CHAPTER 14

Statistics

EXERCISE 14A

1. (i) In singular form, statistics means the subject which deals with collection, presentation, analysis and interpretation of numerical data.

(ii) In plural form, statistics means data.

2. Characteristics of statistics

(i) Statistics are a large collection of observations.

(ii) Statistics are collected for a pre–determined purpose.

(iii) Quantitative facts alone constitute data. Qualitative characteristics like intelligence, richness, poverty, goodness, badness, etc. which cannot be measured numerically, do not form data.

(iv) Statistics in an experiment are comparable and can be classified into different groups.

Limitations of Statistics

(i) Statistics deals with groups only and not with isolated measurements.

(ii) Statistical methods are applicable on facts expressed in numerical form with their quantitative characteristics but not qualitative descriptions.

(iii) Statistical laws are true on averages only.

3. Statistical data are of two types:

(i) **Primary Data:** The data collected by the investigator herself or himself for a specific purpose is known as primary data.

(ii) **Secondary Data:** The data collected by someone, other than the investigator, is known as secondary data. This data should be used after evaluating the credibility of the source of data and the methods used to collect it.

Primary data is more reliable as this data is original in character.

4. The four examples of data that we can collect from our day-to-day life are:

(i) Number of children per family in a colony consisting of fixed number of families.

(ii) Heights of students in various sections of class IX of a school.

(iii) Number of books lent by the school library in each month of the year 2013–2014.

(iv) Election results obtained from newspaper or TV.

5. (i) **Raw Data:** The numerical data recorded in its original form is called *raw* (or *ungrouped*) data.

(ii) **Variables or Variates:** The quantity measured in an experiment is called a variable.

Examples: Number of workers in a factory, heights, ages and weights of people.

(iii) **Array:** The raw data when arranged in an ascending or descending order of magnitude is called an *array*.

(iv) **Frequency:** The number of times an observation occurs in the given data, is called the *frequency* of the observation.

(v) **Frequency Distribution Table:** A tabular arrangement of given numerical data displaying the frequency of each observation, is called an *ungrouped or discrete frequency distribution* and the table itself is called an *ungrouped or discrete frequency distribution table*.

(vi) **Cumulative Frequency:** In an ungrouped or discrete frequency distribution, the cumulative frequency of a particular value of the variable is the total of all the frequencies up to and including that value.

(vii) **Class Intervals:** Groups into which all the observations in the given data are condensed, are known as class intervals.

(viii) **Class Size (or width):** The difference between the true upper limit and the true lower limit of a class is known as its class size.

(ix) **Class Mark:** The class mark is the mid-point of the class interval.

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

(x) **Class Limits:** The end numbers of a class interval are called the class limits. The smaller number is the *lower class limit* and the larger number is the *upper class limit*. For example, in the class interval 0–5, 0 is the lower class limit and 5 is the upper class limit.

(xi) **True Class Limits:** In exclusive form of grouped frequency distribution, the upper and lower limits of a class are respectively called the true upper limit and true lower limit.

For example, consider the classes 0–10 and 10–20.

Then, 0 is the true lower limit and 10 is the true upper limit for class interval 0–10.

Also, 10 is the true lower limit and 20 is the true upper limit of the class interval 10–20.

6. Frequency distribution table for the given data is as follows:

Variate	*Tally marks*	*Frequency*
15	𝍸	4
16	𝍸 |	6
18	𝍸 |	6
20	𝍸 |	6
24	𝍸	5
25	𝍸	5
27	|||	3

28	|||	3
29	|	1
30	|	1

7. The frequency distribution table for the given data is as follows:

Marks	*Tally marks*	*Frequency*
0	||	2
1	|	1
2	||||	4
3	𝍸	5
4	||||	4
5	|||	3
6	|||	3
7	|||	3
8	||	2
9	|||	3
10		0

(i) If the minimum pass marks is 40% i.e., 4, then the number of students passed is

$$4 + 3 + 3 + 3 + 2 + 3 = 18.$$

(ii) If the marks obtained by the students are below 4, then the students are fail.

$\therefore$ the number of failed students is

$$2 + 1 + 4 + 5 = 12.$$

(iii) Since non of the student got 10 marks, therefore, the highest marks obtained by the students are 9.

$\therefore$ The number of students who secured the highest marks is 3.

(iv) The number of students who received more than 60% marks i.e., are 3 + 2 + 3 = 8.

8. Maximum marks obtained by 40 students = 24.

Minimum marks obtained by 40 students = 40.

$\therefore$ Range = 24 – 0 = 24, class size = 5.

Since $\frac{24}{5}$ = 4.8, we should have five classes, each of size 5.

The classes of equal size, covering the given data are:

0–5, 5–10, 10–15, 15–20, 20–25.

Thus, the frequency distribution table is as follows:

Marks	0–5	5–10	10–15	15–20	20–25	Total
Frequency	7	9	8	9	7	40

9. Maximum marks obtained by 40 students = 26.

Minimum marks obtained by 40 students = 1.

$\therefore$ Range = 26 – 1 = 25, class size = 4.

Since $\frac{25}{4}$ = 6.25, we should have 7 classes, each of size 4.

The classes of equal size, covering the given data are:

0–4, 4–8, 8–12, 12–16, 16–20, 20–24, 24–28.

Thus, the frequency distribution table is as follows:

Marks	*Tally marks*	*Frequency*
0–4	𝍸	5
4–8	𝍸 ||	7
8–12	𝍸	5
12–16	𝍸 ||||	9
16–20	𝍸 |	6
20–24	𝍸	5
24–28	|||	3

10. Maximum weekly wages of 30 workers = 168

Minimum weekly wages of 30 workers = 62.

$\therefore$ Range = 168 – 62 = 106, Class size = 10

we should have 11 classes, each of size 10.

Since, $\frac{106}{10}$ = 10.6, we should have 11 classes, each of size 10.

The classes equal size, covering the given data are:

60–70, 70–80, 80–90, 90–100, 100–110, 110–120, 120–130, 130–140, 140–150, 150–160, 160–170.

Thus, the frequency distribution table is as follows:

Weekly wages	*Tally marks*	*Frequency*
60–70	|	1
70–80	||||	4
80–90	|||	3
90–100	|||	3
100–110	|||	3
110–120		0
120–130	|||	3
130–140	||	2
140–150	|	1
150–160	𝍸 |	6
160–170	||||	4

11. Maximum number of marks out of 60 = 58.

Minimum number of marks out of 60 =11.

$\therefore$ Range = 58 – 11 = 47, class size = 10.

Since $\frac{47}{10}$ = 4.7, we should have 5 classes, each of size 10.

(i) As the frequency distribution has to be presented in inclusive form, so the classes covering the given data are 11–20, 21–30, 31–40, 41–50, 51–60.

Thus, we obtain the following frequency distribution

Inclusive form

Marks	11–20	21–30	31–40	41–50	51–60
Tally marks	𝍸 ||	𝍸 𝍸	𝍸 |	||||	|||
Frequency	7	10	6	4	3

(ii) As the frequency distribution has to be presented in exclusive form, so the classes covering the given data are 11–21, 21–31, 31–41, 41–51, 51–61.

Thus, we obtain the following frequency distribution:

Exclusive form

Marks	11–21	21–31	31–41	41–51	51–61
Tally marks	𝍸 ||	𝍸 𝍸	𝍸 |	||||	|||
Frequency	7	10	6	4	3

12. Since the class marks are uniformly spaced, therefore the class size is the difference between the consecutive class marks.

∴ Class size = 52 – 47 = 5.

Let 'x' represent the class mark of class interval and 'h' be its class size.

Then, lower and upper limits of class intervals are $\left(x-\frac{h}{2}\right)$ and $\left(x+\frac{h}{2}\right)$ respectively.

∴ Lower limit of the first class interval

$$= \left(47-\frac{5}{2}\right) = 44.5.$$

And upper limit of the first class interval

$$= \left(47+\frac{5}{2}\right) = 49.5.$$

So, the first class interval is 44.5 – 49.5.

Similarly, we obtain the other class intervals, which are given below:

Class limits: 44.5–49.5, 49.5–54.5, 54.5–59.5, 59.5–64.5, 64.5–69.5, 69.5–74.5, 74.5–79.5.

13. (i) Maximum weight = 72.4.

Minimum weight = 44.6.

Since the last class is 72–76,

∴ the class size is 4.

Also, previous class before 72–76 is 68–72 and the previous class before 68–72 is 64–68.

Proceeding in this way, we get the following frequency distribution table:

Weight	*Tally marks*	*Frequency*
44–48	||||	4
48–52	𝍸	5
52–56	||	2
56–60	||||	4
60–64	||||	4
64–68	𝍸 |	6
68–72	||||	4
72–76	|	1

(ii) The upper class limit of the first three class intervals are 48, 52, 56.

(iii) The maximum weight that can be included in the fourth class interval is 59.9 kg.

(iv) Since class mark = $\frac{\text{upper limit + lower limit}}{2}$,

Class mark of the class 44–48 = $\frac{44+48}{2}$

$$= \frac{92}{2} = 46.$$

Similarly, class marks of the classes 48–52, 52–56, 56–60, 60–64, 64–68, 68–72, 72–76 are 50, 54, 62, 66, 70, 74 respectively.

14. Range = 214 – 78 = 136 g

Class size = 20 g.

Let l be the lower limit of the first class interval.

Then, upper limit of the first class interval = l + 20.

Now, $\frac{\text{lower limit + upper limit}}{2}$ = mid–value

$\Rightarrow \frac{l+l+20}{2} = 80$

$\Rightarrow 2l = 160 - 20$

$\Rightarrow 2l = 140$

$\Rightarrow l = 70$

∴ First class interval is 70–90.

So, the classes of equal size, covering the data are

70–90, 90–110, 110–130, 130–150, 150–170, 170–190, 190–210, 210–230.

Thus, we obtain the following frequency distribution table:

Weight (in g)	*Weight (in g)*	*Frequency*
70–90	𝍸	5
90–110	𝍸 𝍸 |||	13
110–130	𝍸 𝍸 𝍸 ||	17

130–150	𝍸 𝍸	10
150–170	|	1
170–190		0
190–210	|||	3
210–230	|	1

15. Range = 84 – 71 = ₹ 13

Class size = ₹ 2

Since $\frac{13}{2}$ = 6.5, we have 7 classes of equal size 2.

Let l be the lower limit of the first class interval.

Then, upper limit of the first class = $l + 2$

Now, $\frac{\text{lower limit + upper limit}}{2}$ = mid–value

$\Rightarrow \frac{l + l + 2}{2} = 72$

$\Rightarrow 2l = 144 - 2$

$\Rightarrow 2l = 142$

$\Rightarrow l = 71.$

$\therefore$ The first class interval is 71–73.

So, the classes of equal size, covering the data are

71–73, 73–75, 75–77, 77–79, 79–81, 81–83, 83–85.

Thus, the following frequency distribution table is obtained:

Weekly wages (₹)	*Number of labourers*
71–73	4
73–75	4
75–77	5
77–79	6
79–81	4
81–83	4
83–85	3

(i) The least weekly wage is ₹ 71.

(ii) Since the class mark of the class interval 77–79 is ₹ 78, therefore, 6 labourers earn an average of ₹ 78 per day.

(iii) 8 labourers have their daily wages less than ₹ 75.

(iv) 11 labourers have their daily wages not less than ₹ 79.

16. The frequency table is given below:

Class	0–10	10–20	20–30	30–40	40–50
Frequency	8	15	23	20	18

17. 'Less than' cumulative frequency table:

Marks obtained	*Number of students*
Less than 20	2
Less than 40	9
Less than 60	20
Less than 80	38
Less than 100	50

'More than' cumulative frequency table:

Marks obtained	*Number of students*
More than 0	50
More than 19	48
More than 39	41
More than 59	30
More than 79	12

18. Frequency table is given below:

Marks	0–10	10–20	20–30	30–40	40–50
Number of students	5	7	8	6	4

19. Frequency table is given below:

Marks obtained	*Number of students*
0–10	9
10–20	3
20–30	13
30–40	35
40–50	24
50–60	16

20. From the given frequency distribution table, we get

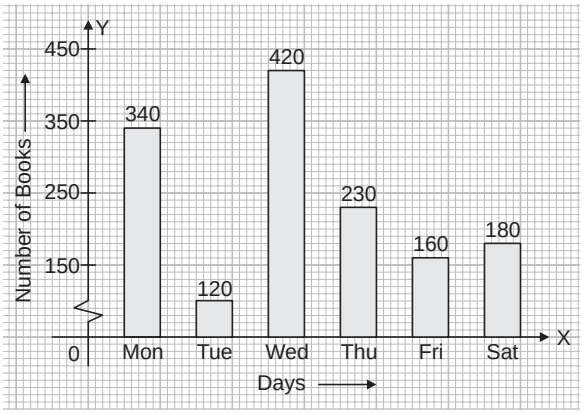
$a = 12$, $b = 25 - 12 = 13$,

$c = 25 + 10 = 35$, $d = 43 - 35 = 8$,

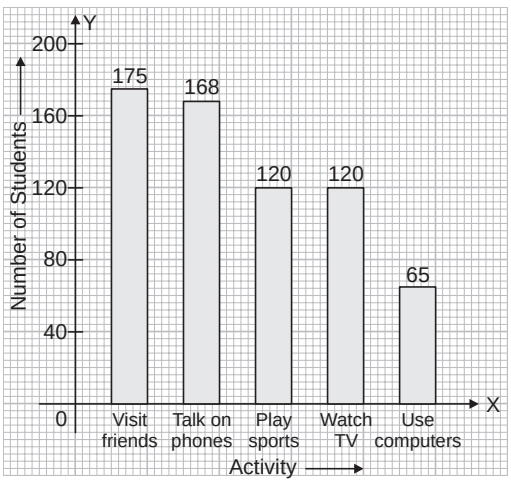
$e = 48 - 43 = 5$, $f = 48 + 2 = 50$.

EXERCISE 14B

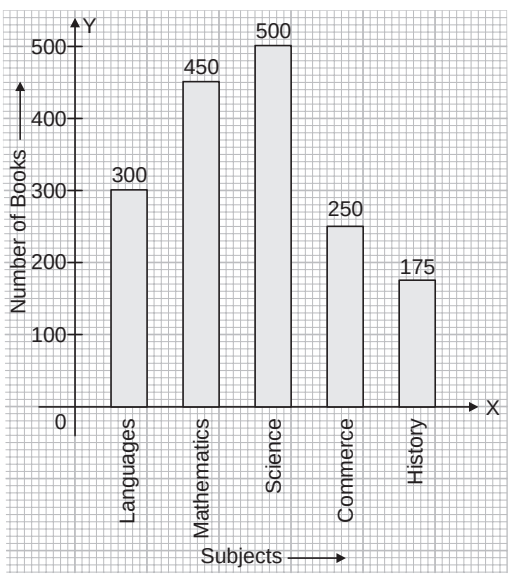
1. The bar graph of the given data is as follows:



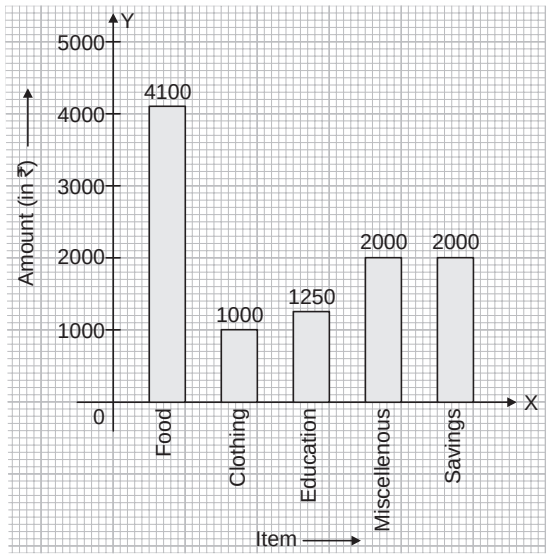
2. The bar graph of the given data is as follows:



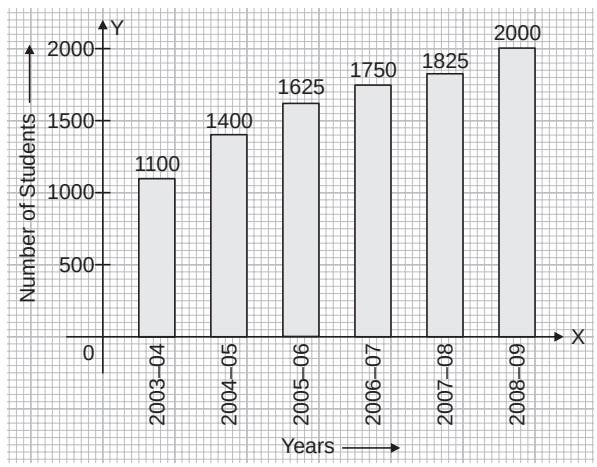
3. The bar graph of the given data is as follows:



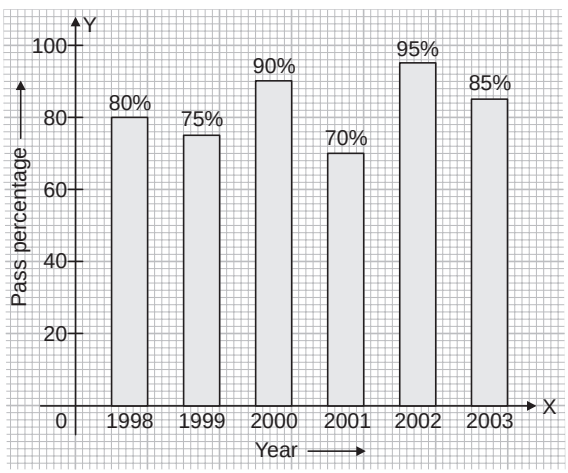
4. The bar graph of the given data is as follows:



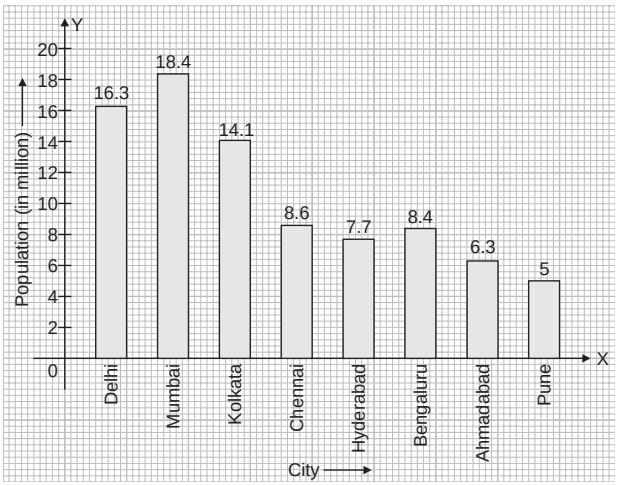
5. The bar graph of the given data is as follows:



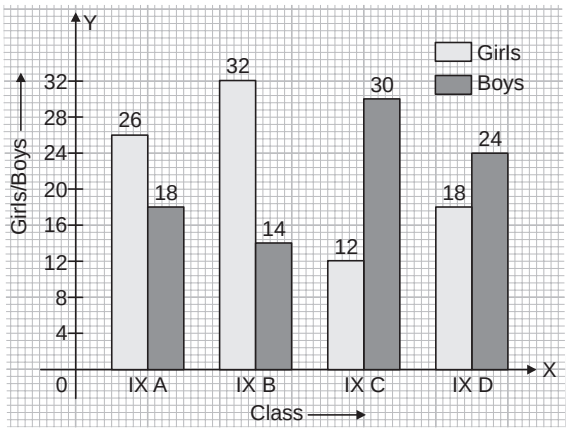
6. The bar graph of the given data is as follows:



7. The bar graph of the given data is as follows:



8. The bar graph of the given data is as follows:



9. (i) Salary.

(ii) Travelling allowance (TA).

(iii) Total expenditure of the company is

3,00,000 + 1,00,000 + 1,15,000 + 2,50,000 + 1,75,000 + 1,90,000 = ₹ 11,30,000

(iv) ₹ 175000

10. (i) ₹ 3,000

(ii) The maximum expenditure is ₹ 3,500 which is on food.

(iii) Expenditure on clothing and education together = 1,000 + 2,000 = ₹ 3,000

(iv) The minimum expenditure is ₹ 1,000 which is on clothing.

11. (i) Economics.

(ii) Enrollment in economics is 350 and enrollment in Chemistry is 175.

∴ The enrollment in economics is two times more than the enrollment is Chemistry.

(iii) 350.

(iv) Number of students in economics is 350 whereas in Physics is 150.

∴ 200 students are more in economics than in Physics.

12. (i) 50 is the least score which is in Hindi.

(ii) The highest score is 90 which is in Mathematics.

(iii) Highest score = 90 and lowest score = 50.

∴ Required ratio = 90 : 50 = 9 : 5

(iv) The average of his/her marks

$$= \frac{60+90+50+84+74}{5} = \frac{364}{5} = 72.8$$

13. (i) It gives the information about rice and wheat production in five states of India.

(ii) W.B.

(iii) U.P.

(iv) U.P.

(v) Maharashtra.

14. (i) Decreasing

(ii) Increasing

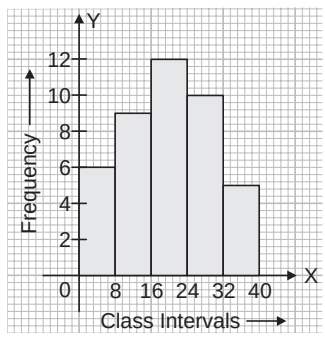
(iii) 2013

(iv) 2009

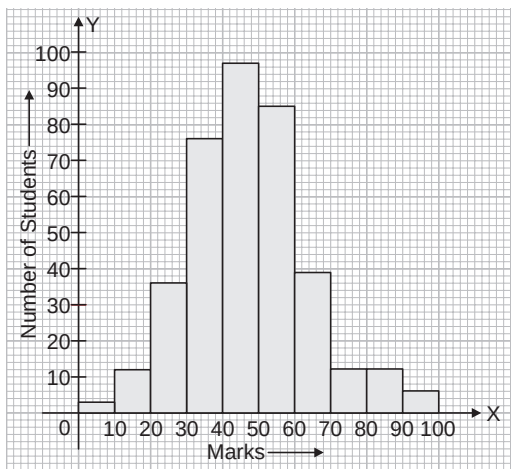
(v) 2009 and 2011.

EXERCISE 14C

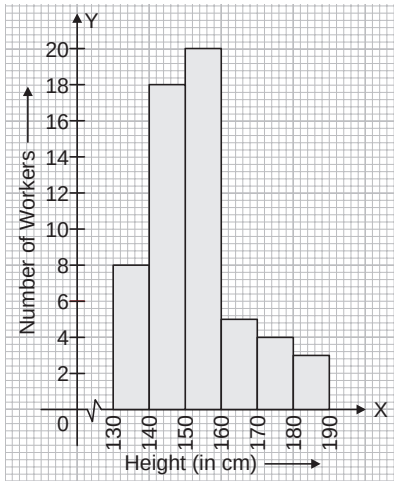
1. The histogram of the given frequency distribution is as follows:



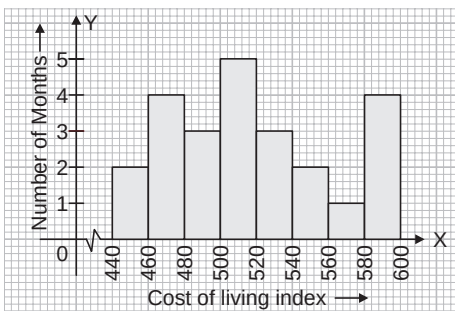
2. The histogram of the given data is as follows:



3. The histogram of the given data is as follows:



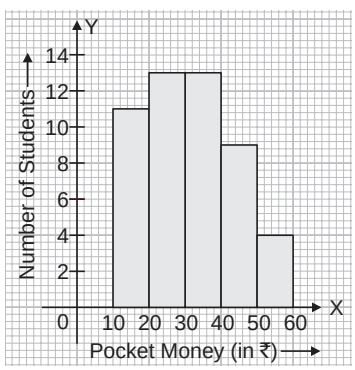
4. The histogram of the given data is as follows:



5. Frequency distribution table of the given data is as follows:

Pocket money (in ₹)	10–20	20–30	30–40	40–50	50–60
Number of students	11	13	13	9	4

Histogram of the given data is as follows:



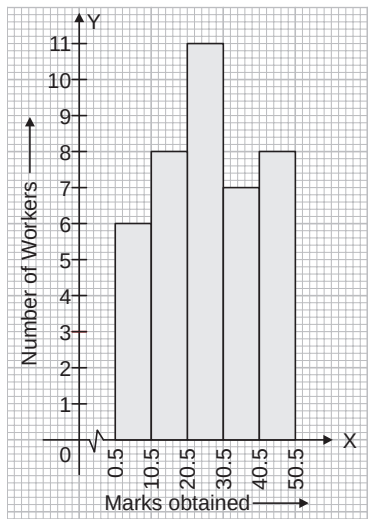
6. The frequency distribution table is as follows:

Marks obtained	1–10	11–20	21–30	31–40	41–50
Number of students	6	8	11	7	8

Frequency distribution table: (exclusive form)

Marks obtained	0.5–10.5	10.5–20.5	20.5–30.5	30.5–40.5	40.5–50.5
Number of students	6	8	11	7	8

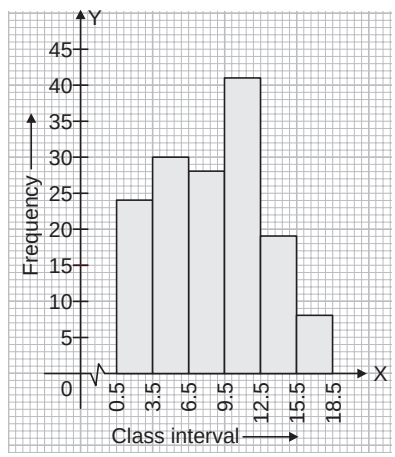
Histogram of the given data is as follows:



7. The frequency distribution table in exclusive form is given by:

Class interval	*Frequency*
0.5–3.5	24
3.5–6.5	30
6.5–9.5	28
9.5–12.5	41
12.5–15.5	19
15.5–18.5	8

The histogram of the given data is as follows:



(i) The total frequency in the table is 24 + 30 + 28 + 41 + 19 + 8 = 150.

(ii) The greatest frequency is 41 which lies in the class interval 10–12.

(iii) Since total frequency = 150 and number of scores reported for the interval 4–6 is 30.

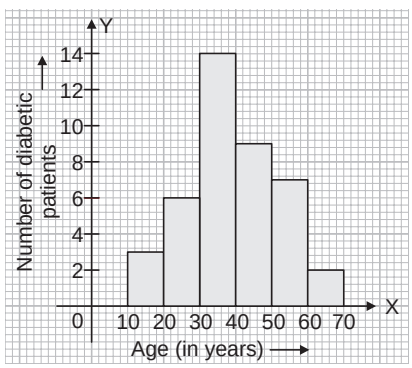
$\therefore$ Required percentage = $\frac{30}{150} \times 100 = 20\%$.

(iv) Scores were reported from 10 through 18 are 41 + 19 + 8 = 68.

8. (a) The frequency distribution table of the given data is given by:

Age (in years)	*Number of diabetic patients*
10–20	3
20–30	6
30–40	14
40–50	9
50–60	5
60–70	2

(b) The histogram of the given data is as follows:



(c) (i) The minimum number of diabetic patients is 2 which lies in the interval 60–70.

(ii) The maximum number of diabetic patients is 14 which lies in the interval 30–40.

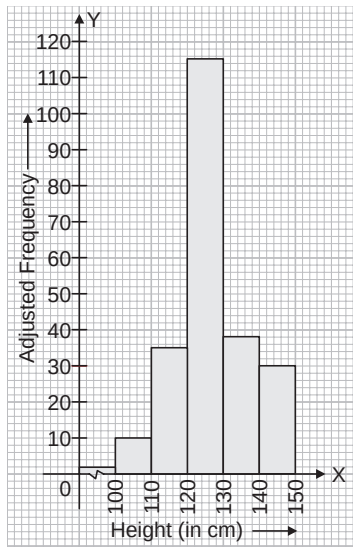
(iii) The total number of diabetic patients in the age group 10–70 is 3 + 6 + 14 + 9 + 5 + 2 = 39.

(iv) There are a diabetic patients in the age group 40–50 whereas there are 2 diabetic patients in the age group 60–70. Thus, diabetic patients are more in the age group 40–50 than in the age group 60–70.

9. The following distribution table with adjusted frequency is as follows:

Height (in cm)	*Number of students (frequency)*	*Adjusted frequency*
0–100	20	$\frac{10}{100} \times 20 = 2$
100–110	10	10
110–120	35	35
120–130	115	115
130–140	38	38
140–150	30	30

The histogram of the given data with above frequency distribution table is given by:



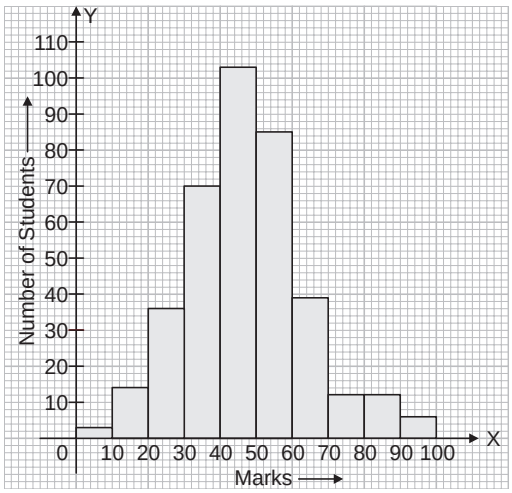
(i) Students having at least 130 cm height = 38 + 30 = 68.

(ii) Students having at least 1 m height but less than 120 cm height = 10 + 35 = 45.

10. The frequency distribution table in exclusive form is as follows:

Marks	*Number of students*
0–10	3
10–20	12
20–30	36
30–40	70
40–50	103
50–60	85
60–70	39
70–80	12
80–90	12
90–100	6

The histogram of the above frequency distribution table is given by



(i) Number of students who secured less than 60.

Marks = 3 + 12 + 36 + 70 + 103 + 85 = 309.

(ii) Number of students who secured 50 or more than 50.

Marks = 85 + 39 + 12 + 12 + 6 = 154.

11. (i) Frequency distribution table:

Weights	*Number of persons*
50–55	12
55–60	8
60–65	5
65–70	4
70–75	5
75–80	7
80–85	6
85–90	3

(ii) Number of persons weigh 70 kg or more = 5 + 7 + 6 + 3 = 21.

(iii) Number of persons weigh less than 60 kg = 12 + 8 = 20.

(iv) Number of persons in the range of 50–55 kg = 12.

(iv) If one more person weighing 82 kg joins this graph, then the number of persons in the range of 80–85 will become 7.

Then, number of persons weigh 75 kg or more shall be 7 + 7 + 3 = 17.

12. The histogram and the frequency polygon of the given data given at the end of the solution.

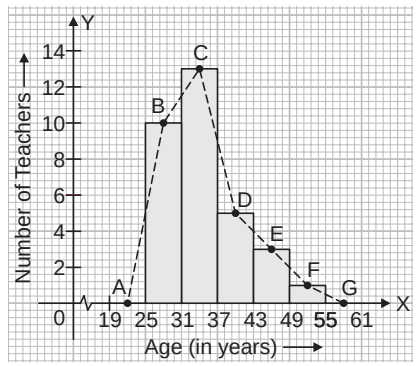
In it, ABCDEFG is the required frequency polygon.

(i) Maximum number of teachers is 13 which lies in the age group 31–37.

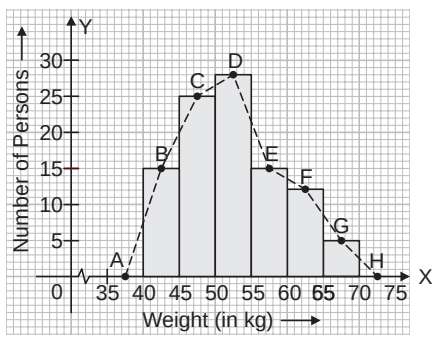
(ii) Least number of teachers is 1 which lies in the age group 49–55.

(iii) The average number of teachers who belong to the oldest group is $= \frac{49+55}{2} = \frac{104}{2} = 52$ years.

(iv) The average number of teachers who belong to the youngest age group is $= \frac{25+31}{2} = \frac{56}{2} = 28$ years.



13. The histogram and frequency polygon of the given data is as follows:

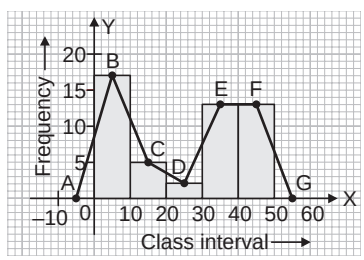


Here, ABCDEFGH is the required frequency polygon.

14. The frequency distribution table in exclusive form is given by:

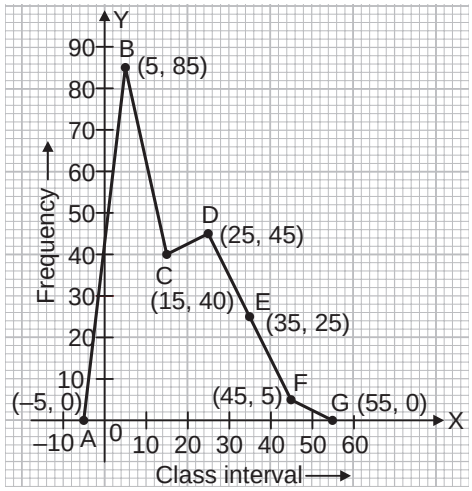
Class interval	0–10	10–20	20–30	30–40	40–50
Frequency	17	5	2	13	13

The histogram and frequency polygon of the given data is as follows:



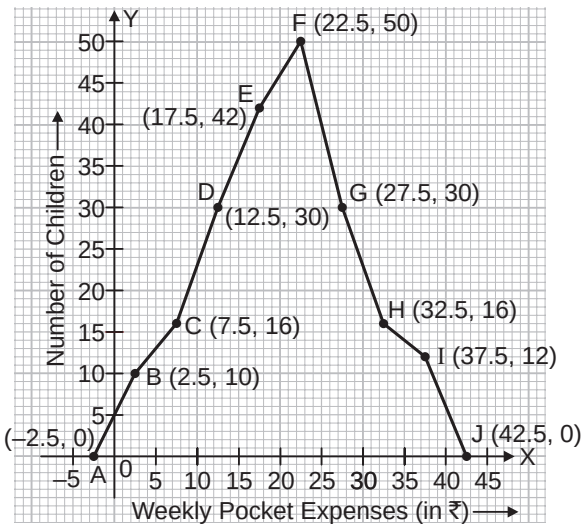
Here, ABCDEFG is the required frequency polygon.

15. The frequency polygon of the given data is as follows:



Here, ABCDEFG is the required frequency polygon.

16. The frequency polygon of the given data is as follows:

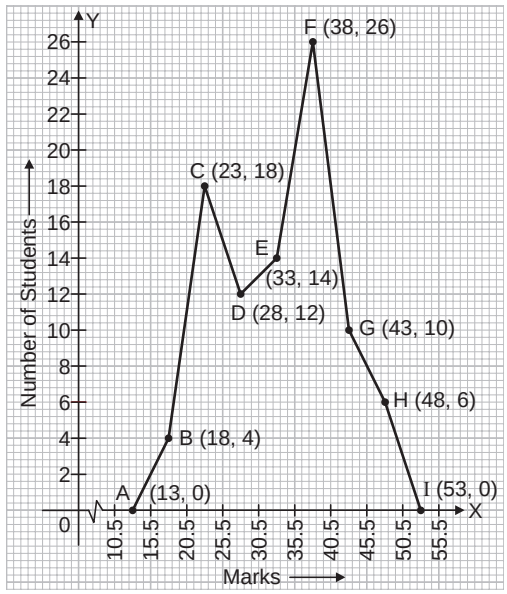


Here, ABCDEFGHI is the required frequency polygon.

17. The frequency distribution table in exclusive form is given by:

Marks	15.5–20.5	20.5–25.5	25.5–30.5	30.5–35.5	35.5–40.5	40.5–45.5	45.5–50.5
Number of students	4	18	12	14	26	10	6

The frequency polygon for the above frequency distribution table is as follows:

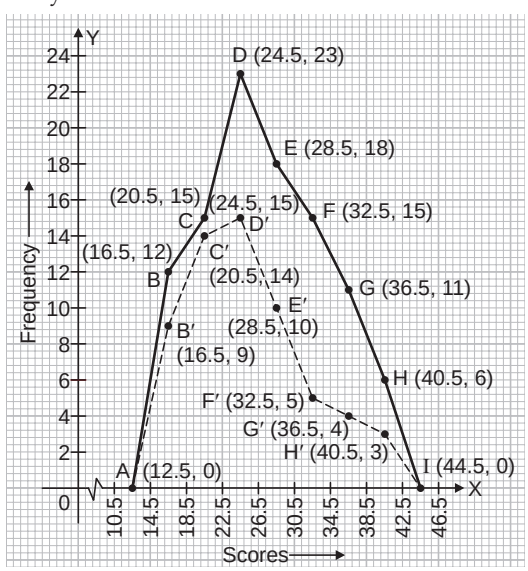


Here, ABCDEFGHI is the required frequency polygon.

18. The frequency distribution table in exclusive form is given as follow as:

Scores	*Group A*	*Group B*
14.5–18.5	12	9
18.5–22.5	15	14
22.5–26.5	23	15
26.5–30.5	18	10
30.5–34.5	15	5
34.5–38.5	11	4
38.5–42.5	6	3
Total	100	60

The frequency polygon for the group A and group B is given by:



Thus, ABCDEFGHI is the frequency polygon for group A and AB′C′D′E′F′G′H′I is the frequency polygon for group B.

19. (i) The maximum frequency is 180 which lies in the class interval 2000–2500.

(ii) From the given graph, we see that for 70 days an average of 2750 patients were treated as outpatients in the hospital of during the year 2012–2013.

(iii) From the given graph, we see that 3750 patients were treated as outpatients in the hospitals for 30 days during the year 2012–2013.

20. (i) The maximum number of teachers in Group A is 14 which lies in the age Group 50–55.

(ii) The minimum number of teachers in Group B is 1 which lies in the age Group 25–30.

(iii) In the age group 45–50, Group A has 4 teachers where has Group B has 11 teachers.

$\therefore$ Group B has 7 more teachers in age group 45–50 as compared to Group A.

(iv) The frequency distribution table for Group A and Group B is given below:

Age (in years)	*Group A*	*Group A*
25–30	13	1
30–35	10	6
35–40	8	8
45–45	12	7
45–50	4	11
50–55	14	9
55–60	5	4
60–65	1	2
Total	67	48

Group A has 67 teachers and Group B has 48 teachers.

$\therefore$ Difference = 67 – 48 = 19.

Thus, Group A has 19 more teachers than Group B.

EXERCISE 14D

1. (i) $\text{Mean} = \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$$\text{Mean} = \frac{1+4+4+3+6+12+10+8}{8} = \frac{48}{8} = \mathbf{6}$$

(ii) Mean

$$= \frac{4.4+3.8+3.9+4.4+3.7+4.6+4.0+3.7+3.3+4.2}{10}$$

$$= \frac{40}{10} = \mathbf{4}$$

(iii) $\text{Mean} = \dfrac{92+102+99+103+104}{5} = \dfrac{500}{5} = \mathbf{100}$

(iv) $\text{Mean} = \dfrac{3+(-1)+7+0+11}{5} = \dfrac{20}{5} = \mathbf{4}$

(v) $\text{Mean} = \dfrac{6.9+1.3+5.7+9.8+6.4}{5} = \dfrac{30.1}{5} = \mathbf{6.02\ cm}$

(vi) $\text{Mean} = \dfrac{70+43+19+7+31}{5} = \dfrac{170}{5} = \mathbf{₹\ 34}$

(vii) $\text{Mean} = \dfrac{38.5+40+37+36.5+38+37.5+38.5}{7}$

$$= \frac{266}{7} = \mathbf{38°C}$$

(viii) We first convert the given set of numbers into minutes.

So, we have the following set of numbers:

90 minutes, 30 minutes, 105 minutes.

$$\therefore \quad \text{Mean} = \frac{90+30+105}{3} = \frac{225}{3}$$

$$= 75 = \mathbf{1\ hour\ 15\ minutes.}$$

2. $\text{Mean} = \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

(i) First seven natural numbers are: 1, 2, 3, 4, 5, 6, 7

$$\therefore \quad \text{Mean} = \frac{1+2+3+4+5+6+7}{7} = \frac{28}{7} = \mathbf{4}$$

(ii) First seven whole numbers are: 0, 1, 2, 3, 4, 5, 6

$$\therefore \quad \text{Mean} = \frac{0+1+2+3+4+5+6}{7} = \frac{21}{7} = \mathbf{3}$$

(iii) First seven odd natural numbers are: 1, 3, 5, 7, 9, 11, 13

$$\therefore \quad \text{Mean} = \frac{1+3+5+7+9+11+13}{7} = \frac{49}{7} = \mathbf{7}$$

(iv) First eight even natural numbers are: 2, 4, 6, 8, 10, 12, 14, 16

$$\therefore \quad \text{Mean} = \frac{2+4+6+8+10+12+14+16}{8}$$

$$= \frac{72}{8} = \mathbf{9}$$

(v) First four prime numbers are: 2, 3, 5, 7

$$\therefore \quad \text{Mean} = \frac{2+3+5+7}{4} = \frac{17}{4} = \mathbf{4.25}$$

(vi) Prime numbers between 5 and 25 are: 7, 11, 13, 17, 19, 23

$$\therefore \quad \text{Mean} = \frac{7+11+13+17+19+23}{6} = \frac{90}{6} = \mathbf{15}$$

(vii) First six multiples of 3 are 3, 6, 9, 12, 15, 18

$$\therefore \quad \text{Mean} = \frac{3+6+9+12+15+18}{6} = \frac{63}{6} = \mathbf{10.5}$$

(viii) All the factors of 30 are: 1, 2, 3, 5, 6, 10, 15, 30

$$\therefore \quad \text{Mean} = \frac{1+2+3+5+6+10+15+30}{8}$$

$$= \frac{72}{8} = \mathbf{9}$$

3. Average income of the family

$$= \frac{\text{Sum of all the monthly income}}{\text{Number of persons in family}}$$

$$= \frac{8000 + 10000 + 10000 + 11000}{10}$$

$$= \frac{39000}{10} = ₹\ 3900.$$

Hence, the average income is **₹ 3900.**

4. Mean enrolment

$$= \frac{\text{Sum of all the enrolments}}{\text{Number of years}}$$

$$= \frac{1640 + 2040 + 2590 + 3200 + 3500 + 3710}{6}$$

$$= \frac{16680}{6} = 2780$$

Hence, the mean enrolment is **2780.**

5. Mean score $= \frac{\text{Sum of all the scores}}{\text{Number of students}}$

$$= \frac{38 + 31 + 41 + 36 + 29 + 27 + 32 + 38 + 39 + 45}{10}$$

$$= \frac{356}{10} = 35.6$$

Hence, mean score is **35.6.**

6. Mean score $= \frac{\text{Sum of all the scores}}{\text{Number of tests}}$

$$= \frac{60 + 71 + 82 + 83 + 93 + 97}{6}$$

$$= \frac{486}{6} = 81$$

Hence, mean score is **81.**

7. Mean number of hours $= \frac{\text{Sum of all the hours}}{\text{Number of days}}$

$$= \frac{3\frac{1}{2} + 1\frac{1}{4} + 2\frac{3}{4} + 3 + 2\frac{1}{2}}{5}$$

$$= \frac{\frac{7}{2} + \frac{5}{4} + \frac{11}{4} + 3 + \frac{5}{2}}{5}$$

$$= \frac{\frac{14 + 5 + 11 + 12 + 10}{4}}{5}$$

$$= \frac{\frac{52}{4}}{5} = \frac{13}{5} = 2\frac{3}{5} \text{ hours}$$

Hence, mean number of hours are $\mathbf{2\frac{3}{5}}$ **hours or 2 hours 36 minutes.**

8. Mean practice time $= \frac{\text{Sum of all the minutes}}{\text{Number of practice}}$

$$= \frac{30 + 50 + 20 + 55 + 45}{5}$$

$$= \frac{280}{5} = 40 \text{ minutes}$$

Hence, mean practice time is **40 minutes.**

9. Mean score $= \frac{\text{Sum of all the percentage score}}{\text{Number of test}}$

Now,

$$\text{Mean score for A} = \frac{86 + 53 + 76 + 62 + 85 + 83 + 52}{7}$$

$$= \frac{497}{7} = 71$$

$$\text{Mean score for B} = \frac{72 + 73 + 50 + 52 + 68 + 77}{6}$$

$$= \frac{392}{6} = 65.3$$

Thus, **A** has the higher mean score.

10. Mean maximum temperature

$$= \frac{\text{Sum of all the recorded temperatures}}{\text{Number of days}}$$

$$= \frac{27.3 + 21.4 + 28.5 + 24.4 + 29.7 + 28.2 + 33}{7}$$

$$= \frac{192.5}{7} = 27.5\ ^\circ\text{C}$$

Hence, mean maximum temperature is **27.5 °C.**

11. Mean age $= \frac{\text{Sum of all the ages}}{\text{Number of teachers}}$

$$= \frac{35 + 27 + 32 + 23 + 39 + 39 + 40 + 55 + 28 + 32}{10}$$

$$= \frac{350}{10} = 35 \text{ years}$$

Hence, mean age is **35 years.**

12. Mean weight $= \frac{\text{Sum of all the weights}}{\text{Number of students}}$

(i) Mean weight

$$= \frac{43 + 49.5 + 45 + 48.3 + 45.5 + 50.2 + 51.2 + 49.3}{8}$$

$$= \frac{382}{8} = 47.75 \text{ kg}$$

Hence, means weight is **47.75 kg.**

(ii) If the student with weight 59 kg is also included, then Mean weight

$$= \frac{43 + 49.5 + 45 + 48.3 + 45.5 + 50.2 + 51.2 + 49.3 + 59}{9}$$

$$= \frac{441}{9} = 49 \text{ kg}$$

Hence, mean weight is **49 kg.**

13. The mean of 15 numbers is 25.

Let the given numbers be $x_1, x_2, \ldots, x_{15}$.

Then,mean of these numbers $= \frac{x_1 + x_2 + \ldots + x_{15}}{15} = 25$

$$\Rightarrow \quad x_1 + x_2 + \ldots + x_{15} = 375 \qquad \ldots(1)$$

New numbers are $x_1 - 4$, $x_2 - 4$, …, $x_{15} - 4$.

Mean of new numbers $= \dfrac{x_1 - 4 + x_2 - 4 + ... + x_{15} - 4}{15}$

$= \dfrac{x_1 + x_2 + ... + x_{15} - 15 \times 4}{15}$

$= \dfrac{375 - 60}{15}$ [Using (1)]

$= \dfrac{315}{15} = 21$

Hence, new mean is **21.**

14. Let the given numbers be $x_1, x_2, \ldots, x_8$.

Then, mean of these numbers $= \dfrac{x_1 + x_2 + ... + x_8}{8} = 25$

$\Rightarrow \quad x_1 + x_2 + \ldots + x_8 = 200$ …(1)

New numbers are $3x_1, 3x_2, \ldots, 3x_8$.

Mean of new numbers $= \dfrac{3x_1 + 3x_2 + ... + 3x_8}{8}$

$= \dfrac{3(x_1 + x_2 + ... + x_8)}{8}$ [Using (1)]

$= \dfrac{3 \times 200}{8} = 75$

Hence, new mean is **75.**

15. **(i)** $\text{Mean} = \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$\Rightarrow \quad 8 = \dfrac{12 + 10 + 7 + a + 8 + 4}{6}$

$\Rightarrow \quad 48 = 41 + a$

$\Rightarrow \quad a = 7$

(ii) $\text{Mean} = \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$\Rightarrow \quad 15 = \dfrac{16 + 9 + 13 + m + 12 + 19}{6}$

$\Rightarrow \quad 90 = 69 + m$

$\Rightarrow \quad \boldsymbol{m = 21}$

(iii) $\text{Mean} = \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$\Rightarrow \quad 24 = \dfrac{x + x + 2 + x + 4 + x + 6 + x + 8}{5}$

$\Rightarrow \quad 120 = 5x + 20$

$\Rightarrow \quad 5x = 100$

$\Rightarrow \quad \boldsymbol{x = 20}$

(iv) Let the sixth observation be x.

Then, mean $= \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$\Rightarrow \quad 17.5 = \dfrac{9 + 10 + 23 + 25 + 14 + x}{6}$

$\Rightarrow \quad 105 = 81 + x$

$\Rightarrow \quad \boldsymbol{x = 24}$

(v) $\text{Mean} = \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$\Rightarrow \quad 18 = \dfrac{x + x + 3 + x + 6 + x + 9 + x + 12 + x + 15}{6}$

$\Rightarrow \quad 108 = 6x + 45$

$\Rightarrow \quad 6x = 63$

$\Rightarrow \quad \boldsymbol{x = 10.5}$

So, first four observations are 10.5, 10.5 + 3, 10.5 + 6, 10.5 + 9 i.e.,10.5, 13.5, 16.5, 19.5.

Thus, mean of these numbers

$= \dfrac{10.5 + 13.5 + 16.5 + 19.5}{4} = \dfrac{60}{4} = 15$

Hence, mean of first four observations = **15.**

16. Let the least score be x in the fifth test to have an average of 80.

Then,

$\text{mean} = \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$\Rightarrow \quad 80 = \dfrac{75 + 80 + 84 + 73 + x}{5}$

$\Rightarrow \quad 400 = 312 + x$

$\Rightarrow \quad x = 88$

Hence, the least score she should get in her next test is **88.**

17. $\text{Mean} = \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$\Rightarrow \quad 8 = \dfrac{6 + y + 7 + x + 14}{5}$

$\Rightarrow \quad 40 = 27 + y + x$

$\Rightarrow \quad x + y = 13$

$\Rightarrow \quad \boldsymbol{y = 13 - x}$

18. $\text{Mean} = \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$\Rightarrow \quad 10 = \dfrac{6 + 10 + x + 11 + 12 + y}{6}$

$\Rightarrow \quad 60 = 39 + x + y$

$\Rightarrow \quad x + y = 21$ …(1)

Also, given that

$x - y = -7$ …(2)

Solving equations (1) and (2), we get

$\boldsymbol{x = 7}$ and $\boldsymbol{y = 14.}$

19.

Age (in years) x_i	*Frequency* x_i	$f_i x_i$
12	2	24
13	4	52
14	6	84
15	9	135
16	8	128
17	7	119
18	4	72
Total	$\Sigma f_i = 40$	$\Sigma f_i x_i = 614$

$\text{Mean} = \dfrac{\Sigma f_i x_i}{\Sigma f_i} = \dfrac{614}{40} = 15.35$

Hence, mean is **15.35.**

20. Let the assumed mean be 'a' = 30.

Marks x_i	*Frequency* f_i	$d_i = x_i - a$	$f_i\, d_i$
20	4	–10	–40
22	6	–8	–48
25	8	–5	–40
30	10	0	0
35	8	5	40
39	7	9	63
45	5	10	50
50	2	20	40
Total	50		$\Sigma f_i d_i = 65$

$$\text{Mean} = a + \frac{\Sigma f_i d_i}{\Sigma f_i} = 30 + \frac{65}{50}$$

$$= 30 + 1.3 = 31.3$$

Hence, mean is **31.3.**

21. Let assumed mean be 'a' = 56.

Weight (in kg) x_i	*Number of students* f_i	$d_i = x_i - a$	$f_i\, d_i$
50	8	–6	–48
52	10	–4	–40
54	15	–2	–30
56	20	0	0
58	8	2	16
60	6	4	24
62	2	6	12
64	1	8	8
Total	$\Sigma f_i = 70$		$\Sigma f_i d_i = -58$

$$\text{Mean} = a + \frac{\Sigma f_i d_i}{\Sigma f_i} = 56 + \frac{(-58)}{70}$$

$$= 56 - 0.82 = 55.17$$

Hence, mean weight of 70 students is **55.17 kg.**

22. Let the assumed mean 'a' = 3

Number of heads (x_i)	*Number of tosses* (f_i)	$d_i = x_i - a$	$f_i\, d_i$
0	34	–3	–102
1	140	–2	–280
2	338	–1	–338
3	283	0	0
4	160	1	160
5	25	2	50
6	20	3	60
Total	$\Sigma f_i = 1000$		$\Sigma f_i d_i = -450$

$$\text{Mean} = a + \frac{\Sigma f_i d_i}{\Sigma f_i} = 3 + \frac{(-450)}{1000}$$

$$= 3 - 0.45 = 2.55.$$

Hence, the mean is **2.55.**

23.

x_i	f_i	$f_i\, x_i$
3	6	18
5	8	40
7	15	105
9	p	$9p$
11	8	88
13	4	52
Total	$\Sigma f_i = 41 + p$	$\Sigma f_i x_i = 303 + 9p$

$$\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow \quad 7.5 = \frac{3.03 + 9p}{41 + p}$$

$$\Rightarrow \quad 307.5 + 7.5p = 30.3 + 9p$$

$$\Rightarrow \quad 4.5 = 1.5p$$

$$\Rightarrow \quad \mathbf{p = 3}$$

24.

x_i	f_i	$f_i\, x_i$
10	3	30
15	10	150
20	f	$20f$
25	7	175
35	5	175
Total	$\Sigma f_i = 25 + f$	$\Sigma f_i x_i = 530 + 20f$

$$\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow \quad 20.6 = \frac{530 + 20f}{25 + f}$$

$$\Rightarrow \quad 575 + 20.6f = 530 + 20f$$

$$\Rightarrow \quad 15 = 0.6f$$

$$\Rightarrow \quad \mathbf{f = 25}$$

25.

x_i	f_i	$f_i x_i$
15	2	30
17	3	51
19	4	76
$20 + p$	$5p$	$100p + 5p^2$
23	6	138
Total	$\Sigma f_i = 15 + 5p$	$\Sigma f_i x_i = 5p^2 + 100p + 295$

$$\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow \quad 20 = \frac{5p^2 + 100p + 295}{15 + 5p}$$

$$\Rightarrow \quad 300 + 100p = 5p^2 + 100p + 295$$

$$\Rightarrow \quad 5p^2 = 5$$

$$\Rightarrow \quad p^2 = 1$$

$$\Rightarrow \quad p = \pm 1$$

$$\Rightarrow \quad p = 1$$ [Neglecting –1 as observations cannot be negative]

EXERCISE 14E

1. (i) The given set of data is already in ascending order.

Here, number of observations, $n = 10$, which is even.

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

$$= \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{5+6}{2} = \frac{11}{2} = 5.5$$

Hence, median is **5.5.**

(ii) Arranging the data is ascending order, we have

6, 6, 8, 11, 14, 21.

Here, number of observations, $n = 6$, which is even.

$\therefore$ Median

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

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

$$= \frac{3\text{rd observation} + 4\text{th observation}}{2}$$

$$= \frac{8+11}{2} = \frac{19}{2} = 9.5$$

Hence, median is **9.5.**

(iii) Arranging the data in ascending order, we have

17, 17, 17, 18, 19, 20, 46

Here, number of observations, $n = 7$, which is odd.

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

$$= \left(\frac{7+1}{2}\right)\text{th observation}$$

$$= \left(\frac{8}{2}\right)\text{th observation}$$

$$= 4\text{th observation} = 18$$

Hence, median is **18.**

(iv) Arranging the data in ascending order, we have

31, 33, 41, 45, 48, 51, 61, 78, 92

Here, number of observations, $n = 9$, which is odd.

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

$$= \left(\frac{9+1}{2}\right)\text{th observation}$$

$$= \left(\frac{10}{2}\right)\text{th observation}$$

$$= 5\text{th observation} = 48$$

Hence, median is **48.**

(v) Arranging the data in ascending order, we have,

33, 35, 41, 46, 55, 58, 64, 77, 87, 90, 92

Here, number of observations, $n = 11$, which is odd.

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

$$= \left(\frac{11+1}{2}\right)\text{th observation}$$

$$= \left(\frac{12}{2}\right)\text{th observation}$$

$$= 6\text{th observation} = 58$$

Hence, median is **58**.

(vi) Arranging the data in ascending order, we have

38, 39, 40, 41, 42, 42, 43, 44, 46, 47, 49, 50, 52.

Here, number of observations, $n = 13$, which is odd.

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

$$= \left(\frac{13+1}{2}\right)\text{th observation}$$

$$= \left(\frac{14}{2}\right)\text{th observation}$$

$$= 7\text{th observation} = 43$$

Here, median is **43.**

(vii) Arranging the data in ascending order, we have

0, 36, 40, 69, 73, 83, 105, 248

Here, number of observations, $n = 8$, which is even.

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

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

$$= \frac{4\text{th observation} + 5\text{th observation}}{2}$$

$$= \frac{69+73}{2} = 71$$

Hence, median is **71.**

(viii) Arranging the data in ascending order, we have

66, 69, 72, 78, 82, 98, 99, 101, 102, 108

Here, number of observations $n = 10$, which is even

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

$$= \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{observation}}{2}$$

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

$$= \frac{82+98}{2} = \frac{180}{2} = 90$$

Hence median is **90.**

(ix) Arranging the data in ascending order, we have

22, 24, 26, 26, 27, 27, 28, 28, 29, 31, 32, 32, 33, 35, 35, 36, 36, 37.

Here, number of observations, $n = 19$, which is odd.

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

$= \left(\frac{19+1}{2}\right)$th observation

$= 10$th observation $= 29$

Hence, median is **29.**

(x) Arranging the data in ascending order, we have

1980, 2000, 2225, 2350, 3000, 3200, 3275, 3520, 3520, 3750, 4100, 4220

Here, number of observations, $n = 12$, which is even.

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

$$= \frac{\left(\frac{12}{2}\right)\text{th observation} + \left(\frac{12}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{3200+3275}{2} = 3237.5$$

Hence, median is **3237.5.**

2. (i) The first seven prime numbers are:

2, 3, 5, 7, 11, 13, 17

Here, number of observations, $n = 7$, which is odd.

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

$= \left(\frac{7+1}{2}\right)$th observation

$= 4$th observation $= 7$

Hence, median is **7.**

(ii) Prime numbers less than 25 are:

2, 3, 5, 7, 11, 13, 17, 19, 23

Here, number of observations, $n = 9$, which is odd.

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

$= \left(\frac{9+1}{2}\right)$th observation

$= 5$th observation $= 11$

Hence, median is **11**.

3. Arranging the age of the family members in ascending order, we have

8, 10, 13, 14, 38, 42

Here, number of observations, $n = 6$, which is even.

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

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

$$= \frac{3\text{rd observation} + 4\text{th observation}}{2}$$

$$= \frac{13+14}{2} = 13.5$$

Hence, median age of the family is **13.5.**

4. Arranging the donation in ascending order, we have

100, 100, 100, 100, 100, 100, 150, 200, 200, 300

Here, number of observations, $n = 10$, which is even.

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

$$= \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{100+100}{2} = 100$$

Hence, median donation is ₹ **100.**

5. Arranging the marks in ascending order, we have

10, 11, 13, 17, 17, 18, 19, 20, 23, 25, 28, 29, 29, 30, 35.

Here, number of observations, $n = 15$, which is odd.

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

$$= \left(\frac{15+1}{2}\right)\text{th observation}$$

$$= 8\text{th observation} = 20$$

Hence, median marks = **20.**

6. Arranging the ages in ascending order, we have

6, 8, 8, 10, 10, 12, 15, 18, 19, 19.5

Here, number of observations, $n = 10$, which is even

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

$$= \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{10+12}{2} = 11$$

Hence, median age of participants is **11 years.**

7. Arranging the weights in ascending order, we have

27, 28, 29, 30, 31, 32, 34, 35, 36, 37, 41, 42, 43, 44, 45

Here, number of observations, $n = 15$, which is odd

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

$$= \left(\frac{15+1}{2}\right)\text{th observation}$$

$$= 8\text{th observation} = 35$$

Hence, median weight is **35 kg.**

8. Arranging the heights in ascending order, we have

146.9, 148.4, 148.6, 149.1, 150.8, 151.7, 153.2, 153.8, 155, 155.3, 158.5, 160.1, 160.3, 161.2

Here, number of observations, $n = 14$, which is even.

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

$$= \frac{\left(\frac{14}{2}\right)\text{th observation} + \left(\frac{14}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{153.2+153.8}{2} = 153.5$$

Hence, median height is **153.5 cm.**

9. Arranging the marks of social science, we have

20, 23, 25, 27, 28, 41, 43, 48, 49, 55, 60, 67

Here, number of observations, $n = 12$, which is even.

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

$$= \frac{\left(\frac{12}{2}\right)\text{th observation} + \left(\frac{12}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{41+43}{2} = 42$$

Arranging the marks of science, we have

25, 28, 30, 32, 33, 46, 48, 53, 54, 60 65, 72

Here, number of observations, $n = 12$, which is even.

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

$$= \frac{\left(\frac{12}{2}\right)\text{th observation} + \left(\frac{12}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{46+48}{2} = 47$$

Since median marks of Science is higher than median marks of Social Science, therefore, the level of achievement is higher in **Science.**

10. Here, the number of observations, $n = 10$, which is even

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

$$\Rightarrow \quad 24 = \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$$

$$\Rightarrow \quad 24 = \frac{5\text{th observation} + 6\text{th observation}}{2}$$

$$\Rightarrow \quad 24 = \frac{x+2+x+4}{2}$$

$$\Rightarrow \quad 48 = 2x + 6$$

$$\Rightarrow \quad 2x = 42$$

$$\Rightarrow \quad \boldsymbol{x = 21.}$$

11. Here, the number of observations, $n = 10$, which is even.

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

$\Rightarrow 35 = \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$

$\Rightarrow 35 = \frac{5\text{th observation} + 6\text{th observation}}{2}$

$\Rightarrow 35 = \frac{34+x}{2}$

$\Rightarrow 70 = 34 + x$

$\Rightarrow \boldsymbol{x = 36}$

Also, if 45 is changed to 33, then new set of data is

24, 27, 28, 31, 33, 34, 36, 37, 40, 42.

Here, the number of observations, $n = 10$, which is even.

$\therefore$ New median = Average of $\left(\frac{n}{2}\right)$th observation and $\left(\frac{n}{2}+1\right)$th observation

$= \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$

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

$= \frac{33+34}{2} = 33.5$

Hence, new median is **33.5.**

12. Here, the number of observations, $n = 10$, which is even.

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

$\Rightarrow 23 = \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$

$\Rightarrow 23 = \frac{5\text{th observation} + 6\text{th observation}}{2}$

$\Rightarrow 23 = \frac{22+x}{2}$

$\Rightarrow 46 = 22 + x$

$\Rightarrow x = 24$

If 32 is replaced by 23, then new set of data is

12, 14, 17, 20, 22, 23, 24, 26, 28, 32.

Here, number of observation, $n = 10$, which is even.

$\therefore$ New median = Average of $\left(\frac{n}{2}\right)$th observation and $\left(\frac{n}{2}+1\right)$th observation

$= \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$

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

$= \frac{22+23}{2} = 22.5$

Hence, new median is **22.5.**

13. Arranging the weight in ascending order, we have

27, 28, 29, 30, 31, 32, 34, 35, 36, 37, 41, 42, 43, 44, 45

Here, number of observations, $n = 15$, which is odd.

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

$= \left(\frac{15+1}{2}\right)$th observation

$=$ 8th observation $= 35$

Hence, median weight is 35 kg.

Now, if 27 kg is replaced by 25 kg and 44 kg by 46 kg, then the new set of observations is

25, 28, 29, 30, 31, 32, 34, 35, 36, 37, 41, 42, 43, 45, 46

Here, number of observation, $n = 15$, which is odd.

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

$= \left(\frac{15+1}{2}\right)$th observation

$=$ 8th observation $= 35$

Hence, new median weight is **35 kg.**

EXERCISE 14F

1. (i) Arranging the data in ascending order, we have

2, 3, 3, 7, 9

Since 3 occurs most frequently, i.e., 2 times.

$\therefore$ Mode is **3.**

(ii) Arranging the data in ascending order, we have

2, 3, 3, 4, 4, 5, 7

Since 3 and 4 occur most frequently, i.e., 2 times.

$\therefore$ Modes are **3** and **4.**

(iii) Since none of the observation is repeated therefore, there is **no mode.**

(iv) Arranging the data in ascending order, we have

1, 5, 8, 8, 9, 10, 11, 11, 11, 11, 12, 12, 17

Since 11 occurs most frequently, i.e., 4 times.

$\therefore$ Mode is **11**.

(v) Arranging the data in ascending order, we have

1, 1, 2, 2, 3, 3, 3, 4, 4, 5, 5, 6, 6, 7, 7, 7, 7, 7, 7, 7, 8, 10, 11, 11, 12, 15

Since 7 occurs most frequently, i.e., 7 times.

$\therefore$ Mode is **7.**

2. Arranging the ages in ascending order, we have

17, 17, 17, 18, 19, 20, 46

Since 17 occurs most frequently, i.e., 3 times.

$\therefore$ Modal age is **17 years.**

3. Arranging the scores in ascending order, we have

0, 16, 18, 25, 35, 39, 50, 50, 72, 82.

Since 50 occurs most frequently, i.e., 2 times.

$\therefore$ Modal score is **50.**

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

3, 3, 3, 4, 4, 5, 6, 7, 7, 7, 8, k

Here, 3 and 7 occurs most frequently i.e., 3 times.

So, for mode to be 7, k must be 7.

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

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

Here, 3, 5, 6 and 9 occur most frequently, i.e., 2 times.

So, for mode to be 9, we must have $k = 9$.

If 3 is added to each element, then new set of data is

9, 9, 7, 8, 8, 9, 9, 10, 11, 12, 12, 12

Since 12 occurs most frequently i.e., 3 times.

$\therefore$ New mode is **12**.

6. Here, the number of observations, $n = 9$, which is odd.

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

$$\Rightarrow \quad 45 = \left(\frac{9+1}{2}\right)\text{th observation}$$

$$\Rightarrow \quad 45 = 5\text{th observation}$$

$$\Rightarrow \quad 45 = 2x + 3$$

$$\Rightarrow \quad 2x = 42$$

$$\Rightarrow \quad \boldsymbol{x = 21}$$

Thus, the numbers are 42, 43, 44, 44, 45, 45, 45, 46 and 47.

$\because$ 45 occurs most frequently i.e., 3 times.

$\therefore$ Mode is **45.**

7.
$$\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$$

$$\Rightarrow \quad 4 = \frac{1+5+7+x+1+9+x-2+3}{7}$$

$$\Rightarrow \quad 28 = 24 + 2x$$

$$\Rightarrow \quad 2x = 4$$

$$\Rightarrow \quad \boldsymbol{x = 2}$$

Thus, the given numbers are:

1, 5, 7, 3, 9, 0, 3

Arranging the numbers in ascending order, we have

0, 1, 3, 3, 5, 7, 9

Since 3 occurs most frequently, i.e., 2 times.

$\therefore$ Mode is **3.**

8. Arranging the given data in ascending year, we have

90, 90, 90, 90, 95, 95, 95, 100, 100, 105

Here, 90 occurs most frequently, i.e., 4 times.

$\therefore$ Modal size = **90 cm.**

If the size of shirt is misread as 90 instead of 95, then the correct data becomes:

90, 90, 90, 95, 95, 95, 95, 100, 100, 105

Here, 95 occurs most frequently.

$\therefore$ Correct modal size is **95 cm.**

9. Arranging the data in ascending order, we have

2, 4, 4, 5, 5, x

(i) When there is no mode

Since 4 + 4 occur most frequently, i.e., 2 times and there is no mode, therefore we must have $x = 2$.

(ii) When there is only one mode

Here, 4 × 5 occur most frequently, i.e., 2 times

$\therefore$ x must be either 4 or 5.

10. Since 3 has the maximum frequency = 7, therefore, 7 occurs most frequently.

Hence, mode is **3.**

11.
$$\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$$

$$= \frac{22+23+16+25+28+23+20+23+25+25}{10}$$

$$= \frac{230}{10} = 23$$

$$\Rightarrow \quad \text{Mean} = 23$$

Arranging the data in ascending order, we have

16, 20, 22, 23, 23, 23, 25, 25, 25, 28

Here, number of observations, $n = 10$, which is even.

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

$$= \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$$

$$= \frac{5\text{th observation} + 6\text{th observation}}{2} = \frac{23+23}{2}$$

$$\Rightarrow \quad \text{Median} = \boldsymbol{23}$$

Now, $\quad \text{Mode} = 3 \text{ median} - 2 \text{ mean}$

$$= 3\,(23) - 2\,(23) = 69 - 46 = 23$$

Hence, mode is **23.**

12.
$$\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$$

$$\Rightarrow \quad x = \frac{2+3+5+1+7+6}{6}$$

$$\Rightarrow \quad x = \frac{24}{6} = 4$$

Also, mean of the numbers 3, 5, 4, 2, 3, 7 and y is x, i.e., 4

$$\Rightarrow \quad 4 = \frac{3+5+4+2+3+7+y}{7}$$

$$\Rightarrow \quad 28 = 24 + y$$

$$\Rightarrow \quad y = 4$$

Thus, the numbers are 3, 5, 4, 2, 3, 7, 4.

Arranging these numbers in ascending order, we have

2, 3, 3, 4, 4, 5, 7

Here, number of observations, $n = 7$, which is odd

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

$\Rightarrow \quad z = \left(\frac{7+1}{2}\right)$th

$\Rightarrow \quad z =$ 4th observation $= 4$

Hence, $x = 4$, $y = 4$, $z = 4$.

13. (i) $\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$

$= \frac{7+3+5+11+9}{5} = \frac{35}{5} = 7$

$\Rightarrow$ Mean = **7.**

Arranging the data in ascending order, we have

3, 5, 7, 11, 9

Here, number of observations , = 5, which is odd.

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

$= \left(\frac{6}{2}\right)$th observation

= 3rd observation = 7

$\Rightarrow$ Median = **7.**

Since all the numbers appear equal number of times.

$\therefore$ there is **no mode.**

(ii) $\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$

$= \frac{22+38+18+14+22+30}{6}$

$= \frac{144}{6} = 24$

$\Rightarrow$ Mean = **24**

Arranging the data in ascending order, we have

14, 18, 22, 22, 30, 38

Here, number of observations, $n = 6$, which is even.

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

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

$= \frac{\text{3rd observation + 4th observation}}{2}$

$= \frac{22+22}{2} = \mathbf{22}$

$\Rightarrow$ Median = **22.**

Also, 22 occurs most frequently.

$\therefore$ Mode is **22.**

(iii) $\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$

$= \frac{5\frac{1}{2}+2\frac{1}{4}+7+5\frac{3}{4}+4\frac{1}{2}}{5}$

$= \frac{\frac{11}{2}+\frac{9}{4}+7+\frac{23}{4}+\frac{9}{2}}{5}$

$= \frac{\frac{22+9+28+23+18}{4}}{5}$

$= \frac{100}{20} = \mathbf{5}$

Arranging the data in ascending order, we have

$2\frac{1}{4}, 4\frac{1}{2}, 5\frac{1}{2}, 5\frac{3}{4}, 7$

Here, number of observations, $n = 5$, which is odd.

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

$= \left(\frac{5+1}{2}\right)$th observation

= 3rd observation

$= 5\frac{1}{2}$

Hence, median is $\mathbf{5\frac{1}{2}}$.

Also, none of the observation is repeated.

$\therefore$ There is **no mode.**

(iv) $\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$

$= \frac{1+0.01+1.1+0.12+1+1.03}{6}$

$= \frac{4.26}{6} = 0.71$

Hence, mean **= 0.71.**

Arranging the data in ascending order, we have

0.01, 0.12, 1, 1, 1.03, 1.1

Here, number of observations, $n = 6$, which is even.

$\therefore$ Median = Average of $\left(\frac{n}{2}\right)$th observation and $\left(\frac{n}{2}+1\right)$th observations

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

$= \frac{\text{3rd observation + 4th observation}}{2}$

$= \frac{1+1}{2} = \mathbf{1}$

$\Rightarrow$ Median = **1**

Since 1 occurs most frequently, i.e., 2 times.

$\therefore$ Mode is **1.**

14. Mean $= \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$$= \frac{17+2+7+27+25+5+14+18+10+24+10+8+7+10}{14}$$

$$= \frac{184}{14} = 13.14$$

Arranging the data in ascending, we have

2, 5, 7, 7, 8, 10, 10, 10, 14, 17, 18, 24, 25, 27

Here, number of observations, $n = 14$, which is even.

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

$$= \frac{\left(\frac{14}{2}\right)\text{th observation} + \left(\frac{14}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{10+10}{2} = 10$$

Hence, median is **10.**

Also, since 10 occurs most frequently, i.e., 3 times.

$\therefore$ Mode is **10.**

15. **(i)** Mean $= \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$$= \frac{1340+1345+1345+1350+1350+1520}{6}$$

$$= \frac{8250}{6} = 1375$$

Hence, mean is **₹ 1375.**

(ii) Arranging the data in ascending order, we have

₹ 1340, ₹ 1345, ₹ 1345, ₹ 1350, ₹ 1350, ₹ 1520

Here, number of observations, $n = 6$, which is even.

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

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

$$= \frac{3\text{rd observation} + 4\text{th observation}}{2}$$

$$= \frac{1345+1350}{2} = 1347.50$$

Hence, median is **₹ 1347.50.**

(iii) Also, since 1345 and 1350 occur most frequently, i.e., 2 times.

$\therefore$ Modal salary is **₹ 1345** and **₹ 1350.**

16. **(i)** **(a)** Mean $= \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

$$= \frac{0+\frac{1}{2}+\frac{1}{2}+1+1+1+1+1\frac{1}{2}+3\frac{1}{2}+10}{10}$$

$$= \frac{\frac{1}{2}+\frac{1}{2}+4+\frac{3}{2}+\frac{7}{2}+10}{10} = 2$$

$\therefore$ Mean distance = **2 km.**

(b) Here, the data is already arranged in ascending order and the number of observations, $n = 10$, which is even.

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

$$= \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{1+1}{2} = 1$$

Hence, median distance **1 km.**

(c) Also, here 1 occurs most frequently, i.e., 4 times.

$\therefore$ Modal distance is **1 km.**

(ii) Since bus service is provided for students living more than $1\frac{1}{2}$ km from school, therefore, there are two students who are entitled to bus service.

(iii) Mean is not a good measure of central tendency, because it gets affected by the extreme values and therefore does not provide the correct description of the average distance between home and school for the given number of students.

EXERCISE 14G

1. Mean of 10 numbers = 25.

$\therefore$ Total of 10 numbers = $25 \times 10 = 250$

Since S is subtracted from each number

$\therefore$ Total of new 10 numbers = $250 - 5 \times 10$

$= 250 - 50 = 200$

$\therefore$ New mean $= \dfrac{200}{10} = 20$

Hence, new mean is **20.**

2. Mean of 15 numbers = 8

$\therefore$ Total of 15 numbers = 120

Since 2 is added is every number,

$\therefore$ New total of 15 numbers = $120 + 2 \times 15$

$= 120 + 30 = 150$

$\therefore$ New mean $= \dfrac{150}{15} = 10$

Hence, new mean is **10.**

3. The mean of 25 numbers = 27

$\therefore$ Total of 25 numbers = $25 \times 27 = 675$

Since each number is multiplied by 4,

$\therefore$ New total = $4 \times 675 = 2700$

$\therefore$ New mean = $\frac{2700}{25} = 108$

Hence, new mean is **108.**

4. The mean of 5 numbers = 27

$\therefore$ Total of 5 numbers = $5 \times 27 = 135$

Mean of remaining 4 numbers = $27 - 2 = 25$

$\therefore$ Total of 4 numbers = $25 \times 4 = 100$

$\therefore$ Excluded number = (total of 5 numbers) – (total of 4 numbers)

$= 135 - 100 = 35$

Hence, excluded number is **35.**

5. Mean weight of 35 students = 45 kg

$\therefore$ Total weight of 35 students = $45 \times 35 = 1575$ kg.

If the weight of the teacher is included, then mean weight increases by 500 g i.e., 0.5 kg.

$\therefore$ New mean weight of 36 members = 45.5 kg

$\therefore$ New total weight of 36 members = $45.5 \times 36 = 1638$

$\therefore$ Weight of the teacher

= (new total weight of 36 member) – (total weight of 35 students)

$= 1638 - 1575 = 63$

Hence, the weight of the teacher is **63 kg.**

6. The mean of 20 numbers = 18

$\therefore$ Total of 20 numbers = $18 \times 20 = 360$

Since 3 is added to each of the first ten numbers,

$\therefore$ New total of 20 numbers

$= 360 + 3 \times 10 = 360 + 30 = 390$

$\therefore$ New mean = $\frac{390}{20} = 19.5$

Hence, the new mean is **19.5.**

7. The mean weight of 6 girls in a group = 48 kg.

$\therefore$ Total weight of 6 girls = $48 \times 6 = 288$ kg.

Also, total weight of 5 girls = $44 + 51 + 45 + 46 + 49$

$= 235$ kg.

$\therefore$ Weight of the sixth girl = (total weight of 6 girls) – (total weight of 5 girls)

$= 288 - 235 = 53$ kg.

Hence, the weight of the sixth girl is **53 kg.**

8. Incorrect mean of 80 items = 25

$\therefore$ Incorrect sum = $25 \times 80 = 2000$

Since at the time of calculation, two items were wrongly taken as 60 and 40 instead of 16 and 4,

$\therefore$ Correct sum = $2000 - 60 - 40 + (16 + 4) = 1920$

$\therefore$ Correct mean = $\frac{1920}{80} = 24$

Hence, correct mean is **24.**

9. Mean score in 9 innings = 58

$\therefore$ Total score in 9 innings = $9 \times 58 = 522$

Also, mean score in 10 innings = 61

$\therefore$ Total score in 10 innings = $61 \times 10 = 610$

So, run to be scored by the cricketer in the tenth inning to raise the mean score to 61.

= (total score in 10 innings) – (total score in 9 innings)

$= 610 - 522 = 88$

Hence, 88 runs of scores are needed in 10^{th} inning.

10. A school has four sections of class X having 40, 35, 45 and 42 students with mean marks obtained in mathematics test are 50, 45, 40 and 30 respectively.

$\therefore$ Overall average of marks per student

$$= \frac{40 \times 50 + 35 \times 45 + 45 \times 40 + 42 \times 30}{40 + 35 + 45 + 42}$$

$$= \frac{6635}{162} = 40.956$$

Hence, overall average of marks per student is **40.956.**

11. Let the number of boys = x

and the number of girls = y

Then, according to the question

$$71 = \frac{\text{Total score of boys}}{x}$$

and $$75 = \frac{\text{Total score of girls}}{y}$$

$\Rightarrow$ Total score of boys = $71x$

and total score of girls = $73y$

$\Rightarrow$ Total score of the school = $71x + 73y$

Also, average score of the school in examination is 71.8

$$\Rightarrow \quad 71.8 = \frac{\text{Total score of the school}}{\text{Total students in the school}}$$

$$\Rightarrow \quad 71.8 = \frac{71x + 73y}{x + y}$$

$$\Rightarrow \quad 71.8\,(x + y) = 71x + 72y$$

$$\Rightarrow \quad 71.8x - 71x = 73y - 71.8y$$

$$\Rightarrow \quad 0.8x = 1.2y$$

$$\Rightarrow \quad \frac{x}{y} = \frac{3}{2}$$

$$\Rightarrow \quad x : y = 3 : 2.$$

Hence, the required ratio is **3 : 2.**

12. Let the number of girls in the class is x and the number of boys in the class is y.

Then, total number of students in the class is

$$x + y = 150 \qquad \ldots(1)$$

According to given conditions in the question,

Mean weight of 150 students in a class is 60 kg.

$\therefore$ Total weight of 150 students = $150 \times 60 = 9000$ kg.

Also, mean weight of girls in the class is 55.

$\Rightarrow$ $55 = \dfrac{\text{Total weight of girls}}{x}$

$\Rightarrow$ Total weight of girls $= 55x$ kg.

Similarly, total weight of boys $= 70y$ kg.

Total weight of 150 students = Total weight of girls + Total weight of boys

$\Rightarrow$ $9000 = 55x + 70y$

$\Rightarrow$ $11x + 14y = 1800$ …(2)

On solving (1) and (2), we get

$x = 100, y = 50$

Hence, number of girls in the class is **100** and number of boys in the class is **50.**

13. Let the number of male employees be x and the number of female employees be y.

Then, mean weekly salary paid to all employees was ₹ 600.

$\Rightarrow$ $600 = \dfrac{\text{Sum of weekly salary to all employees}}{\text{Number of employees}}$

$\Rightarrow$ $600 = \dfrac{\text{Sum of weekly salary to all employees}}{x+y}$

$\Rightarrow$ $600x + 600y$ = Sum weekly salary to all employees

Also, mean weekly salary to male employees was ₹ 620.

$\Rightarrow$ $620 = \dfrac{\text{Sum of weekly salary to male employees}}{\text{Number of male employees}}$

$\Rightarrow$ $620 = \dfrac{\text{Sum of weekly salary of male employees}}{x}$

$\Rightarrow$ Sum of weekly salary of male employees $= 620x$.

Similarly, Sum of weekly salary of female employees $= 520y$.

Now, total number of employees

$= x + y$ …(1)

And sum of weekly salary to all employees

= Sum of weekly salary of male employees + Sum of weekly salary of female employees

$\Rightarrow 600x + 600y = 620x + 520y$

$\Rightarrow$ $20x - 80y = 0$

$\Rightarrow$ $x = 4y$

$\therefore$ Total number of employees $= 5y$

$\Rightarrow$ Percentage of male employees $= \dfrac{4y}{5y} \times 100$

$= \mathbf{80\%}$.

And percentage of female employees $= \dfrac{y}{5y} \times 100 = \mathbf{20\%}$.

14. In a school, there are 85 boys and 35 girls.

$\therefore$ Total number of students $= 85 + 35 = 120$

Mean marks of the boys = 40%

$\Rightarrow$ Total marks of the boys $= 40 \times 85 = 3400$

Similarly, total marks of the girls $= 60 \times 35 = 2100$

$\therefore$ Total marks of the school $= 3400 + 2100 = 5500$

$\therefore$ Average marks of the school $= \dfrac{5500}{120} = 45.83$

Hence, required percentage is **45.83%.**

15. Average weight of A, B, C is 45 kg.

$\therefore$ Total weight of A, B, C $= 45 \times 3 = 135$ kg.

Let weight of A be x, weight of B be y, weight of C be z.

Then, $x + y + z = 135$ …(1)

$\therefore$ Average weight of A and B is 40 kg.

$\therefore$ $x + y = 80$ …(2)

Similarly, $y + z = 86$ …(3)

Solving (1) and (2), we have

$z = 55$

Substituting the value of z in (3), we have

$y + 55 = 86$

$\Rightarrow$ $y = 31$

Hence, weight of B = **31 kg.**

CHECK YOUR UNDERSTANDING

MULTIPLE-CHOICE QUESTIONS

1. (a) **Primary data**

Since the data is collected by a student ifself, therefore, the data collected by him is a primary data.

2. (b) **Secondary data**

To analyse the election results, the data collected from newspapers is the secondary data because this data is collected by someone, other than the investigator.

3. (c) **1 and 2**

Size of shoes and number of pages in a book are discrete variable because these variables cannot take all possible values between two given values.

4. (b) **Range**

The difference between maximum and minimum observations is known as range.

5. (b) **55**

Range = Maximum value – minimum value

$\Rightarrow$ 20 = 75 – minimum value

$\Rightarrow$ Minimum value = 75 – 20 = 55.

6. (c) **10**

The class intervals are 0 – 10, 10 – 20, 20 – 30, …

$\therefore$ Class width = Upper limit – lower limit

= 10 – 0 = 10

7. (d) **20**

The class intervals are 1–20, 21–40, 41–60, …

Then, the class intervals in exclusive form are,

0.5 – 20.5, 20.5 – 40.5, 40.5 – 60.5, …

$\therefore$ Class width = 20.5 – 0.5 = 20.

8. (d) **6**

Since the class marks are uniformly spaced, therefore, class size is the difference between two consecutive class marks.

$\therefore$ Class size = 34 – 28 = 6.

9. (b) **10–20**

The given class intervals are in exclusive form

$\therefore$ 10 is considered in the class 10 – 20.

10. (b) **4.5**

The class mark of the class interval 2.4 – 6.6 is

$\frac{2.4+6.6}{2} = 4.5.$

11. (d) **40.5–45.5**

Since the class marks are uniformly spaced, therefore the class size is the difference between the consecutive class marks:

$\therefore$ Class size = 43 – 38 = 5.

Let x be the class mark of a class interval and h be its class size.

Then, lower and upper limits of class intervals are $\left(x-\frac{h}{2}\right)$ and $\left(x+\frac{h}{2}\right)$ respectively.

$\therefore$ Lower limit of the first class interval is $38-\frac{5}{2}$

$= 35.5$

Upper limit of the first class interval is $38+\frac{5}{2} = 40.5$

Hence, the first class interval is 35.5 – 40.5.

Similarly, other class intervals are 40.5 – 45.5, 45.5 – 50.5, 50.5 – 55.5, …

Hence, class corresponding to class mark 43 is 40.5 – 45.5.

12. (a) **212, 237**

Since the class size of a distribution is 25 and first class interval is 200 – 224,

$\therefore$ the given class intervals in inclusive form are 199.5 – 224.5, 224.5 – 249.5, …

$\therefore$ Class marks of the two class intervals are

$$\frac{199.5+224.5}{2} \text{ and } \frac{224.5+249.5}{2}$$

i.e., 212 and 237.

13. (i) (c) **55**

The class mark of R is $= \frac{60+50}{2} = \frac{110}{2} = 55.$

(ii) (b) **10**

The class width of T is = 80 – 70 = 10.

(iii) (d) **8**

The frequency of Q is 8.

(iv) (b) **10**

The class size of P is 40 – 30 = 10.

14. (b) **11**

The frequency of the class 3 – 15 is 11.

15. (b) **9**

Class	*Cumulative frequency*	*Frequency*
10–20	5	5
20–30	14	9
30–40	25	11

$\therefore$ Frequency of the class interval is 9.

16. (a) **20**

Class interval	*Cumulative frequency*	*Frequency*
0–10	3	3
10–20	17	14
20–30	37	20
30–40	92	55

$\therefore$ Frequency of the class interval 20–30 is 20.

17. (c) **12**

Class intervals	*Cumulative frequency*	*Frequency*
59–69	65	35
69–79	30	12
79–89	18	10
89–99	8	8

$\therefore$ From the above table, we see that frequency for the class interval 70–80 is 12.

18. (c) **5 cm**

For 100 people, the length of the bar is 0.25 cm.

$\therefore$ For 2000 people, the length of the bar is

$$\frac{0.25}{100}\times 2000 = 5 \text{ cm.}$$

19. (a) **having no significance**

In a bar graph, the widths of bars have no significance.

20. (c) **class marks of the classes**

For drawing a frequency polygon of a continuous frequency distribution, we plot the points whose ordinates are the frequency of respective classes and abscissa are respectively the class marks of the classes.

21. (a) **the *x*-axis**

One of the sides of a frequency polygon is the x–axis.

22. (d) **Standard deviation**

Standard deviation is not a measure of central tendency.

23. (c) **50.5**

The sum of the counting numbers through 100 is

$$\frac{100(100+1)}{2} = 5050.$$

$\therefore$ Mean of numbers from 1 to 100 = $\frac{5050}{100} = 50.5.$

24. (d) **4.25**

The first four prime numbers are 2, 3, 5, 7

$\therefore$ Mean $= \dfrac{2+3+5+7}{4} = 4.25.$

25. (a) **34**

The three consecutive even integers in which 32 is the smallest are 32, 34, 36

$\therefore$ Required mean $= \dfrac{32+34+36}{3} = \dfrac{102}{3} = 34.$

26. (c) **is increased by 3**

If each observation of the data is increased by 3, then their mean is increased by 3.

27. (b) **335**

Mean of 30 observations = 12

$\therefore$ Sum of 30 observations = $30 \times 12 = 360$

If 25 is subtracted from the sum of observations, then required sum is $360 - 25 = 335$.

28. (c) **34**

The prime numbers between 30 and 40 are 31, 37.

$\therefore$ Mean $= \dfrac{31+37}{2} = \dfrac{68}{2} = 34.$

29. (b) **9**

Mean x_1 and $x_2 = 6$

$\Rightarrow \dfrac{x_1 + x_2}{2} = 6$

$\Rightarrow x_1 + x_2 = 12$ …(1)

Also, mean of $x_1, x_2, x_3 = 7$

$\Rightarrow \dfrac{x_1 + x_2 + x_3}{2} = 7$

$\Rightarrow x_1 + x_2 + x_3 = 21$ …(2)

From (1) and (2), we have

$12 + x_3 = 21$

$x_3 = 9$

30. (b) $\dfrac{2x+3y}{5}$

Since Sheila received x marks in two of her tests and y marks in three other tests,

$\therefore$ Her total marks are $2x + 3y$

$\therefore$ Average score in all the five tests are $\dfrac{2x+3y}{5}$.

31. (c) **72.5**

Arranging the data in ascending order, we have

50, 50, 70, 70, 70, 75, 75, 75, 90, 90

Here, number of observations, $n = 10$, which is even.

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

$= \dfrac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$

$= \dfrac{5\text{th observation} + 6\text{th observation}}{2}$

$= \dfrac{70+75}{2} = \dfrac{145}{2} = 72.5$

Hence, median marks is 72.5.

32. (d) **26**

Since the number of observations, $n = 16$, which is even,

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

$= \dfrac{\left(\frac{16}{2}\right)\text{th observation} + \left(\frac{16}{2}+1\right)\text{th observation}}{2}$

$= \dfrac{8\text{th observation} + 9\text{th observation}}{2}$

$= \dfrac{25+27}{2} = \dfrac{52}{2} = 26$

Hence, median is 26.

33. (b) **40**

Here, the number of observation, $n = 10$, which is even.

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

$\Rightarrow 35 = \dfrac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$

$\Rightarrow 70 = 5\text{th observation} + 6\text{th observation}$

$\Rightarrow 70 = 30 + x$

$\Rightarrow x = 40$

34. (a) **occurs most frequently**

Mode of a set of observations is the value which occurs most frequently.

35. (b) **4**

Arranging the data in ascending order, we have

2, 3, 4, 4, 4, 4, 4, 6, 6, 6, 6, 7, 8

Here, 4 occurs most frequently, i.e., 5 times.

$\therefore$ Mode is 4.

36. (d) **7**

Arranging the given data in ascending order, we have

3, 4, 5, 5, 5, 6, 6, 7, 7, 7, 8, x

Here, 5 and 7 occur most frequently, i.e., 3 times.

So, for mode to be 7, the value of x must be 7.

37. (b) **1**

The given data is

7, 8, 8, 9, 9 and x

When, $x = 9$, then mode is 9.

When, $x = 8$, then mode is 8.

$\therefore$ The difference between the modes is $9 - 8 = 1$.

38. (a) **Mode = 3 median – 2 mean**

For a frequency distribution, mean, median and mode are connected by the following relation.

Mode = 3 median – 2 mean.

39. (d) **20**

Here, the number of observations $n = 10$, which is even.

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

$$\Rightarrow 22 = \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$$

$$\Rightarrow 22 = \frac{5\text{th observation} + 6\text{th observation}}{2}$$

$\Rightarrow 44 = x + 1 + x + 3$

$\Rightarrow 2x = 40$

$\Rightarrow x = 20$

40. (c) **3, 3, 4**

Consider the set 3, 3, 4.

Here, number of observations, $n = 3$, which is odd.

Then, median $= \left(\frac{n+1}{2}\right)$th observation

$= \left(\frac{3+1}{2}\right)$th observation

= 2nd observation = 3.

$\Rightarrow$ Median = 3

Also, 3 occurs most frequently, i.e., 2 times.

$\therefore$ Mode = 3.

$\Rightarrow$ Median = Mode = 3.

41. (b) **6**

Here, range = maximum value – minimum value

= 149 – 65 = 84

Class size = 120 – 105 = 15

Since $\frac{84}{15} = 5.6$,

$\therefore$ there are 6 class intervals of equal class size 15.

42. (d) **21**

From the graph, we have

the number of students who secured 60 or more marks is

10 + 5 + 3 + 3 = 21.

43. (a) **15**

From the graph, we have, the number teachers whose age is less than 40 years is

2 + 4 + 3 + 6 = 15.

44. (d) **2**

Minimum class size = 5.

$\therefore$ Adjusted frequency is given by

Class intervals	*Frequency*	*Adjusted frequency*
5–10	6	$\frac{5}{5}\times 6 = 6$
10–15	12	$\frac{5}{5}\times 12 = 12$
15–25	10	$\frac{5}{10}\times 10 = 5$
25–45	8	$\frac{5}{20}\times 8 = 2$
45–75	15	$\frac{5}{30}\times 15 = 2.5$

$\therefore$ Adjusted frequency for the class 25–45 is 2.

45. (d) **18, 20, 22**

Let the three even consecutive integers be

$2n - 2, 2n, 2n + 2$

Then, average $= \frac{\text{Sum of integers}}{\text{Number of integers}}$

$$\Rightarrow 20 = \frac{2n-2+2n+2n+2}{3}$$

$\Rightarrow 60 = 6n$

$\Rightarrow n = 10$

$\therefore$ Numbers are 18, 20, 22.

46. (c) **93 marks**

Let the marks in fourth math test be 'x' in order to have an average of exactly 87.

Then, mean $= \frac{\text{Sum of observations}}{\text{Number of observations}}$

$$\Rightarrow 87 = \frac{92+85+7.8+x}{4}$$

$\Rightarrow 348 = 255 + x$

$\Rightarrow x = 93$

Hence, he should obtain 93 marks in his fourth math test.

47. (d) **$2M^2 - 1$**

The mean of x and $\frac{1}{x}$ is M.

$$\Rightarrow \frac{x+\frac{1}{x}}{2} = M$$

$$\Rightarrow x+\frac{1}{x} = 2M$$

On squaring both sides, we get

$$\left(x+\frac{1}{x}\right)^2 = 4M^2$$

$$\Rightarrow x^2+\frac{1}{x^2}+2 = 4M^2$$

$$\Rightarrow x^2+\frac{1}{x^2} = 4M^2 - 2$$

$$\Rightarrow \quad x^2 + \frac{1}{x^2} = 2\,(2M^2 - 1)$$

$$\Rightarrow \quad \frac{x^2 + \frac{1}{x^2}}{2} = 2M^2 - 1$$

Hence, mean of x^2 and $\frac{1}{x^2}$ is $2M^2 - 1$.

48. (b) **38**

Mean of six numbers is 23.

$\Rightarrow$ Sum of 6 numbers = $23 \times 6 = 138$

Also, if one number is excluded, then mean of the remaining 5 numbers is 20.

$\therefore$ Sum of 5 numbers = $20 \times 5 = 100$

Thus, excluded number = (sum of 6 numbers) – (sum of 5 numbers)

$= 138 - 100 = 38.$

49. (b) **18**

Let the observations are x_1, x_2, x_3, x_4, x_5.

Then, $\frac{x_1 + x_2 + x_3 + x_4 + x_5}{5} = 15$

$\Rightarrow \quad x_1 + x_2 + x_3 + x_4 + x_5 = 75 \quad \ldots(1)$

Also, $\frac{x_1 + x_2 + x_3}{3} = 14$

$\Rightarrow \quad x_1 + x_2 + x_3 = 42 \quad \ldots(2)$

and $\frac{x_3 + x_4 + x_5}{3} = 17$

$\Rightarrow \quad x_3 + x_4 + x_5 = 51 \quad \ldots(3)$

From (1) and (2), we have

$42 + x_4 + x_5 = 75$

$x_4 + x_5 = 33 \quad \ldots(4)$

From (3) and (4), we have

$x_3 + 33 = 51$

$\Rightarrow \quad x_3 = 18.$

Hence, the third observation is 18.

50. (a) $\bar{x} + \frac{n+1}{2}$

Let the n observations are $x_1, x_2, x_3, \ldots, x_n$.

Let x_1 is increased by 1, x_2 is increased by 2, x_3 is increased by 3, … and so on then,

New mean

$$= \frac{(x_1 + 1) + (x_2 + 2) + (x_3 + 3) + \ldots + (x_n + n)}{n}$$

$$= \frac{x_1 + x_2 + \ldots + x_n + (1 + 2 + \ldots + n)}{n}$$

$$= \frac{x_1 + x_2 + \ldots + x_n}{n} + \frac{1 + 2 + \ldots + n}{n}$$

$$= \bar{x} + \frac{\frac{n(n+1)}{2}}{n} \quad \left\{ \because \quad \bar{x} = \frac{x_1 + x_2 + \ldots + x_n}{n} \right.$$

$$\left. \text{and } 1 + 2 + \ldots + n = \frac{n(n+1)}{2} \right\}$$

$\Rightarrow$ New mean = $\bar{x} + \frac{n+1}{2}$

51. (b) **3**

Variable x_i	*Frequency* f_i	$f_i\, x_i$
1	2	2
2	3	6
x	4	$4x$
4	5	20
5	6	30
Total	$\Sigma f_i = 20$	$\Sigma f_i\, x_i = 58 + 4x$

$$\text{Mean} = \frac{\Sigma f_i\, x_i + x_i}{\Sigma f_i}$$

$$\Rightarrow \quad 3.5 = \frac{58 + 4x}{20}$$

$$\Rightarrow \quad 70 = 58 + 4x$$

$$\Rightarrow \quad 4x = 12$$

$$\Rightarrow \quad x = 3.$$

52. (b) $\mathbf{11\frac{1}{3}}$

$$\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$$

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

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

$$\Rightarrow \quad 5x = 20$$

$$\Rightarrow \quad x = 4$$

Thus, the numbers are 4, 7, 9, 11, 14.

$\therefore$ Mean of last 3 observations = $\frac{9 + 11 + 14}{3}$

$= \frac{34}{3} = 11\frac{1}{3}.$

53. (c) **55.2 km/h**

The correct recorded speeds (in km/h) of 10 motorists are

53, 57, 62, 60, 47, 44, 65, 54, 58, 52

$\therefore$ Correct average speed

$$= \frac{53 + 57 + 62 + 60 + 47 + 44 + 65 + 54 + 58 + 52}{10}$$

$$= \frac{552}{10} = 55.2.$$

Hence, correct average speed = 55.2 km/h.

54. (c) **0.6**

The first five prime numbers are

2, 3, 5, 7, 11

$\therefore$ Mean = $\frac{2 + 3 + 5 + 7 + 11}{5}$

$= \frac{28}{5} = 5.6$

Here, the number of observations, $n = 5$, which is odd.

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

$= \left(\frac{5+1}{2}\right)$th observation

$=$ 3rd observation $= 5$

$\Rightarrow$ Median $= 5$

$\Rightarrow$ Mean − Median $= 5.6 - 5 = 0.6$

55. (d) **Mean = mode**

$$\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$$

$$= \frac{3+4+5+4+3+4+5}{7} = \frac{28}{7} = 4$$

$\Rightarrow$ Mean $= 4$

Arranging the data in ascending order, we have

3, 3, 4, 4, 4, 5, 5

Here, number of observations, $n = 7$, which is odd.

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

$= \left(\frac{7+1}{2}\right)$th observation

$=$ 4th observation $= 4$

$\Rightarrow$ Median $= 4$

Also, 4 occurs, most frequently, i.e., 3 times.

$\therefore$ Mode is 4.

Thus, mean = median = mode.

SHORT ANSWER QUESTIONS

1. The first 10 natural numbers are

1, 2, 3, 4, 5, 6, 7, 8, 9, 10

$$\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$$

$$= \frac{1+2+3+4+5+6+7+8+9+10}{10} = \frac{55}{10} = \mathbf{5.5}$$

Here, number of observations, $n = 10$, which is even.

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

$$= \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$$

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

$$= \frac{5+6}{2}$$

$$= \frac{11}{2} = 5.5$$

Hence, mean = median = 5.5.

2. Since class marks (i.e., mid–point) are uniformly spaced, therefore the class size is the difference between the consecutive class marks.

$\therefore$ Class size $= 15 - 5 = 10$.

Let x be the class mark of a class interval and h be its class size.

Then, lower and upper limit of the class interval are

$\left(x - \frac{h}{2}\right)$ and $\left(x + \frac{h}{2}\right)$ respectively.

$\therefore$ Lower limit of the first class interval $= 5 - \frac{h}{2} = 0$.

Upper limit of the second class interval $= 5 + \frac{h}{2} = 10$.

So, the first class interval is 0–10.

Similarly, we obtain the other class intervals, which are given in the table below:

Class interval	*Frequency*
0–10	2
10–20	6
20–30	9
30–40	7
40–50	4
50–60	2

3. (i) Less than series is as follows:

Less than 20	13
Less than 40	25
Less than 60	45
Less than 80	58
Less than 100	81
Less than 120	100

(ii) More than series is as follows:

More than 0	100
More than 19	87
More than 39	75
More than 59	55
More than 79	42
More than 99	19
More than 119	0

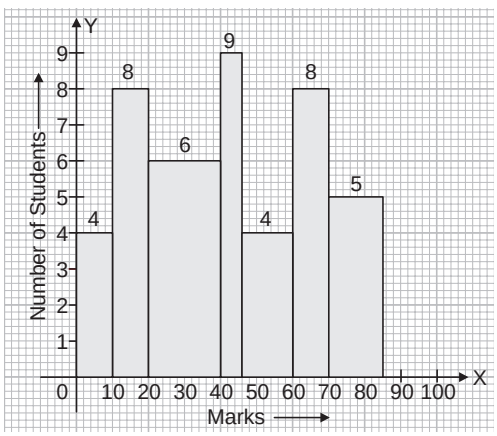
4. Here, the class intervals are not uniformly spaced.

So, we first adjust the frequencies.

Thus, the frequency distribution table with adjusted frequency as follows:

Marks	*Number of students*	*Adjusted frequency*
0–10	8	4
10–20	16	8
20–40	24	6
40–45	9	9
45–60	12	4
60–70	16	8
70–85	15	5

Thus, the histogram of the above distribution table with adjusted frequency is given below:



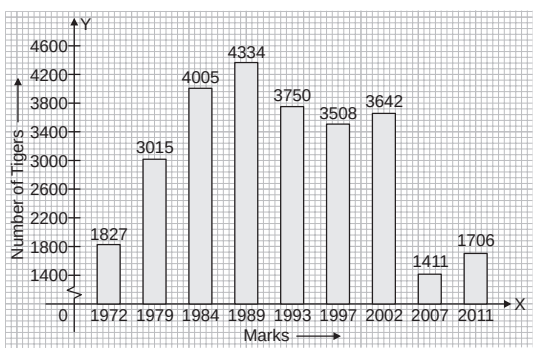
5. Median will be a good representative of the data because:

(i) each value occurs one.

(ii) the data is influenced by extreme values.

VALUE-BASED QUESTIONS

1. **(i)** The bar graph of the given data is as follows:



(ii) Creating awareness and educating people about the significance of tigers and discouraging poacing.

2. **(i)** Maximum value of observation = 24.

Minimum value of observation = 3

Range = 24 – 3 = 21

Class size = 5

Since $\frac{21}{5}$ = 4.2, we should have five classes each of size 5.

The classes of equal size, covering the given data are:

0–5, 5–10, 10–15, 15–20 and 20–25

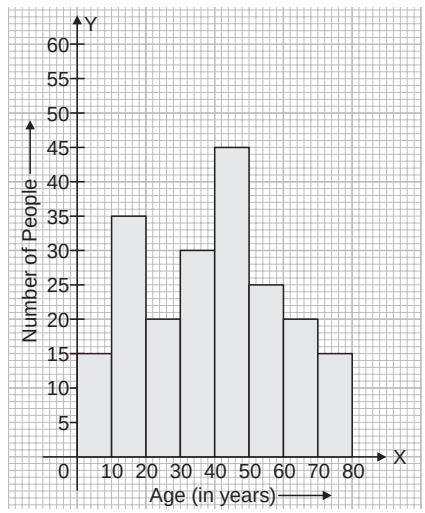
Thus, we obtain the following frequency distribution table.

Number of Patients	*Tally marks*	*Frequency (number of days)*
0–5	||	2
5–10	𝍸 |	6
10–15	𝍸	5
15–20	𝍸 𝍸 ||	12
20–25	𝍸	5

(ii) Number of days for which 15 or more patients were treated = 12 + 5 = 17.

(iii) Commitment, empathy, concern for underprivileged people, responsible behavior, leadership and helpfulness.

3. **(i)** The histogram for the given frequency table is as follows:



(ii) Total population of village

= 15 + 35 + 20 + 30 + 45 + 25 + 20 + 15

= 205

(iii) Number of people whose age is ≥ 50 years

= 25 + 20 + 15 = 60

(iv) Empathy, concern for welfare of the villagers, caring and helpfulness.

4. **(i)** Mean = $\frac{\text{Sum of observations}}{\text{Number of observations}}$

$= \frac{8+1+4+3+6+4+10+12}{8} = \frac{48}{8} = \mathbf{6.}$

Median: Arranging the observations in as ascending order, we have

1, 3, 4, 4, 6, 8, 10, 12

Here, the number of observations, $n = 8$, which is even.

$\therefore$ Median = Average of $\left(\frac{n}{2}\right)$th observation and $\left(\frac{n}{2}+1\right)$th observation.

$\Rightarrow$ Median = Average of $\left(\frac{8}{2}\right)$th observation and $\left(\frac{8}{2}+1\right)$th observation.

$\Rightarrow$ Median = Average of 4th observation and 5th observation.

$\therefore$ Median = $\frac{4+6}{2}$ = **5**

Mode: In the given data, 4 occurs most frequently i.e., two times. So, the mode is **4.**

(ii) Mean = 6, implies that the average percentage of salary spent for buying Diwali gifts = 6%.

Median = 5, implies that four families spend less than 5% of salary for buying Diwali gifts and four families spend more then, 5% of salary for the same.

Mode = 4, implies that out of eight families, most families gifts (i.e., 2 here) spend 4% of salary for the purchase of Diwali gifts.

(iii) Compassion, empathy, caring and generosity.

UNIT TEST

Multiple-Choice Questions

1. (c) **52**

Range = Maximum value – Minimum value
= 99 – 47 = 52

2. (d) **120**

Range = Maximum value – Minimum value
$\Rightarrow$ 38 = Maximum value – 82
$\Rightarrow$ Maximum value = 38 + 82 = 120

3. (c) **11–20**

Since the given class intervals are in inclusive form
$\therefore$ 20 is considered in the class 11–20.

4. (b) **6.5–12.5**

Class mark = 9.5 and class size = 6

$\therefore$ Lower limit of the class interval is $9.5-\frac{6}{2}$ = 6.5

and upper limit of the class interval = $9.5+\frac{6}{2}$ = 12.5

Hence, required class interval is 6.5 – 12.5.

5. (a) **55.5**

Mid–value of a class 60.5 and width of the class is 10.

$\therefore$ Lower limit of the class interval is $60.5-\frac{10}{2}$ = 55.5.

6. (b) **2.5 cm**

In a bar graph, 1 cm represents 30 km.

i.e., length of the bar graph for 30 km is 1 cm.

$\therefore$ Length of the bar graph for 75 km is $\frac{75}{30}$ = 2.5 cm.

7. (c) **Area of the rectangle**

In a histogram, area of the rectangle is proportional to the frequency of the corresponding class.

8. (b) **10**

$$\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$$

$$\Rightarrow \quad 8 = \frac{4+7+x+8+9+10}{6}$$

$$\Rightarrow \quad 48 = 38 + x$$

$$\Rightarrow \quad x = 10$$

9. (a) **5**

The digits are: 1, 2, 3, 4, 5, 6, 7, 8, 9.

Here, the number of observations, $n = 9$ which is odd.

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

= $\left(\frac{9+1}{2}\right)$th observation

= 5th observations = 5.

$\Rightarrow$ Median is 5.

10. (c) **7**

The given numbers are

2, 3, 4, 4, $2x$ + 1, 7, 7, 8 and 9

Here, number of observations, $n = 9$, which is odd.

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

$\Rightarrow \quad 7 = \left(\frac{9+1}{2}\right)$th observation

$\Rightarrow$ 7 = 5th observation = $2x$ + 1

$\Rightarrow \quad 7 = 2x + 1$

$\Rightarrow \quad 2x = 6$

$\Rightarrow \quad x = 3$

$\therefore$ The given numbers are

2, 3, 4, 4, 7, 7, 7, 8, 9

Here, 7 occurs most frequently, i.e., 3 times

$\therefore$ Mode is 7.

Short Answer Questions

11. The continuous grouped frequency distribution table is given below:

Class interval	Frequency
49.5–52.5	7
52.5–55.5	11
55.5–58.5	3

58.5–61.5	8
61.5–64.5	9

55.5 should be included in class interval 55.5–58.5.

12. Here, the number of observations, $n = 10$, which is even.

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

$$\Rightarrow \quad 25 = \frac{\left(\frac{10}{2}\right)\text{th observation} + \left(\frac{10}{2}+1\right)\text{th observation}}{2}$$

$$\Rightarrow \quad 25 = \frac{5\text{th observation} + 6\text{th observation}}{2}$$

$$\Rightarrow \quad 25 = \frac{x+2+x+4}{2}$$

$$\Rightarrow \quad 50 = 2x + 6$$

$$\Rightarrow \quad 2x = 44$$

$$\Rightarrow \quad \boldsymbol{x = 22}$$

13. Arranging the data in ascending order, we have

14, 14, 14, 14, 16, 18, 22, 22, 25, 25, 25, 26, 26, 27, 30

Here, 14 occurs most frequently, i.e., 4 times

$\therefore$ Mode is **14.**

Short Answer Questions

14. Let the average score of 12 innings be x.

Then, average score of 11 innings = $x - 2$.

Total score of 12 innings = $12x$

Total score 11 innings = $11\ (x - 2) = 11x - 22$

Score of the 12th inning = (total score of 12 innings) – (total score of 11 innings)

$$= 12x - (11x - 22) = x + 22$$

$$\therefore \quad x + 22 = 63$$

$$\Rightarrow \quad x = 41$$

Hence, the average score after the 12th inning is **41.**

15. $$\text{Mean} = \frac{\text{Sum of observations}}{\text{Number of observations}}$$

$$\Rightarrow \quad x = \frac{7+2+1+5+3+6}{6}$$

$$\Rightarrow \quad \boldsymbol{x = 4}$$

Then, numbers 7, 3, 3, 2, 5, 4 and y have mean 4

$$\Rightarrow \quad \frac{7+3+3+2+5+4+y}{7} = 4$$

$$\Rightarrow \quad 24 + y = 28$$

$$\Rightarrow \quad \boldsymbol{y = 4}$$

Thus, the numbers are 7, 3, 3, 2, 5, 4, 4.

Arranging these numbers in ascending order, we have

2, 3, 3, 4, 4, 5, 7

Here, number of observations, $n = 7$, which is odd.

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

$$\Rightarrow \quad z = \left(\frac{7+1}{2}\right)\text{th observations}$$

$$\Rightarrow \quad z = 4\text{th observation}$$

$$\Rightarrow \quad \boldsymbol{z = 4}$$

16. Mean of 31 results = 60

$\Rightarrow$ Sum of 31 results = $60 \times 31 = 1860$

Mean of first 16 results = 58

$\Rightarrow$ Sum of first 16 results = 928

Mean of last 16 results = 62

$\Rightarrow$ Sum of last 16 results = 992

Thus,

16th result = Sum of first 16 results + Sum of last 16 results – Sum of 31 results

$= (928 + 992) - 1860$

$= 1920 - 1860$

$\Rightarrow$ 16th result = 60

17. Number of girls = 25

$\Rightarrow$ Number of boys = $60 - 25 = 35$

Mean marks scored by 25 girls = 77

$\therefore$ Total marks scored by 25 girls = $77 \times 25 = 1925$

Similarly, total marks scored by 35 boys = $68 \times 35 = 2380$

$\Rightarrow$ Total marked scored by class = $1925 + 2380 = 4305$

$\therefore$ Mean score of the whose class = $\frac{4305}{60}$ = **71.75**

18. (i)

Class interval	*Tally marks*	*Frequency*
40–49	||||	4
50–59	𝍸 |||	8
60–69	𝍸 |	6
70–79	𝍸 ||	7
80–89	𝍸	5

(ii) The interval 50–59 contains the greatest number of students.

(iii) Students weigh less than 70 kg = 4 + 8 + 6 = 18.

19. Let the temperature of Monday, Tuesday, Wednesday and Thursday be x, y, z and p respectively.

Then, $$\frac{x+y+z}{3} = 30$$

$$\Rightarrow \quad x + y + z = 90 \qquad \ldots(1)$$

Also, $$\frac{y+z+p}{3} = 31$$

$$\Rightarrow \quad y + z + p = 93 \qquad \ldots(2)$$

Given that, the temperature on Thursday is 32°C

$$\therefore \quad p = 32$$

From (2), we have

$$y + z + 32 = 93$$

$$\Rightarrow \quad y + z = 93 - 32$$

$$\Rightarrow \quad y + z = 61 \qquad \ldots(3)$$

From (1) and (3), we have

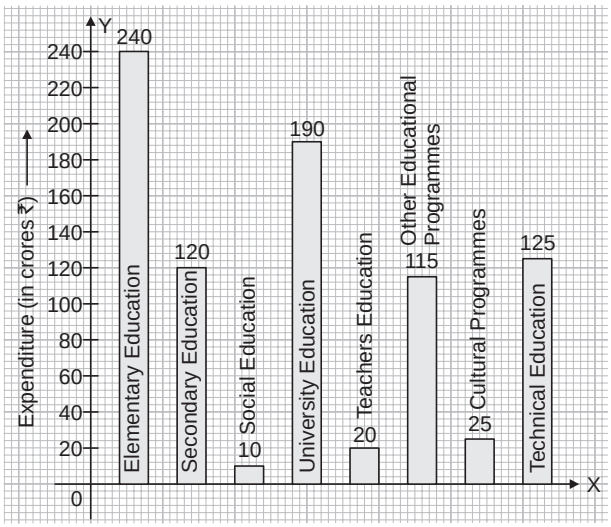
$$x + 61 = 90$$

$$\Rightarrow \quad x = 90 - 61 = 29$$

Hence, temperature on Monday was **29°C.**

Long Answer Questions

20. **(i)** The bar graph of the given data is as follows:



(ii) The expenditure on elementary education is 240 cr and that on social education is 10 cr.

$\therefore$ The required ratio is 240 : 10 i.e., **24 : 1.**

21. Since the class marks are uniformly spaced, therefore the class size is the difference between consecutive class marks,

$\therefore$ Class size = 15 – 5 = 10

Let x be the class mark and h be the class size.

Then, lower limit of the class interval is $x - \frac{h}{2}$ and upper limit of the class interval is $x + \frac{h}{2}$.

Thus, lower limit of the first class interval is $5 - \frac{10}{2} = 0$

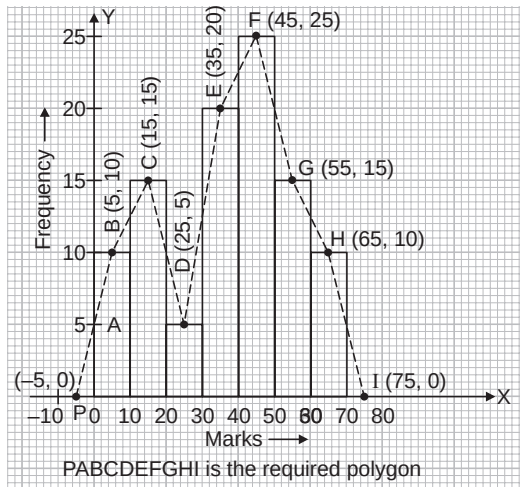
Upper limit of the first class interval is $5 + \frac{10}{2} = 10$

Hence, first class interval is 0–10.

Similarly, we obtain all the class intervals and obtain the following table.

Class interval	*Frequency*
0–10	10
10–20	15
20–30	5
30–40	20
40–50	25
50–60	15
60–70	10

The histogram and frequency polygon of the above frequency distribution is given below:



(i) Number of students who obtained marks between 29 and 40 is 20.

(ii) Number of students who obtained less than 40 marks is 10 + 15 + 5 + 20 = 50.

(iii) Number of students who obtained marks between 49870 is 15 + 10 = 25.

(iv) Number of students who obtained less than 20 marks is 10 + 15 = 25.

22. Let the assumed mean 'a' = 67.5

Class	*Mid-value* x_i	*Frequency* f	$d_i = x_i - a$	$f_i\, d_i$
50–55	52.5	5	–15	–75
55–60	57.5	f	–10	$-10f$
60–65	62.5	10	–5	–50
65–70	67.5	10	0	0
70–75	72.5	9	5	45
75–80	77.5	6	10	60
80–85	82.5	12	15	180
85–90	87.5	8	20	160
Total		$\Sigma f_i = 60 + f$		$\Sigma F_i\, d_i = 320 - 10f$

$$\text{Mean} = \frac{\Sigma f_i d_i}{\Sigma f_i}$$

$$\Rightarrow \quad 69 = 67.5 + \frac{320 - 10f}{60 + f}$$

$$\Rightarrow \quad 1.5 = \frac{320 - 10f}{60 + f}$$

$$\Rightarrow \quad 90 + 1.5f = 320 - 10f$$

$$\Rightarrow \quad 11.5f = 320 - 90$$

$$\Rightarrow \quad \mathbf{f = 20}$$

23. Let the weight of group A, group B, group C be x, y, z respectively.

Then, $\frac{x + y + z}{50} = 47.6$

$$\Rightarrow \quad x + y + z = 2380 \qquad \ldots(1)$$

Mean weight of group A = 40 kg

$\Rightarrow$ Weight of group A i.e., $x = 40 \times 22 = 880$ kg

Similarly, $y = 900$ kg

From (1), we have

$$880 + 900 + z = 2380$$

$$\Rightarrow \quad z = 2380 - 1780 = 600 \text{ kg}$$

Thus, mean weight of the group C = $\frac{600}{10}$ = **60 kg.**