and the lower class limit of the lowest class is 10. The upper class limit of the highest class is:

    (*a*) 15   (*b*) 25   (*c*) 35   (*d*) 40

Sol. Width of each of the five continuous classes in a frequency distribution is 5.

Lower class limit of the lowest class $= 10$

∴ Upper class limit of the lowest class is $10 + 5 = 15$

So, the five continuous classes are

$10 - 15, 15 - 20, 20 - 25, 25 - 30, 30 - 35$

Hence, the upper class limit of the highest class is 35.

So, (*c*) is the correct answer.

5. Let m be the mid-point and l be upper class limit of a class in a continuous frequency distribution. The lower class limit of the class is:

(a) $2m + l$ (b) $2m - l$ (c) $m - l$ (d) $m - 2l$

Sol. We have

$$m = \frac{\text{Lower limit} + l}{2} \quad \Rightarrow \quad 2m = \text{Lower limit} + l$$

$\therefore$ Lower limit $= 2m - l$

Hence, the lower class limit of the class is $2m - l$.

So, (b) is the correct answer.

6. The class marks of a frequency distribution are given as follows:

$$15, 20, 25, ...$$

The class corresponding to the class mark 20 is:

(a) $12.5 - 17.5$ (b) $17.5 - 22.5$ (c) $18.5 - 21.5$ (d) $19.5 - 20.5$

Sol. The class marks are 15, 20, 25, ...

The size of each class interval is $25 - 20 = 20 - 15 = 5$

Hence, the class interval corresponding to the class mark 20 is

$(20 - 2.5) - (20 + 2.5)$ i.e., $17.5 - 22.5$

So, (b) is the correct answer.

7. In the class intervals $10 - 20$, $20 - 30$, the number 20 is included in:

(a) $10 - 20$ (b) $20 - 30$ (c) both the intervals

(d) none of these intervals

Sol. The number 20 is included in $20 - 30$.

Hence, (b) is the correct answer.

8. A group frequency table with class intervals of equal sizes using $250 - 270$ (270 not included in this interval) as one the class interval is constructed for the following data:

$268, 220, 368, 258, 242, 310, 272, 342, 310, 290, 300, 320, 319, 304, 402,$
$318, 406, 292, 354, 278, 210, 240, 330, 316, 406, 215, 258, 236.$

The frequency of the class 310–330 is

(a) 4   (b) 5   (c) 6   (d) 7

Sol. The observations corresponding to class $310 - 330$ (330 not included in this interval) are 310, 310, 320, 319, 318, 316, i.e., 6 observations.

Hence, the frequency of the class $310 - 330$ is 6.

So, (c) is the correct answer

9. A grouped frequency distribution table with classes of equal sizes using $63 - 72$ (72 included) as one of the class is constructed for the following data:

$30, 32, 45, 54, 74, 78, 108, 112, 66, 76, 88, 40, 14, 20, 15, 35, 44, 66, 75, 84,$
$95, 96, 102, 110, 88, 74, 112, 14, 34, 44.$

The number of classes in the distribution will be:

    (*a*) 9   (*b*) 10   (*c*) 11   (*d*) 12

Sol. Minimum value $= 14$

Maximum value $= 112$

The classes are

$13 - 22, 23 - 32, 33 - 42, 43 - 52, 53 - 62, 63 - 72, 73 - 82, 83 - 92,$
$93 - 102$ and $103 - 112.$

The number of classes in the distribution will be 10.

Hence, (*b*) is the correct answer.

10. To draw a histogram to represent the following frequency distribution:

Class Interval	$5-10$	$10-15$	$15-25$	$25-45$	$45-75$
Frequency	6	12	10	8	15

The adjusted frequency for the class $25 - 45$ is:

    (*a*) 6   (*b*) 5   (*c*) 3   (*d*) 2

Sol. The adjusted frequency for the class $25 - 45$ is

$$= \frac{\text{Frequency of the class}}{\text{Class width}} \times \text{Minimum width} = \frac{8}{20} \times 5 = 2$$

Hence, (*d*) is the correct answer.

11. The mean of five numbers is 30. If one number is excluded, their mean becomes 28. The excluded number is

    (*a*) 28   (*b*) 30   (*c*) 35   (*d*) 38

Sol. Mean of five numbers is 30.

Sum of five numbers $= 30 \times 5 = 150$

Let the excluded number be x.

Then, mean of four numbers $= \dfrac{150 - x}{4} = 28$

$\Rightarrow \quad 150 - x = 112 \Rightarrow x = 150 - 112 = 38$

Hence, (*d*) is the correct answer.

12. If the mean of the observations:

$x, x + 3, x + 5, x + 7, x + 10$

is 9, the mean of the last three observations is

    (*a*) $10\dfrac{1}{3}$ (*b*) $10\dfrac{2}{3}$ (*c*) $11\dfrac{1}{3}$ (*c*) $11\dfrac{2}{3}$

Sol. Mean $= 9$

$$\Rightarrow \frac{x + x + 3 + x + 5 + x + 7 + x + 10}{5} = 9$$

$\Rightarrow \qquad\qquad 5x + 25 = 45$

$\Rightarrow \qquad\qquad\qquad x = 4$

Last three observation are $4 + 5, 4 + 7, 4 + 10$ i.e., $9, 11, 14$

$$\text{Mean} = \frac{9+11+14}{3} = \frac{34}{3} = 11\frac{1}{3}$$

Hence, (c) is the correct answer.

13. If $\bar{x}$ represent the mean of n observations $x_1, x_2, ..., x_n$, then the value of

$$\sum_{i=1}^{n}\left(x_i - \bar{x}\right) \text{ is}$$

(a) -1 (b) 0 (c) 1 (d) $n-1$

Sol. We know that algebraic sum of deviations from mean is zero.

$$\sum_{i=1}^{n}\left(x_i - \bar{x}\right) = (x_1 - \bar{x}) + (x_2 - \bar{x}) + (x_3 - \bar{x}) + (x_n - \bar{x})$$

$$= (x_1 + x_2 + x_3 + ... + x_n) - n\bar{x}$$

$$= \sum_{i=1}^{n} x_i - n\bar{x} = n\bar{x} - n\bar{x} = 0 \qquad \left[\because \sum_{i=1}^{n} x_i = n\bar{x}\right]$$

Hence, (b) is correct answer.

14. If each observation of the data is increased by 5, then their mean

  (a) remains the same   (b) becomes 5 times the original mean

  (c) is decreased by 5   (d) is increased by 5

Sol. If each observation of the data is increased by 5, then their mean is also increased by 5.

Hence, (d) is the correct answer.

15. If $\bar{x}$ be the mean of $x_1, x_2, ..., x_n$ and $\bar{y}$ is the mean of $y_1, y_2, ..., y_n$. If $\bar{z}$ is the mean of $x_1, x_2, ..., x_n, y_1, y_2, ..., y_n$, then $\bar{z}$ is equal to

(a) $\bar{x}+\bar{y}$ (b) $\dfrac{\bar{x}+\bar{y}}{2}$ (c) $\dfrac{\bar{x}+\bar{y}}{n}$ (d) $\dfrac{\bar{x}+\bar{y}}{2n}$

Sol. We have $\bar{x}$ is the mean of $x_1, x_2, ..., x_n$ and $\bar{y}$ is the mean of $y_1, y_2, ... y_n$

So, $\bar{x} = \dfrac{(x_1 + x_2 + x_3 + ... + x_n)}{n}$

$\Rightarrow$ $x_1 + x_2 + x_3 + ... + x_n = n\bar{x}$

and $\bar{y} = \dfrac{(y_1 + y_2 + y_3 + ... + y_n)}{n}$

$\Rightarrow$ $y_1 + y_2 + y_3 + ... + y_n = n\bar{y}$

If $\bar{z}$ is the mean of $x_1, x_2, ..., x_n, y_1, y_2, ..., y_n$, then

$$\overline{z} = \frac{n\overline{x} + n\overline{y}}{n+n} = \frac{n(\overline{x}+\overline{y})}{2n} = \frac{(\overline{x}+\overline{y})}{2}$$

Hence, (b) is the correct answer.

16. If $\overline{x}$ is the mean of $x_1, x_2, ..., x_n$, then for $a \neq 0$, the mean of $ax_1, ax_2, ..., ax_n$,
$\dfrac{x_1}{a}, \dfrac{x_2}{a}, ..., \dfrac{x_n}{a}$ is

(a) $\left(a + \dfrac{1}{a}\right)\overline{x}$

(b) $\left(a + \dfrac{1}{a}\right)\dfrac{\overline{x}}{2}$

(c) $\left(a + \dfrac{1}{a}\right)\dfrac{\overline{x}}{n}$

(d) $\dfrac{\left(a + \dfrac{1}{a}\right)\overline{x}}{2n}$

Sol. We know that, if $\overline{x}$ is the mean of $x_1, x_2, ..., x_n$, then

$$\overline{x} = \frac{x_1 + x_2 + x_3 + ... + x_n}{n}$$

$$\Rightarrow \qquad x_1 + x_2 + x_3 + ... + x_n = n\overline{x}$$

Now, the mean of $ax_1, ax_2, ..., ax_n$, $\dfrac{x_1}{a}, \dfrac{x_2}{a}, ..., \dfrac{x_n}{a}$ is

$$\text{Mean} = \frac{(ax_1 + ax_2 + ax_3 + ... + ax_n) + \left(\dfrac{x_1}{a} + \dfrac{x_2}{a} + ... + \dfrac{x_n}{a}\right)}{n+n}$$

$$= \frac{na\overline{x} + n\dfrac{\overline{x}}{a}}{2n} = \frac{n\overline{x}\left(a + \dfrac{1}{a}\right)}{2n} = \frac{\overline{x}\left(a + \dfrac{1}{a}\right)}{2} = \left(a + \dfrac{1}{a}\right)\dfrac{\overline{x}}{2}$$

Hence, (b) is the correct answer.

17. If $\overline{x}_1, \overline{x}_2, \overline{x}_3, ..., \overline{x}_n$ are the means of n groups with $n_1, n_2, ..., n_n$ number of observations respectively, then the mean $\overline{x}$ of all the groups taken together is given by:

(a) $\displaystyle\sum_{i=1}^{n} n_i \overline{x}_i$

(b) $\dfrac{\displaystyle\sum_{i=1}^{n} n_i \overline{x}_i}{n^2}$

(c) $\dfrac{\displaystyle\sum_{i=1}^{n} n_i \overline{x}_i}{\displaystyle\sum_{i=1}^{n} n_i}$

(d) $\dfrac{\displaystyle\sum_{i=1}^{n} n_i \overline{x}_i}{2n}$

Sol. If $\overline{x}_1, \overline{x}_2, \overline{x}_3, ..., \overline{x}_n$ are the mean of n group with $n_1, n_2, ... n_n$ number of observations respectively, then the mean $\overline{x}$

$$\overline{x} = \frac{n_1\overline{x}_1 + n_2\overline{x}_2 + n_3\overline{x}_3 + ... + n_n\overline{x}_n}{n_1 + n_2 + n_3 + ... + n_n} = \frac{\displaystyle\sum_{i=1}^{n} n_i\overline{x}_i}{\displaystyle\sum_{i=1}^{n} n_i}$$

Hence, the mean $\overline{x}$ of all group taken together is given by $\dfrac{\displaystyle\sum_{i=1}^{n} n_i\overline{x}_i}{\displaystyle\sum_{i=1}^{n} n_i}$.

So, (c) is the correct answer.

18. The mean of 100 observations is 50. If one of the observations which was 50 is replaced by 150, the resulting mean will be:

(a) 50.5   (b) 51   (c) 51.5   (d) 52

Sol. We have $\overline{x} = \dfrac{\Sigma x_i}{n}$

$\Rightarrow \quad 50 = \dfrac{\Sigma x_i}{100} \Rightarrow \Sigma x_i = 50 \times 100 = 5{,}000$

If one of the observations which was 50 is replaced by 150, then
$\Sigma x_i = 5{,}000 - 50 + 150 = 5100$

Then, the resulting mean $= \dfrac{5100}{100} = 51$.

Hence, (b) is the correct answer.

19. There are 50 numbers. Each number is subtracted from 53 and the mean of the numbers so obtained is found to be –3.5. The mean of the given numbers is:

(a) 46.5   (b) 49.5   (c) 53.5   (d) 56.5

Sol. $\text{Mean} = \dfrac{\text{Sum of all observations}}{\text{Total number of observations}}$

$\Rightarrow \quad -3.5 = \dfrac{(53 - x_1) + (53 - x_2) + (53 - x_3) + ... + (53 - x_{50})}{50}$

$\Rightarrow \quad -3.5 = \dfrac{(53 \times 50) - (x_1 + x_2 + x_3 + ... + x_{50})}{50}$

$\Rightarrow \quad -3.5 = \dfrac{53 \times 50 - 50\overline{x}}{50}$

$\Rightarrow \quad -3.5 = 53 - \overline{x} \quad \Rightarrow \overline{x} = 53 + 3.5 = 56.5$

Hence, (d) is the correct answer.

20. The mean of 25 observations is 36. Out of these observations if the mean of first 13 observations is 32 and that of the last 13 observations is 40, the 13th observation is:

    (a) 23   (b) 36   (c) 38   (d) 40.

Sol. Mean of first 13 observations = 32

$\therefore$ Sum of all first 13 observations $= (32 \times 13) = 416$

        Mean of last 13 observations $= 40$

$\therefore$ Sum of all last 13 observations $= (40 \times 13) = 520$

        Mean of 25 observations $= 36$

$\therefore$ Sum of all first 25 observations $= (36 \times 25) = 900$

Hence, 13th observation $= 416 + 520 - 900 = 36$

Hence, (b) is the correct answer.

21. The median of the data 78, 56, 22, 34, 45, 54, 39, 54, 84 is

    (a) 45   (b) 49.5   (c) 54   (d) 56

Sol. Arranging the data in ascending order, we get

    22, 34, 39, 45, 54, 54, 56, 78, 84

Here $n = 9$, which is an odd number.

$\therefore$ $\text{Median} = \left(\dfrac{n+1}{2}\right)^{th} \text{value} = \left(\dfrac{9+1}{2}\right)^{th} \text{value} = 5\text{th value}$

So, median $= 54$.

Hence, (c) is the correct answer.

22. For drawing a frequency polygon of a continous frequency distribution, we plot the points whose ordinates are the frequencies of the respective classes and abcissae are respectively:

    (a) upper limits of the classes (b) lower limits of the classes

    (c) class marks of the classes (d) upper limits of preceding classes

Sol. Abcissac are the class marks of the classes.

Hence, (c) is the correct answer.

23. Median of the following numbers:

    4, 4, 5, 7, 6, 7, 7, 12, 3 is

    (a) 4   (b) 5   (c) 6   (d) 7

Sol. Arranging the data in ascending order, we get

    3, 4, 4, 5, 6, 7, 7, 7, 12

Here $n = 9$, which is an odd number.

$\therefore$ $\text{Median} = \left(\dfrac{n+1}{2}\right)^{th} \text{value} = \left(\dfrac{9+1}{2}\right)^{th} \text{value} = 5\text{th value}$

Therefore, median $= 6$.

Hence, (c) is the correct answer.

24. Mode of the data 15, 14, 19, 20, 14, 15, 16, 14, 15, 18, 14, 19, 15, 17, 15 is

    (*a*) 14   (*b*) 15   (*c*) 16   (*d*) 17

Sol. We know that mode is the most frequently occurring observation.

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

By arranging the given observations in ascending order, we get

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

We see that 15 occurs maximum number of times i.e it is the most frequently occurring observation.

Hence, mode of the given data = 15

So, (*b*) is the correct answer.

25. In a sample study of 642 people, it was found that 514 people have a high school certificate. If a person is selected at random, the probability that the person has a high school certificate is

    (*a*) 0.5   (*b*) 0.6   (*c*) 0.7   (*d*) 0.8

Sol. We know that the empirical probability P(E) of an event E happening, is given by

$$P(E) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

Let E be the event that a person selected at random has a high school certificate.

$$\text{So, } P(E) = \frac{\text{Number of persons having high school certificate}}{\text{Total number of people in a sample study}}$$

$$= \frac{514}{642} = 0.8$$

Hence, (*d*) is the correct answer.

26. In a survey of 364 children aged 19 – 36 months, it was found that 91 liked to eat potato chips. If a child is selected at random, the probability that he/she does not like to eat potato chips be:

    (*a*) 0.25   (*b*) 0.50   (*c*) 0.75   (*d*) 0.80

Sol. Total number of children aged 19 – 36 months in a survey = 364

Number of children who liked to eat potato chips = 91

Therefore, number of children who does not like to eat potato chips

= 364 – 91 = 273

Let E denote the event that a child selected at random does not like to potato chips.

Now, P(E) of an event E happening, is given by $= \dfrac{273}{364} = 0.75$

Hence, (*c*) is the correct answer.

27. In a medical examination of students of a class, the following blood groups are recorded:

Blood Group	A	AB	B	O
Number of students	10	13	12	5

A student is selected at random from the class. The probability that he or she has blood group B, is

(a) $\dfrac{1}{4}$ (b) $\dfrac{13}{40}$ (c) $\dfrac{3}{10}$ (d) $\dfrac{1}{8}$

Sol. Total number of students $= 10 + 13 + 12 + 5 = 40$

Let us call event of selected students at random who have blood group B be E.

There are 12 students who has blood group B.

So, $P(E) = \dfrac{12}{40} = \dfrac{3}{10}$

Hence, (c) is the correct answer.

28. Two coins are tossed 1000 times and the outcomes are recorded as below:

Number of heads	2	1	0
Frequency	200	550	250

Based on the information, the probability for at most one head is

(a) $\dfrac{1}{5}$ (b) $\dfrac{1}{4}$ (c) $\dfrac{4}{5}$ (d) $\dfrac{3}{4}$

Sol. Total number of times the two coins are tossed $= 1000$ times

Let E be the event of getting at most one head, i.e., getting 0 head or 1 head.

Number of times E happens *i.e.*, number of times getting at most 1 head $= 250 + 550 = 800$

∴ $P(E) = \dfrac{800}{1000} = \dfrac{4}{5}$

Hence, (c) is the correct answer.

29. 80 bulbs are selected at random from a lot and their life time (in hrs) is recorded in the form of a frequency table given below:

Life time in (hrs)	300	500	700	900	1100
Frequency	10	12	23	25	5

One bulb is selected at random from the lot. The probability that its life is 1150 hours, is

(a) $\dfrac{1}{80}$ (b) $\dfrac{7}{16}$ (c) 0   (d) 1

Sol. Total number of bulbs $= 80$

Let E be the event that bulb selected at random from the lot has life time 1150 hrs.

We see from the frequency table given above that none of the bulb has life time 1150 hrs.

$\therefore \qquad P(E) = \dfrac{0}{80} = 0$

Hence, (c) is the correct answer.

30. Refer to Q.29 above.

The probability that bulbs selected randomly from the lot has life less than 900 hours is:

$(a) \quad \dfrac{11}{40}$ $\qquad$ $(b) \quad \dfrac{5}{16}$ $\qquad$ $(c) \quad \dfrac{7}{16}$ $\qquad$ $(d) \quad \dfrac{9}{16}$

Sol. Let E be the event that the bulb selected at random from the lot has life time less than 900 hrs.

From the table, we see that the number of bulbs having life time less than 900 hrs.
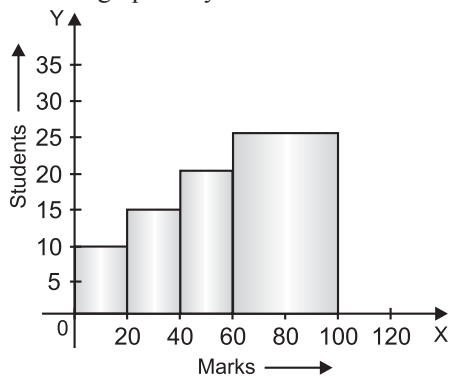
$$= 10 + 12 + 23 = 45$$

Total number of bulbs $= 80$

$\therefore \qquad\qquad\qquad P(E) = \dfrac{45}{80} = \dfrac{9}{16}$

EXERCISE 14.2

1. The frequency distribution:

Marks	$0-20$	$20-40$	$40-60$	$60-100$

has been represented graphically as follows:

Do you think this representation is correct? Why?

Sol. This representation is not correct. The classes $0 - 20$, $20 - 40$, $40 - 60$ and $60 - 100$ are not of uniform width but of varying widths.

2. In a diagnostic test in mathematics given to students, the following marks (out of 100) are recorded: 46, 52, 48, 11, 41, 62, 54, 53, 96, 40, 98, 44. Which 'average' will be a good representative of the above data and why?

Sol. Median will be good representative of the given data. Marks (out of 100) are 46, 52, 48, 11, 41, 62, 54, 53, 96, 40, 98, 44.

Average which will be a good representative of the given data is median because

(*i*) Each value in the data occurs once.

(*ii*) The data is influenced by extreme values.

3. A child says that the median of 3, 14, 12, 20, 5 is 8. What doesn't the child understand about finding the median?

Sol. Before finding the median of the data, data has to be arranged in ascending or descending order.

4. 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

$$= \frac{5^{th} \text{observation} + 6^{th} \text{observation}}{2} = \frac{8+6}{2} = 7$$

Is it correct answer and why?

Sol. The answer 7 is not correct. Before finding the median, the data have first to be arranged in ascending or descending order.

5. Is it correct to say that, in histogram, the area of each rectangle is proportional to the class size of the corresponding class interval? If not, correct the statement.

Sol. The given statement is not correct. In a histogram, the area of each rectangle is proportional to the frequency of its class.

6. The class mark of continuous distribution are:

1.04, 1.14, 1.24, 1.34, 1.44, 1.54 and 1.64.

Is it correct to say that the last interval will be $1.55 - 1.73$? Justify your answer.

Sol. The class mark of continuous distribution are: 1.04, 1.14, 1.24, 1.34, 1.44, 1.54 and 1.64.

The difference between the two consecutive marks is

$$1.14 - 1.04 = 1.24 - 1.14 = \text{.......} 1.64 - 1.54. = 0.10$$

The class size of interval $1.55 - 1.73$ is

$$= 1.73 - 1.55 = 0.18$$

Hence, it is not correct to say that the last interval will be $1.55 - 1.73$ because the difference between two consecutive marks (0.10) is not equal to the class size (0.18).

7. 30 children were asked the number of hours they watched TV programmes last week.

The results are recorded as under:

Number of hours	$0-5$	$5-10$	$10-15$	$15-20$
Frequency	8	16	4	2

Can we say that number of children who watched TV for 10 or more hours a week are 22? Justify your answer.

Sol. 10 is considered in $10-15$ and not in $5-10$. So, we can not say that number of children who watched TV for 10 or more hours a week is 22. In fact, the number of children who watch TV for 10 or more hours a week are $4+2=6$.

10. Can the experimental probability of an event be a negative number? If not, why?

Sol. The experimental probability of an event cannot be a negative number since the number of trials in which the event can happen cannot be negative, and the total number of trials is always positive.

9. Can the experimental probability of an event be greater than 1? Justify your answer.

Sol. The experimental probability of an event cannot be greater than 1 since the number of trials in which the event can happen cannot be greater than the total number of trials.

10. As the number of tosses of a coin increases, the ratio of the number of heads to the total number of tosses will be $\frac{1}{2}$. Is it correct? If not, write the correct one.

Sol. No, it is not correct. As the number of trials increases, the required ratio is very close to $\frac{1}{2}$, not exactly $\frac{1}{2}$ always.

EXERCISE 14.3

1. The blood groups of 30 students are recorded A, B, O, A, O, A, O, B, A, O, B, A, AB, B, A, AB, B, A, B, A, A, O, A, AB, B, A, O, B, A. Prepare a frequency distribution table for the data.

Sol.   Frequency distribution table

Blood Group	Number of students (Frequency)
A	12
B	8
AB	4
O	6
Total	30

2. The value of π upto 34 decimal places is given below:

3.1459265358979323846264338327950288.

Make a frequency distribution of the digits 0 to 9 after the decimal point.

Sol.   Frequency distribution table

Digit	Frequency
0	1
1	1
2	5
3	6
4	3
5	4
6	3
7	2
8	5
9	4

3. 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.

Sol.   Frequency distribution table

Scores	Frequency
48	3
58	3
64	4
66	7
69	6
71	3
73	2
81	1
83	2
84	2

4. 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.

Sol. The mid-points are 5, 15, 25, 35 and 45. The common difference of class marks is 10.

Therefore, we need to subtract and add $\dfrac{10}{2} = 5$ from and to either side

of each class mark. Hence, the class intervals corresponding to each class mark are $0 - 10, 10 - 20, 20 - 30, 30 - 40, 40 - 50$.

A continuous grouped frequency distribution is given below:

Class	Frequency
$0 - 10$	4
$10 - 20$	8
$20 - 30$	13
$30 - 40$	12
$40 - 50$	6

5. Convert the given frequency distribution into a continuous grouped frequency distribution:

Class interval	Frequency
$150 - 153$	7
$154 - 157$	7
$158 - 161$	15
$162 - 165$	10
$166 - 169$	5
$170 - 173$	6

In which intervals would 153.5 and 157.5 be included?

Sol.

Class interval	Continuous class interval	Frequency
$150 - 153$	$149.5 - 153.5$	7
$154 - 157$	$153.5 - 157.5$	7
$158 - 161$	$157.5 - 161.5$	15
$162 - 165$	$161.5 - 165.5$	10
$166 - 169$	$165.5 - 169.5$	5
$170 - 173$	$169.5 - 173.5$	6
Total		50

$$h = \frac{(\text{lower limit of a class}) - (\text{upper limit of previous class})}{2}$$

$$\Rightarrow \quad h = \frac{154 - 153}{2} \quad \Rightarrow \quad h = \frac{1}{2} \quad \Rightarrow \quad h = 0.5$$

Therefore, we subtract 0.5 from the lower limit of each class and add 0.5 in the upper limit of each class to make it continous.

i.e., Each Lower Limit $- 0.5$, Each Upper Limit $+ 0.5$

153.5 is included in the second interval and 157.5 is included in the third interval.

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

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

Draw a bar graph to represent the data above.

Sol. To represent the above data by a bar graph, we first draw a horizontal and a vertical line. Since six values of the numerical data are given. So, we mark six points on the horizontal line at equal distances and erect rectangles of the same width at these points. The heights of the rectangles are proportional to the numerical values of the data as shown in the figure given below.
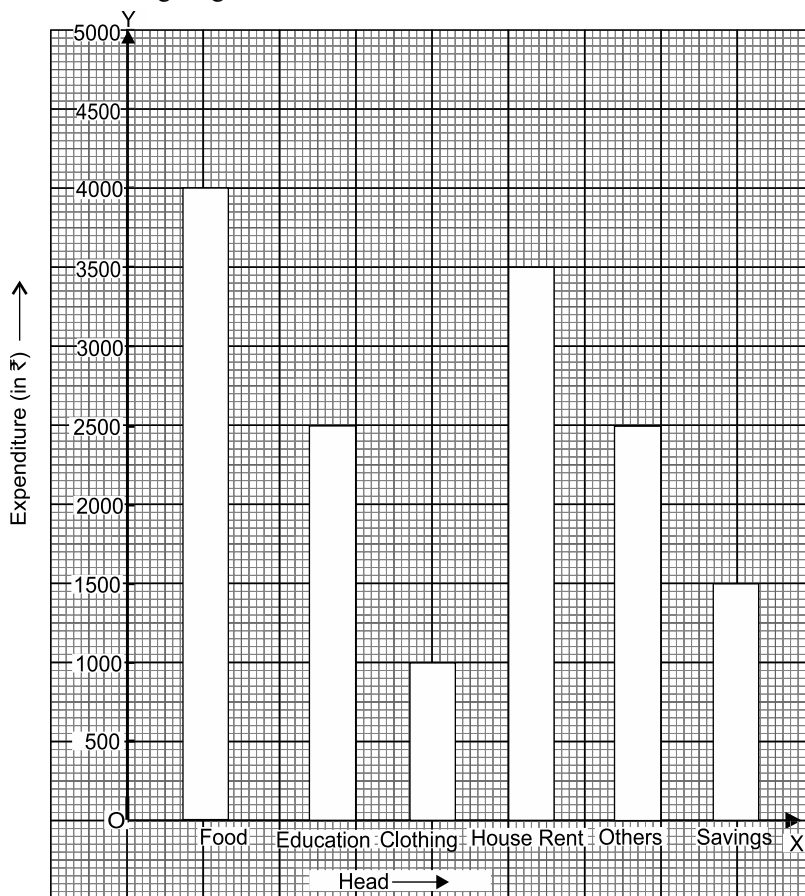
7. Expenditure on Education of a country during a five year period (2002-06), in crores of rupees, is given below:

Elementary Education	240
Secondary Education	120
University Education	190
Teacher's Training	20
Social Education	10

Other Educational Programmes	115
Cultural Programmes	25
Technical Education	125

Represent the information above by a bar graph.

Sol. In order to construct a bar graph representing the above data, we follow the following steps:

Step 1: Take a graph paper and draw the mutually perpendicular lines OX and OY as shown in the figure given below. Call OX as the horizontal axis and OY as the vertical axis.

Step 2: Along OX, mark education of a country and along OY, mark expenditure on education of a country.

Step 3: Along OX, choose the uniform (equal) width of the bars and the uniform gap between them, according to the space available for the graph.

Step 4: Choose a suitable space to determine the heights of the bars, according to the availability of space.

Here, we choose 1 big box to represent 20 crores of rupees.

Step 5: Calculate the heights of various bars as follows :

The height of the bar for the expenditure on elementary education

$$= \frac{240}{20} = 12 \text{ big divisions}$$

The height of the bar for the expenditure on secondary education

$$= \frac{120}{20} = 6 \text{ big divisions}$$

The height of the bar for the expenditure on university education

$$= \frac{190}{20} = 9.5 \text{ big divisions}$$

The height of the bar for the expenditure on teacher's training

$$= \frac{20}{20} = 1 \text{ big division}$$

The height of the bar for the expenditure an social education

$$= \frac{10}{20} = 0.5 \text{ big division}$$

The height of the bar for the expenditure on other educational programmes

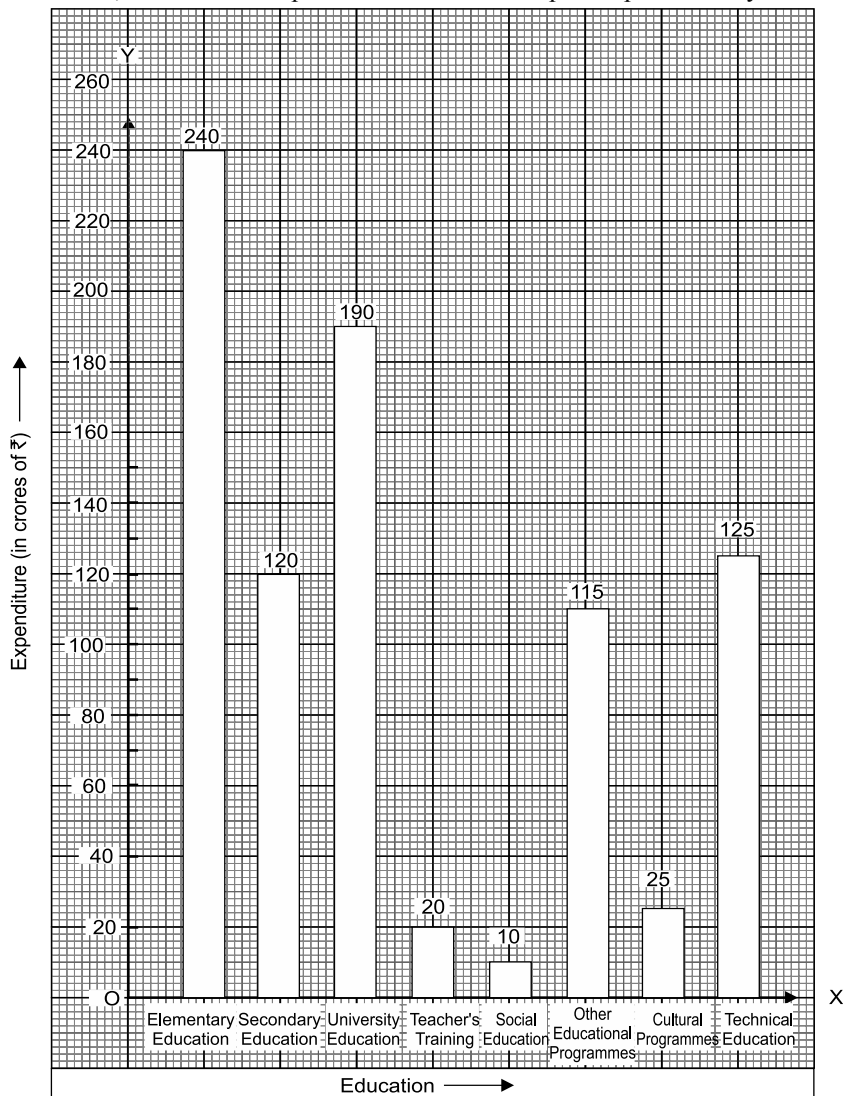$$= \frac{115}{20} = 5.75 \text{ big divisions}$$

The height of the bar for the expenditure on cultural programmes

$$= \frac{25}{20} = 1.25 \text{ big divisions}$$

The height of the bar for the expenditure on technical education

$$= \frac{125}{20} = 6.25 \text{ big divisions}$$

Step 6. We draw the bars as shown in the figure and on the top of each bar, we write the expenditure in crores of rupees represented by it.

8. The following table gives the frequencies of most commonly used letters *a, e, i, o, r, t, u* from a page of a book:

Letters	a	e	i	o	r	t	u
Frequency	75	125	80	70	80	95	75

Represent the information above by a bar graph.

Sol. We go through the following steps to construct the bar graph:

Step 1. Take a graph paper and draw two lines OX and OY perpendicular to each other. Call the horizontal line as OX and the vertical line as OY.

Step 2. Along the horizontal axis OX, mark "Frequency" and along the vertical axis OY mark "Letters".
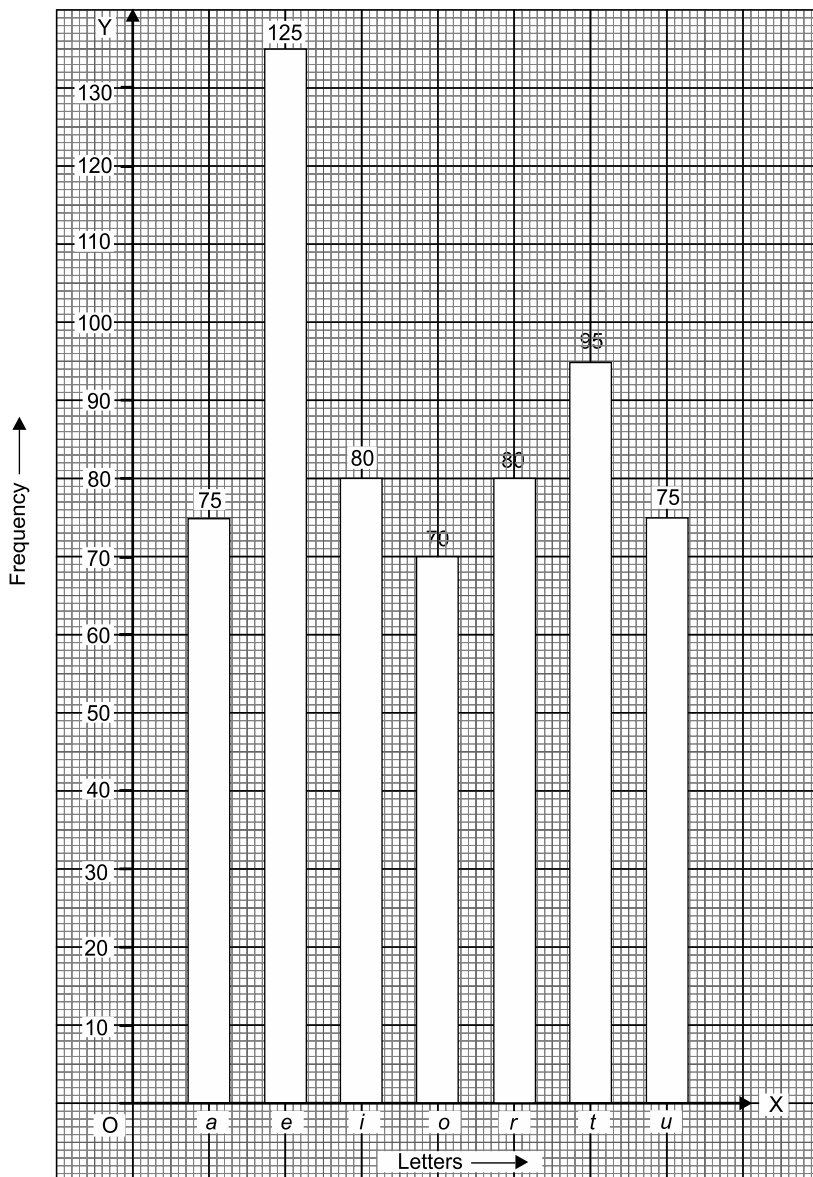
Step 3. Along the horizontal axis OX, choose the uniform (equal) width of the bars and the uniform gap between them.

Step 4. Choose a suitable scale to determine the heights of the bars, according to the space available for the graph. Here, we choose 1 small division to represent 1 letter.

Step 5. Calculate the heights of various bars as follows:

Height of the bar for letter 'a' = 75 × 1 = 75 small divisions = 7.5 big divisions

Height of the bar for letter 'e' = 125 × 1 = 125 small divisions = 12.5 big divisions

Height of the bar for letter 'i' = 80 × 1 = 80 small divisions = 8 big divisions

Height of the bar for letter 'o' = 70 × 1 = 70 small divisions = 7 big divisions

Height of the bar for letter 'r' = 80 × 1 = 80 small divisions = 8 big divisions

Height of the bar for letter 't' = 95 × 1 = 95 small divisions = 9.5 big divisions

Height of the bar for letter 'u' = 75 × 1 = 75 small divisions = 7.5 big divisions

Step 6. We draw the bars as shown in the figure and on the top of each bar, we write the frequency of letters represented by it.

9. 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

Sol.

x_i	f_i	$x_i f_i$
10	6	60
15	8	120
20	p	$20p$
25	10	250
30	6	180
Total	$30 + p$	$610 + 20p$

Mean = 20.2

$\Rightarrow$ $\qquad 20.2 = \dfrac{\Sigma x_i f_i}{\Sigma f_i}$

$$\Rightarrow \qquad 20.2 = \frac{610 + 20p}{30 + p}$$

$$\Rightarrow \qquad 606 + 20.2p = 610 + 20p$$

$$\Rightarrow \qquad 0.2p = 4$$

$$\Rightarrow \qquad p = 20$$

10. Obtain the mean of the following distribution:

Frequency	Variable
4	4
8	6
14	8
11	10
3	12

Sol.

x_i	f_i	$x_i f_i$
4	4	16
6	8	48
8	14	112
10	11	110
12	3	36
Total	40	322

$$\text{Mean} = \frac{\Sigma x_i f_i}{\Sigma f_i} = \frac{322}{40} = 8.05$$

11. A class consists of 50 students out of which 30 are girls. The mean of marks scored by girls in a test is 73 (out of 100) and that of boys is 71. Determine the mean score of the whole class.

Sol. There are 50 students in a class. Out of these 50 students, 30 are girls.

So, number of boys in the class = 50 – 30 = 20

$$\text{Mean marks of 30 girls} = 73$$
$$\text{Total marks of 30 girls} = 73 \times 30 = 2190$$
$$\text{Mean marks of 20 boys} = 71$$
$$\text{Total marks of 20 boys} = 71 \times 20 = 1420$$

$$\text{Hence, mean of the whole class} = \frac{2190 + 1420}{50} = \frac{3610}{50} = 72.2$$

12. 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.

Sol. $\qquad$ Mean of 50 students = 80.4

$\therefore \qquad$ Sum of 50 observations = $80.4 \times 50 = 4020$

As, 96 was misread as 69,

so the correct total $= 4020 - 69 + 96 = 4047$

Hence, the correct mean $= \dfrac{4047}{50} = 80.94$

13. Ten observations 6, 14, 15, 17 , $x + 1$, $2x - 13$, 30 , 32, 34, 43, are in ascending. The median of the data is 24. Find the value of x.

Sol. Ten observations 6, 14, 15, 17, $x + 1$, $2x - 13$, 30, 32, 34, 43, are in an ascending order.

Here, $n = 10$ (even)

$\therefore$ Median $=$ average of $\left(\dfrac{10}{2}\right)^{th}$ value and $\left(\dfrac{10}{2}+1\right)^{th}$ value

$=$ average of 5th item and 6th item

$\Rightarrow$ Median $= \dfrac{x+1+2x-3}{2} = \dfrac{3x-12}{2}$

Now, $\dfrac{3x-12}{2} = 24 \Rightarrow 3x = 48 + 12 = 60$

$\therefore$ $x = 60 \div 3 = 20$

Hence, the value of $x = 20$.

14. 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 of the data.

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

$2, 5, 7, 7, 8, 10, 10, 10, 14, 17, 18, 24, 25, 27, 28, 48$.

We find, 10 occurs most frequently i.e maximum number of times.
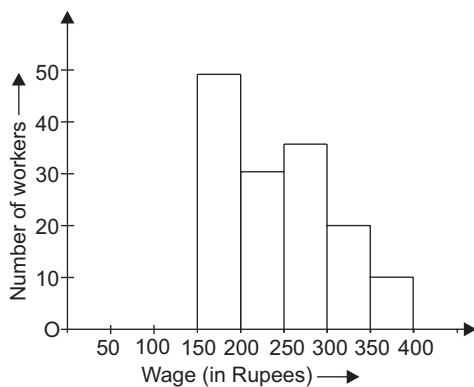
Therefore, mode of the data $= 10$

Here, $n = 16$ (even)

$\therefore$ Median $=$ average of $\left(\dfrac{16}{2}\right)^{th}$ value and $\left(\dfrac{16}{2}+1\right)^{th}$ value

$=$ average of 8th value and 9th value

$\Rightarrow$ Median $= \dfrac{10+14}{2} = \dfrac{24}{2} = 12$

Hence, median $= 12$ and mode $= 10$.

15. In the given figure, there is a histogram depicting daily wages of workers in a factory. Construct the frequency distribution table.

Sol.

Class Interval	Frequency
150 – 200	50
200 – 250	30
250 – 300	35
300 – 350	20
350 – 400	10
Total	**145**

16. A company selected 4,000 households at random and surveyed them to find out a relationship between income level and the number of television sets in a home. The information so obtained is listed in the following table:

Monthly income (in ₹)	No. of Television/household			
	0	1	2	Above 2
<10000	20	80	10	0
10000 – 14999	10	240	60	0
15000 – 19999	0	380	120	30
20000 – 24999	0	520	370	80
25000 and above	0	1100	760	220

Find the probability:

(*i*) of a household earning ₹10000 – ₹14999 per year and having exactly one television.

(*ii*) of a household earning ₹25000 and more per year and owning 2 televisions.

(*iii*) of a household not having any television.

Sol. Number of households selected at random $= 4000$

(i) Number of households earning ₹10000 – ₹14999 per year and having exactly one television $= 240$

So, required probability $= \dfrac{240}{4000} = \dfrac{60}{1000} = 0.06$

(ii) Number of households earning ₹ 25,000 and more per year and owing 2 televisions $= 760$

So, required probability $= \dfrac{760}{4000} = 0.19$

(iii) Number of households not having any televisions $= 20 + 10 = 30$

So, required probability $= \dfrac{30}{4000} = \dfrac{3}{400}$

17. Two dice are thrown simultaneously 500 times. Each time the sum of the two numbers appearing on their tops is noted and recorded as given in the following table:

Sum	Frequency
2	14
3	30
4	42
5	55
6	72
7	75
8	70
9	53
10	46
11	28
12	15

If the dice are thrown once more, what is the probability of getting a sum

(i) 3?   (ii) more than 10?

(iii) less than or equal to 5?   (iv) between 8 and 12?

Sol. Two dice are thrown 500 times. So, the total number of trials are 500.

(i) Let E_1 be the event that sum of two numbers appearing on the uppermost faces of two dice be 3. Number of times in which the event happened is 30.

∴ $P(E_1) = \dfrac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$

$= \dfrac{30}{500} = \dfrac{3}{50} = 0.06$

(ii) Let E_2 be the event that sum of two numbers appearing on the uppermost faces of two dice be more than 10, i.e., sum 11 or 12.

Number of times in which the event happened $= 28 + 15 = 43$

$$\therefore \quad P(E_2) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{43}{500} = 0.086$$

(*iii*) Let E_3 be the event that sum of two numbers appearing on the uppermost faces of two dice be less than or equal to 5.

Number of times in which the event happened $= 14 + 30 + 42 + 55 = 141$

$$\therefore \quad P(E_3) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{141}{500} = 0.282$$

(*iv*) Let E_4 be the event that sum of two numbers appearing on the uppermost faces of two dice be between 8 and 12.

Number of times in which the event happened $= 53 + 46 + 28 = 127$

$$\therefore \quad P(E_4) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{127}{500} = 0.254$$

18. Bulbs are packed in cartons each containing 40 bulbs. Seven hundred cartons were examined for defective bulbs and the results are given in the following table:

Number of defective bulbs	0	1	2	3	4	5	6	More than 6
Frequency	400	180	48	41	18	8	3	2

One carton was selected at random. What is the probability that it has
  (*i*) no defective bulbs?
  (*ii*) defective bulbs from 2 to 6?
  (*iii*) defective bulbs less than 4?

Sol. 700 hundred carton were examined for defective bulbs.

One carton was selected at random.

  (*i*) Let E_1 be the event that selected carton has no defective bulb.
    From the table given above, we see that the number of times the event happened $= 400$

$$\therefore \ P(E_1) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{400}{700} = \frac{4}{7}$$

  (*ii*) Let E_2 be the event that selected carton has defective bulbs from 2 to 6.

From the table given above, we see that the number of times the event happened $= 48 + 41 + 18 + 8 + 3 = 118$

$$\therefore P(E_2) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{118}{700} = \frac{59}{350}$$

(*iii*) Let E_3 be the event that selected carton has defective bulbs less than 4.

From the table given above, we see that the number of times the event happened $= 400 + 180 + 48 + 41 = 669$

$$\therefore P(E_3) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{669}{700}$$

19. Over the past 200 working days, the number of defective parts produced by a machine is given in the following table:

Number of defective parts	Days
0	50
1	32
2	22
3	18
4	12
5	12
6	10
7	10
8	10
9	8
10	6
11	6
12	2
13	2

Determine the probability that tomorrow's output will have
   (*i*) no defective part,   (*ii*) at least one defective part,
  (*iii*) not more than 5 defective parts, (*iv*) more than 13 defective parts.

Sol. Total number of past working days are 200.

  (*i*) Let E_1 be the event that tomorrow's output will have no defective part.
   From the table given above, we see that the number of times the event happened $= 50$

$$\therefore \quad P(E_1) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{50}{200} = \frac{1}{4} = 0.25$$

(*ii*) Let E_2 be the event that the tomorrow's output will have at least one defective part.

From the table given above, we see that the number of times the event happened

$$= 200 - (\text{Number of no defective parts})$$
$$= 200 - 50 = 150$$

$\therefore$ $P(E_2) = \dfrac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$

$$= \dfrac{150}{200} = \dfrac{3}{4} = 0.75$$

(*iii*) Let E_3 be the event that tomorrow's output will have not more than 5 defective parts.

From the table given above, we see that the number of times the event happened, *i.e.*, no defective part, one defective part, two defective parts, three defective parts, four defective parts and five defective parts.

$$= 50 + 32 + 22 + 18 + 12 + 12 = 146$$

$\therefore$ $P(E_3) = \dfrac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$

$$= \dfrac{146}{200} = 0.73$$

(*iv*) Let E_4 be the event that tomorrow's output will have more than 13 defective parts. From the table given above, we see that the number of times the event happened $= 0$ (since there are no more than 13 defective parts)

$\therefore$ $P(E_4) = \dfrac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$

$$= \dfrac{0}{200} = 0$$

20. A recent survey found that the ages of workers in a factory is distributed as follows:

Age (*in years*)	Number of workers
$20 - 29$	38
$30 - 39$	27
$40 - 49$	86
$50 - 59$	46
60 and above	3

If a person is selected at random, find the probability that the person is:
  (*i*) 40 years or more,   (*ii*) under 40 years,
  (*iii*) having age from 30 to 39 years, (*iv*) under 60 but over 39 years.

Sol. Total number of workers in a factory $= 38 + 27 + 86 + 46 + 3 = 200$

(*i*) Let E_1 be the event that the person selected at random is of 40 years or more.

From the table given above, we see that the number of times the event E_1 happened

$$= \ 86 + 46 + 3 = 135$$

$$\therefore \ \ P(E_1) \ = \ \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{135}{200} = 0.675$$

(*ii*) Let E_2 be the event that the person selected at random is under 40 years.

From the table given above, we see that the number of times the event happened

$$= 38 + 27 = 65$$

$$\therefore \ \ P(E_2) \ = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{65}{200} = 0.325$$

(*iii*) Let E_3 be the event that the person selected at random is having age from 30 to 39 years.

From the table given above, we see that the number of times the event happened = 27

$$\therefore \ \ P(E_3) \ = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{27}{200} = 0.135$$

(*iv*) Let E_4 be the event that the person selected at random is having age under 60 but over 39 years.

From the table given above, we see that the number of times the event happened

$$= 86 + 46 = 132$$

$$\therefore \ \ P(E_4) \ = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

$$= \frac{132}{200} = 0.66$$

EXERCISE 14.4

1. The following are the marks (out of 100) of 60 students in mathematics.
   16, 13, 5, 80, 86, 7, 51, 48, 24, 56, 70, 19, 61, 17, 16, 36, 34, 42, 34, 35, 72, 55,
   75, 31, 52, 28, 72, 97, 74, 45, 62, 68, 86, 35, 85, 36, 81, 75, 55, 26, 95, 31, 7,
   78, 92, 62, 52, 56, 15, 63, 25, 36, 54, 44, 47, 27, 72, 17, 4, 30.
   Construct a grouped frequency distribution table with width 10 of each
   class starting from 0 – 9.

Sol. We have 0–9 as one of the class intervals and the class size is the same. Therefore, the classes of equal size and 0–9, 10–19,........, 90–99.

Frequency Distribution Table

Class Intervals	Tally Marks	Frequency
0 – 9	|	1
10 – 19	||	2
20 – 29	ⅢⅠ	5
30 – 39	ⅢⅠ|	6
40 – 49	|||	3
50 – 59	||||	4
60 – 69	|||	3
70 – 79	||	2
80 – 89	ⅢⅠ	5
90 – 99	||||	4

2. Refer to Q1 above. Construct a grouped frequency distribution table with width 10 of each class, in such a way that one of the classes is 10 – 20 (20 not included).
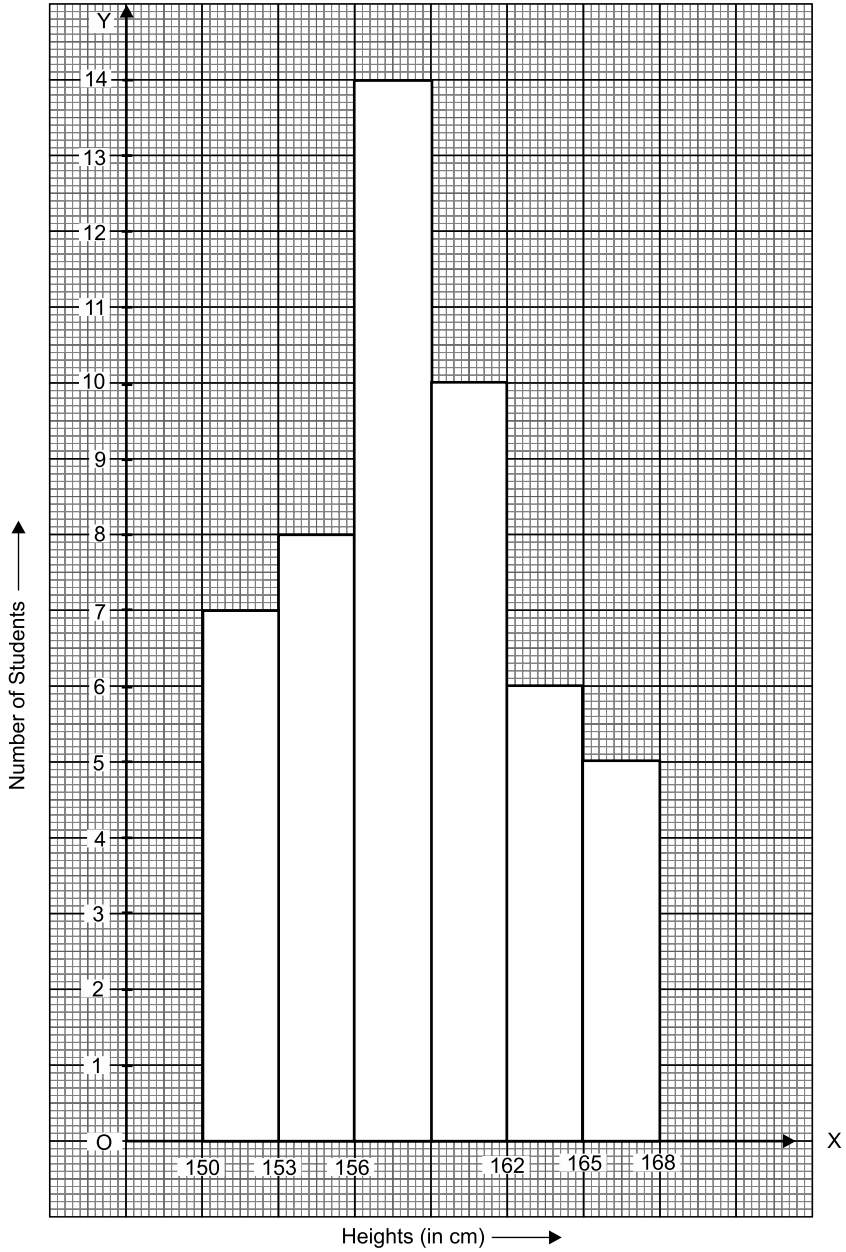
Sol.   Frequency Distributtion Table

Class Intervals	Tally Marks	Frequency
0 – 10	||||	4
10 – 20	ⅢⅠ ||	7
20 – 30	ⅢⅠ	5
30 – 40	ⅢⅠ ⅢⅠ	10
40 – 50	ⅢⅠ	5
50 – 60	ⅢⅠ |||	8
60 – 70	ⅢⅠ	5
70 – 80	ⅢⅠ |||	8
80 – 90	ⅢⅠ	5
90 – 100	|||	3

3. Draw a histogram of the following distribution :

Heights (in cm)	Number of students
150 – 153	7
153 – 156	8
156 – 159	14
159 – 162	10
162 – 165	6
165 – 168	5

Sol. Histogram which represents the given frequency distribution is shown below :

4. Draw a histogram to represent the following grouped frequency distribution:

Ages (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

Sol. The given table is in inclusive form. So, we first convert it into an exclusive form, as given below.

Ages (in years)	Number of teachers
19.5 – 24.5	10
24.5 – 29.5	28
29.5 – 34.5	32
34.5 – 39.5	48
39.5 – 44.5	50
44.5 – 49.5	35
49.5 – 54.5	12

A histogram for this table is shown in the figure given below:
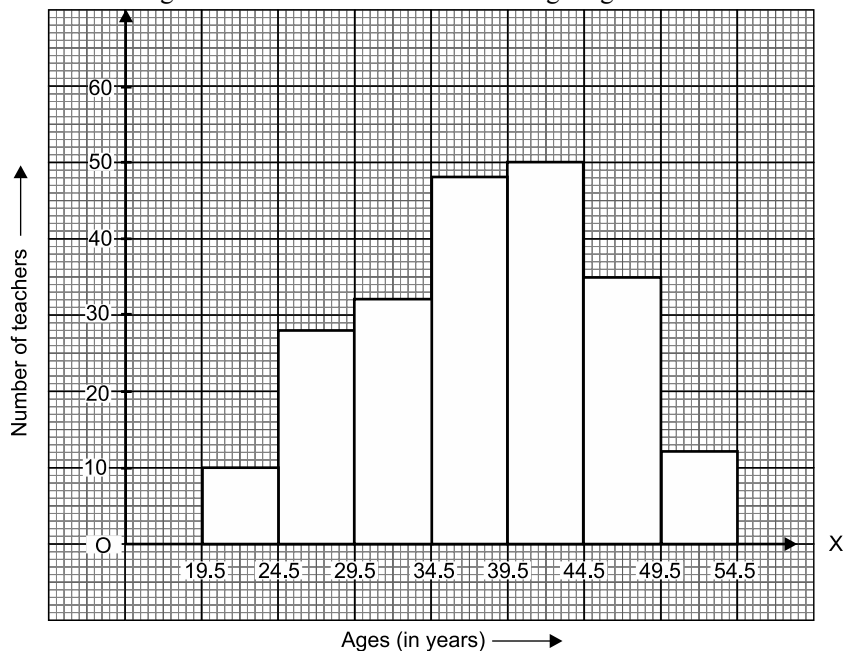
5. The lengths of 62 leaves of a plant are measured in millimetres and the data is represented in the following table :

Length (in mm)	Number of leaves
118 – 126	8
127 – 135	10
136 – 144	12
145 – 153	17
154 – 162	7
163 – 171	5
172 – 180	3

Draw a histogram to represent the data above.

Sol. The given table is in inclusive form. So, we will first convert it into an exclusive form as given below :

Length (in mm)	Number of leaves
117.5 – 126.5	8
126.5 – 135.5	10
135.5 – 144.5	12
144.5 – 153.5	17
153.5 – 162.5	7
162.5 – 171.5	5
171.5 – 180.5	3

A histogram for this table is shown in the figure given below:
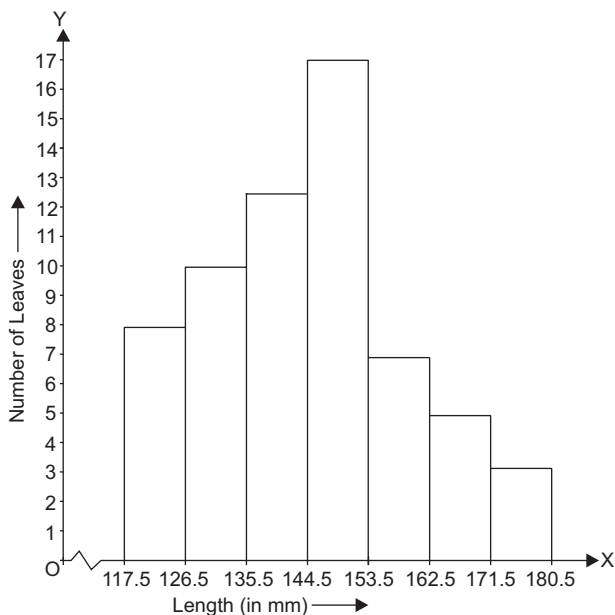
6. The marks obtained (out of 100) by a class of 80 students are given below:

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.

Sol. Here, the class intervals are of unequal width. So, we shall first input compute adjusted frequencies of each class. The minimum class size is 20 – 10 = 10. The adjusted frequencies are computed by using the following formula :

$$\text{Adjusted frequency} = \frac{\text{Minimum class} - \text{size}}{\text{Class} - \text{size}} \times \text{Frequency of the class}$$

The adjusted frequencies are computed in the following table :

Marks	Number of Students (Frequency)	Adjusted Frequency
10 – 20	6	$\frac{10}{10} \times 6 = 6$
20 – 30	7	$\frac{10}{10} \times 7 = 7$
30 – 50	15	$\frac{10}{20} \times 15 = 7.5$
50 – 70	16	$\frac{10}{20} \times 16 = 8$
70 – 100	26	$\frac{10}{30} \times 26 = 8.66$

Now, we construct rectangles with class-limits as bases and respective adjusted frequencies as heights.
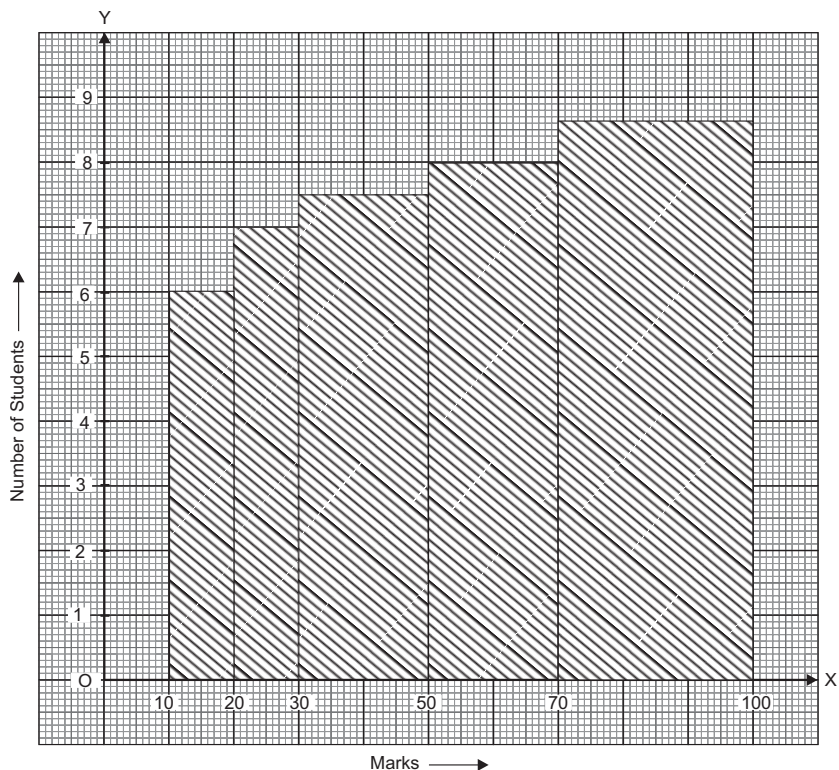
7. Following table shows a frequency distribution for the speed of cars passing through at a particular spot on a high way :

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.

Sol. In the figure given below, a histogram and a frequency polygon (in dotted lines) are drawn on the same scale.
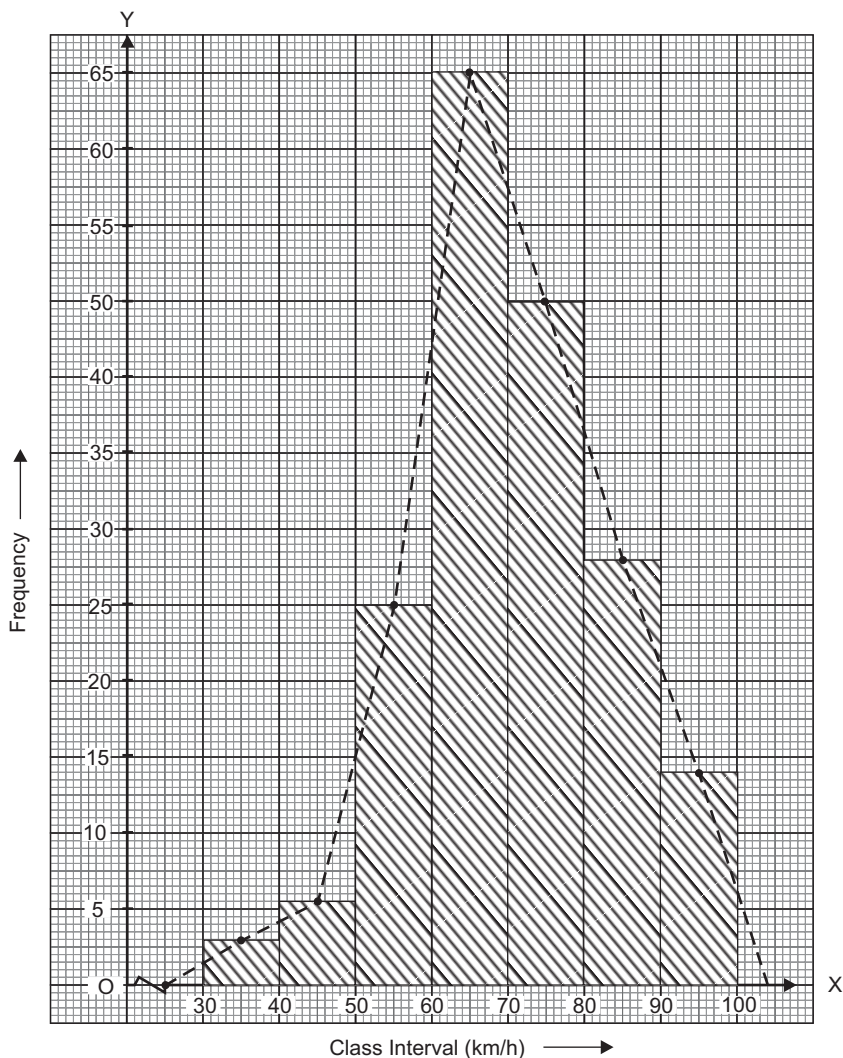
8. Refer to Q. 7:

Draw the frequency polygon representing the above data without drawing the histogram.

Sol. First, we obtain the class marks as given in the following table.

Class interval (km/h)	Class Marks	Frequency
30 – 40	35	3
40 – 50	45	6
50 – 60	55	25
60 – 70	65	65

70 – 80	75	50
80 – 90	85	28
90 – 100	95	14

Now, we plot the points (35, 3), (45,6), (55, 25), (65, 65), (75, 50), (85, 28) and (95, 14).

Now, we join the plotted points by line segments. The end points (35,3) and (95,14) are joined to the mid-points (25, 0) and (105, 0) respectively of imagined class-intervals to obtain the frequency polygon.
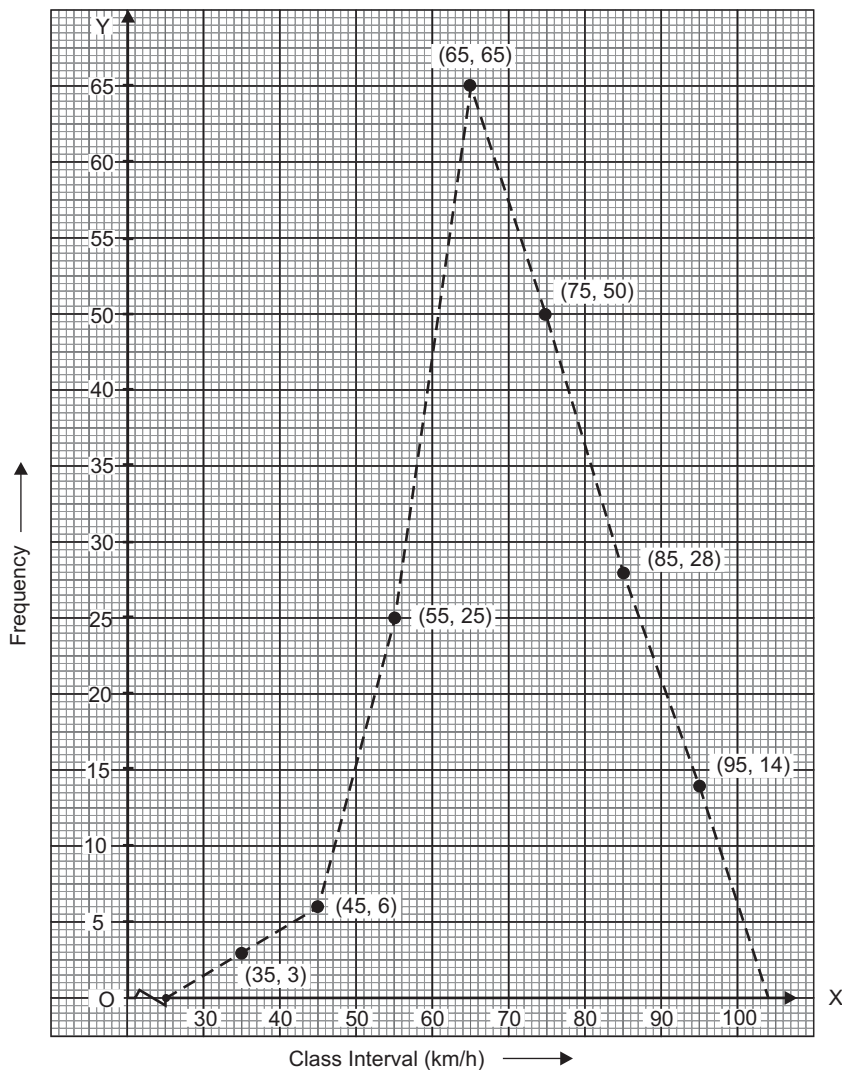
9. Following table gives the distribution of students of sections A and B of a class according to the marks obtained by them.

Section A		Section B	
Marks	*Frequency*	*Marks*	*Frequency*
0 – 15	5	0 – 15	3
15 – 30	12	15 – 30	16
30 – 45	28	30 – 45	25
45 – 60	30	45 – 60	27
60 – 75	35	60 – 75	40
75 – 90	13	75 – 90	10

Represent the marks of the students of both the sections on the same by two frequency polygons. What do you observe?

Sol. First, we obtain in the class marks as given in the following tables :

Section A		
Marks	*Class Marks*	*Frequency*
0 – 15	7.5	5
15 – 30	22.5	12
30 – 45	37.5	28
45 – 60	52.5	30
60 – 75	67.5	35
75 – 90	82.5	13

Section B		
Marks	*Class Marks*	*Frequency*
0 – 15	7.5	3
15 – 30	22.5	16
30 – 45	37.5	25
45 – 60	52.5	27
60 – 75	67.5	40
75 – 90	82.5	10

We represent class marks on X-axis on a suitable scale and the frequencies on Y-axis on a suitable scale.

To obtain the frequency polygon for section A, we plot the points (7.5, 5), (22.5, 12), (37.5, 28), (52.5, 30), (67.5, 35) and (82.5, 13) and join these by line segments.

To obtain the frequency polygon for section B, we plot the points (7.5, 3), (22.5, 16), (37.5, 25), (52.5, 27), (67.5, 40) and (82.5, 10) on the same scale and join these points by dotted line segments.

The two frequency polygon are shown in the figure given below:
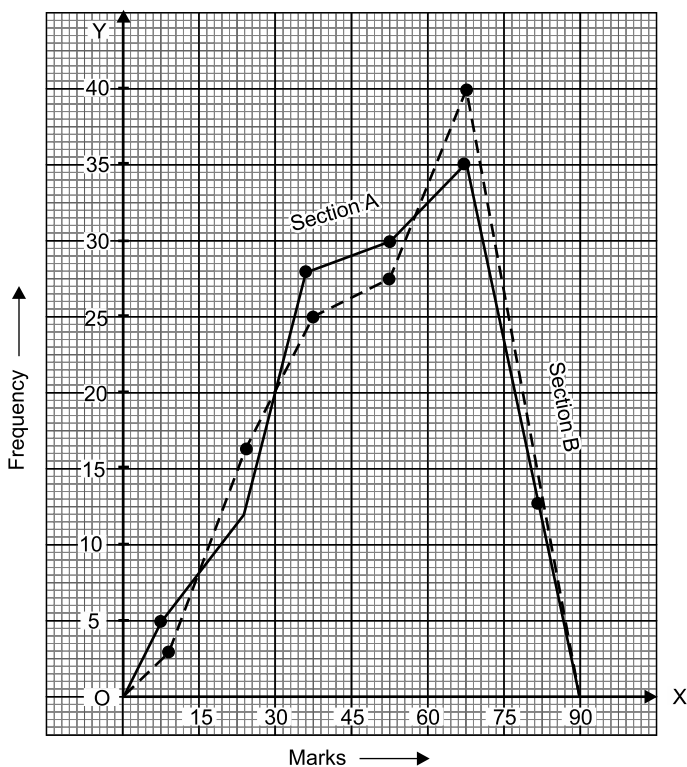
We observe that section B has more students who scored high marks in the exam than section A. This tells us that section B has performed better in exam than section. A.

10. The mean of the following distribution is 50.

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

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

Sol.

x_i	f_i	$f_i x_i$
10	17	170
30	$5a+3$	$150a+90$
50	32	1600
70	$7a-11$	$490a-770$
90	19	1710
Total	$\Sigma f_i = 60+12a$	$\Sigma f_i x_i = 2800+640a$

$$\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$= \frac{2800+640a}{60+12a}$$

$$\therefore \quad \frac{2800+640a}{60+12a} = 50$$

$$\Rightarrow \quad 2800+640\,a = 3000+600\,a$$

$$\Rightarrow \quad 40\,a = 200$$

$$\Rightarrow \quad a = \frac{200}{40} \quad \Rightarrow \quad a = 5$$

So, frequency of $30 = 5a+3 = 5\,(5)+3 = 25+3 = 28$

and frequency of $70 = 7a-11 = 7\,(5)-11 = 35-11 = 24$

11. 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.

Sol. Let the number of boys be n_1 and number of girls be n_2.

Using $$\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

where $\bar{x}_1 = 70$, $\bar{x}_2 = 73$ and $\bar{x}_3 = 71$.

$$71 = \frac{n_1 \times 70 + n_2 \times 73}{n_1 + n_2}$$

$\Rightarrow$ $71\, n_1 + 71\, n_2 = 70\, n_1 + 73\, n_2$

$\Rightarrow$ $n_1 = 2n_2$

$\Rightarrow$ $\dfrac{n_1}{n_2} = \dfrac{2}{1}$

Hence, the ratio of the number of boys to the number of girls is 2 : 1.

12. A total of 25 patients admitted to a hospital are tested for levels of blood sugar, (mg/dl) and the results obtained were as follows :

87	71	83	67	85
77	69	76	65	85
85	54	70	68	80
73	78	68	85	73
81	78	81	77	75

Find mean, median and mode (mg/dl) of the above data.

Sol. Mean : Sum of all observations $= 1891$

Number of observations, $n = 25$

$$\text{Mean}\,(\bar{x}) = \frac{x_1 + x_2 ...... + x_n}{n}$$

$$= \frac{1891}{25}$$

$$= 75.64$$

Median : Arranging the observations in ascending order, we get

54, 65, 67, 68, 68, 69, 70, 71, 73, 73, 75, 76, 77, 77, 78, 78, 80, 81, 81, 83, 85, 85, 85, 85, 87

Here, Number of observation $(n) = 25$ (odd)

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

$$= \left(\frac{25+1}{2}\right)^{th} \text{value}$$

$$= 13\text{th value} = 77$$

We see from the given data that the observation 85 occurs maximum number of times (4 times).

$$\therefore \qquad \text{Mode} = 85.$$

Hence, mean $= 75.64$, median $= 77$ and mode $= 85$.