EXERCISE 23.1 PAGE NO: 23.6

1. Ashish studies for 4 hours, 5 hours and 3 hours on three consecutive days. How many hours does he study daily on an average?

Solution:

Given Ashish studies for 4 hours, 5 hours and 3 hours on three consecutive days
Average number of study hours = sum of hours/ number of days
Average number of study hours = (4 + 5 + 3) ÷ 3
= 12 ÷ 3
= 4 hours
Thus, Ashish studies for 4 hours on an average.

2. A cricketer scores the following runs in 8 innings: 58, 76, 40, 35, 48, 45, 0, 100. Find the mean score.

Solution:

Given runs in 8 innings: 58, 76, 40, 35, 48, 45, 0, 100
Mean score = total sum of runs/number of innings
The mean score = (58 + 76 + 40 + 35 + 48 + 45 + 0 + 100) ÷ 8
= 402 ÷ 8
= 50.25 runs.

3. The marks (out of 100) obtained by a group of students in science test are 85, 76, 90, 84, 39, 48, 56, 95, 81 and 75. Find the
(i) Highest and the lowest marks obtained by the students.
(ii) Range of marks obtained.
(iii) Mean marks obtained by the group.

Solution:

In order to find the highest and lowest marks, we have to arrange the marks in ascending order as follows:
39, 48, 56, 75, 76, 81, 84, 85, 90, 95

(i) Clearly, the highest mark is 95 and the lowest is 39.

(ii) The range of the marks obtained is: (95 – 39) = 56.

(iii) From the following data, we have
Mean marks = Sum of the marks/ Total number of students
Mean marks = (39 + 48 + 56 + 75 + 76 + 81 + 84 + 85 + 90 + 95) ÷ 10
= 729 ÷ 10
= 72.9.
Hence, the mean mark of the students is 72.9.

4. The enrolment of a school during six consecutive years was as follows:
1555, 1670, 1750, 2019, 2540, 2820
Find the mean enrolment of the school for this period.

Solution:
Given enrolment of a school during six consecutive years as follows
1555, 1670, 1750, 2019, 2540, 2820
The mean enrolment = Sum of the enrolments in each year/ Total number of years
The mean enrolment = (1555 + 1670 + 1750 + 2019 + 2540 + 2820) ÷ 6
= 12354 ÷ 6
= 2059.
Thus, the mean enrolment of the school for the given period is 2059.

5. The rainfall (in mm) in a city on 7 days of a certain week was recorded as follows:

Day	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**
Rainfall (in mm)	**0.0**	**12.2**	**2.1**	**0.0**	**20.5**	**5.3**	**1.0**

(i) Find the range of the rainfall from the above data.
(ii) Find the mean rainfall for the week.
(iii) On how many days was the rainfall less than the mean rainfall.

Solution:
(i) The range of the rainfall = Maximum rainfall – Minimum rainfall
= 20.5 – 0.0
= 20.5 mm.

(ii) The mean rainfall = (0.0 + 12.2 + 2.1 + 0.0 + 20.5 + 5.3 + 1.0) ÷ 7
= 41.1 ÷ 7
= 5.87 mm.

(iii) Clearly, there are 5 days (Mon, Wed, Thu, Sat and Sun), when the rainfall was less than the mean, i.e., 5.87 mm.

6. If the heights of 5 persons are 140 cm, 150 cm, 152 cm, 158 cm and 161 cm respectively, find the mean height.

Solution:
The mean height = Sum of the heights /Total number of persons
= (140 + 150 + 152 + 158 + 161) ÷ 5
= 761 ÷ 5
= 152.2 cm.

7. Find the mean of 994, 996, 998, 1002 and 1000.

Solution:
Mean = Sum of the given numbers/Total number of given numbers
Mean = (994 + 996 + 998 + 1002 + 1000) ÷ 5
= 4990 ÷ 5
= 998.

8. Find the mean of first five natural numbers.

Solution:
We know that first five natural numbers = 1, 2, 3, 4 and 5
Mean of first five natural numbers = (1 + 2 + 3 + 4 + 5) ÷ 5
= 15 ÷ 5
= 3

9. Find the mean of all factors of 10.

Solution:
We know that factors of 10 are 1, 2, 5 and 10
Arithmetic mean of all factors of 10 = (1 + 2 + 5 + 10) ÷ 4
= 18 ÷ 4
= 4.5

10. Find the mean of first 10 even natural numbers.

Solution:
The first 10 even natural numbers are 2, 4, 6, 8, 10, 12, 14, 16, 18 and 20.
Mean of first 10 even natural numbers = (2 + 4 + 6 + 8 + 10 + 12 + 14 + 16 + 18 + 20) ÷ 10
= 110 ÷ 10
= 11

11. Find the mean of x, x + 2, x + 4, x + 6, x + 8

Solution:
Mean = Sum of observations ÷ Number of observations
Mean = (x + x + 2 + x + 4 + x + 6 + x + 8) ÷ 5
Mean = (5x + 20) ÷ 5
Mean = 5 (x + 4) ÷ 5
Mean = x + 4

12. Find the mean of first five multiples of 3.

Solution:
The first five multiples of 3 are 3, 6, 9, 12 and 15.
Mean of first five multiples of 3 are = (3 + 6 + 9 + 12 + 15) ÷ 5
= 45 ÷ 5
= 9

13. Following are the weights (in kg) of 10 new born babies in a hospital on a particular day: 3.4, 3.6, 4.2, 4.5, 3.9, 4.1, 3.8, 4.5, 4.4, 3.6 Find the mean $\overline{X}$

Solution:
We know that
$\overline{X}$ = sum of observations/ number of observations
= sum of weights of babies/ number of babies
$\overline{X}$ = (3.4 + 3.6 + 4.2 + 4.5 + 3.9 + 4.1 + 3.8 + 4.5 + 4.4 + 3.6) ÷ 10
$\overline{X}$ = (40) ÷ 10
$\overline{X}$ = 4 kg

14. The percentage of marks obtained by students of a class in mathematics are:

64, 36, 47, 23, 0, 19, 81, 93, 72, 35, 3, 1 Find their mean.

Solution:
Mean = sum of the marks obtained/ total number of students
= (64 + 36 + 47 + 23 + 0 + 19 + 81 + 93 + 72 + 35 + 3 + 1) ÷ 12
= 474 ÷ 12
= 39.5%

15. The numbers of children in 10 families of a locality are:
2, 4, 3, 4, 2, 3, 5, 1, 1, 5 Find the mean number of children per family.

Solution:
Mean number of children per family = sum of total number of children / total number of families
= (2 + 4 + 3 + 4 + 2 + 3 + 5 + 1 + 1 + 5) ÷ 10
= 30 ÷ 10
= 3
Thus, on an average there are 3 children per family in the locality.

16. The mean of marks scored by 100 students was found to be 40. Later on it was discovered that a score of 53 was misread as 83. Find the correct mean.

Solution:
Given n = the number of observations = 100, Mean = 40
Mean = sum of observations/total number of observations
40 = sum of the observations/ 100
Sum of the observations = 40 x 100
Thus, the incorrect sum of the observations = 40 x 100 = 4000.
Now,
The correct sum of the observations = Incorrect sum of the observations – Incorrect observation + Correct observation
The correct sum of the observations = 4000 – 83 + 53
The correct sum of the observations = 4000 – 30 = 3970
Correct mean = correct sum of the observations/ number of observations
= 3970/100
= 39.7

17. The mean of five numbers is 27. If one number is excluded, their mean is 25. Find the excluded number.

Solution:
We know that
Mean = sum of five numbers/5 = 27
So, sum of the five numbers = 5 x 27 = 135.
Now,
The mean of four numbers = sum of the four numbers/4 = 25
So, sum of the four numbers = 4 x 25 = 100.
Therefore, the excluded number = Sum of the five number – Sum of the four numbers
The excluded number = 135 – 100
= 35.

18. The mean weight per student in a group of 7 students is 55 kg. The individual weights of 6 of them (in kg) are 52, 54, 55, 53, 56 and 54. Find the weight of the seventh student.

Solution:
We know that
Mean = sum of weights of students/ number of students
Let the weight of the seventh student be x kg.
Mean = (52 + 54 + 55 + 53 + 56 + 54 + x)/ 7
55 = (52 + 54 + 55 + 53 + 56 + 54 + x)/ 7
55 x 7 = 324 + x
385 = 324 + x
x = 385 – 324
x = 61 kg.
Therefore weight of seventh student is 61kg.

19. The mean weight of 8 numbers is 15 kg. If each number is multiplied by 2, what will be the new mean?

Solution:
Let x_1, x_2, $x_3 \ldots x_8$ be the eight numbers whose mean is 15 kg. Then,
$15 = x_1 + x_2 + x_3 + \ldots\ldots + x_8 /8$
$x_1 + x_2 + x_3 + \ldots + x_8 = 15 \times 8$

$x_1 + x_2 + x_3 + \ldots + x_8 = 120$.
Let the new numbers be $2x_1, 2x_2, 2x_3 \ldots 2x_8$.
Let M be the arithmetic mean of the new numbers.
Then,
$M = 2x_1 + 2x_2 + 2x_3 + \ldots + 2x_8/8$
$M = 2(x_1 + x_2 + x_3 + \ldots + x_8)/8$
$M = (2 \times 120)/8$
$= 30$

20. The mean of 5 numbers is 18. If one number is excluded, their mean is 16. Find the excluded number.

Solution:
Let x_1, x_2, x_3, x_4 and x_5 be five numbers whose mean is 18. Then,
18 = Sum of five numbers ÷ 5
Hence, sum of five numbers = 18 × 5 = 90
Now, if one number is excluded, then their mean is 16.
So,
16 = Sum of four numbers ÷ 4
Therefore sum of four numbers = 16 × 4 = 64.
The excluded number = Sum of five observations – Sum of four observations
The excluded number = 90 – 64
Therefore The excluded number = 26.

21. The mean of 200 items was 50. Later on, it was discovered that the two items were misread as 92 and 8 instead of 192 and 88. Find the correct mean.

Solution:
Given n = Number of observations = 200
Mean = sum of observations/ number of observations
50 = sum of observations/ 200
Sum of the observations = 50 x 200 = 10,000.
Thus, the incorrect sum of the observations = 50 x 200
Now,
The correct sum of the observations = Incorrect sum of the observations – Incorrect observations + Correct observations
Correct sum of the observations = 10,000 – (92 + 8) + (192 + 88)

Correct sum of the observations = 10,000 – 100 + 280
Correct sum of the observations = 9900 + 280
Correct sum of the observations = 10,180.
Therefore correct mean = correct sum of the observations/ number of observations
= 10180/200
= 50.9

22. The mean of 5 numbers is 27. If one more number is included, then the mean is 25. Find the included number.

Solution:
Given Mean = Sum of five numbers ÷ 5
Sum of the five numbers = 27 × 5 = 135.
Now, New mean = 25
25 = Sum of six numbers ÷ 6
Sum of the six numbers = 25 × 6 = 150.
The included number = Sum of the six numbers – Sum of the five numbers
The included number = 150 – 135
Therefore the included number = 15.

23. The mean of 75 numbers is 35. If each number is multiplied by 4, find the new mean.

Solution:
Let x_1, x_2, x_3…x_{75} be 75 numbers with their mean equal to 35. Then,
$35 = x_1 + x_2 + x_3 + \ldots.. + x_{75} /75$
$x_1 + x_2 + x_3 + \ldots.. + x_{75} = 35 \times 75$
$x_1 + x_2 + x_3 +\ldots+ x_{75} = 2625$
The new numbers are 4 x 1, 4 x 2, 4 x 3…4 x 75
Let M be the arithmetic mean of the new numbers. Then,
$M = 4x_1 + 4x_2 + 4x_3 +\ldots+ 4x_{75}/75$
$M = 4 (x_1 + x_2 + x_3 + \ldots+ x_{75})/75$
$M = (4 \times 2625)/75$
$= 140$

EXERCISE 23.2 PAGE NO: 23.12

1. A die was thrown 20 times and the following scores were recorded:
5, 2, 1, 3, 4, 4, 5, 6, 2, 2, 4, 5, 5, 6, 2, 2, 4, 5, 5, 1
Prepare the frequency table of the scores on the upper face of the die and find the mean score.

Solution:
The frequency table for the given data is as follows:

x:	1	2	3	4	5	6
f:	2	5	1	4	6	2

To compute arithmetic mean we have to prepare the following table:

Scores (x_i)	Frequency (f_i)	$x_i f_i$
1	2	2
2	5	10
3	1	3
4	4	16
5	6	30
6	2	12
Total	$\Sigma f_i = 20$	$\Sigma f_i x_i$

Mean score = $\Sigma f_i x_i / \Sigma f_i$
= 73/20
= 3.65

2. The daily wages (in Rs) of 15 workers in a factory are given below:
200, 180, 150, 150, 130, 180, 180, 200, 150, 130, 180, 180, 200, 150, 180
Prepare the frequency table and find the mean wage.

Solution:

Wages (x_i)	130	150	180	200
Number of workers (f_i)	2	4	6	3

To compute arithmetic mean we have to prepare the following table:

x_i	f_i	$x_i f_i$
130	2	260
150	4	600
180	6	1080
200	3	600
Total	$\Sigma f_i = N = 15$	$\Sigma f_i x_i = 2540$

Mean score = $\Sigma f_i x_i / \Sigma f_i$
= 2540/15
= 169.33

3. The following table shows the weights (in kg) of 15 workers in a factory:

Weight (in Kg)	60	63	66	72	75
Number of workers	4	5	3	1	2

Calculate the mean weight.

Solution:
Calculation of mean:

x_i	f_i	$x_i f_i$
60	4	240
63	5	315
66	3	198
72	1	72
75	2	150
Total	$\Sigma f_i = N = 15$	$\Sigma f_i x_i = 975$

Mean score = $\Sigma f_i x_i / \Sigma f_i$
= 975/15
= 65 kg

4. The ages (in years) of 50 students of a class in a school are given below:

Age (in years)	14	15	16	17	18
Number of students	15	14	10	8	3

Find the mean age.

Solution:

Calculation of mean:

x_i	f_i	$x_i f_i$
14	15	210
15	14	210
16	10	160
17	8	136
18	3	54
Total	$\Sigma f_i = N = 50$	$\Sigma f_i x_i = 770$

Mean score = $\Sigma f_i x_i / \Sigma f_i$
= 770/50
= 15.4 years

5. Calculate the mean for the following distribution:

x:	**5**	**6**	**7**	**8**	**9**
f:	**4**	**8**	**14**	**11**	**3**

Solution:

x_i	f_i	$x_i f_i$
5	4	20
6	8	48
7	14	98
8	11	88
9	3	27
Total	$\Sigma f_i = N = 40$	$\Sigma f_i x_i = 281$

Mean score = $\Sigma f_i x_i / \Sigma f_i$
= 281/40
= 7.025

6. Find the mean of the following data:

x:	**19**	**21**	**23**	**25**	**27**	**29**	**31**
f:	**13**	**15**	**16**	**18**	**16**	**15**	**13**

Solution:

x_i	f_i	$x_i f_i$
19	13	247
21	15	315
23	16	368
25	18	450
27	16	432
29	15	435
31	13	403
Total	$\Sigma f_i = N = 106$	$\Sigma f_i x_i = 2650$

Mean score = $\Sigma f_i x_i / \Sigma f_i$
= 2650/106
= 25

7. The mean of the following data is 20.6. Find the value of p.

x:	**10**	**15**	**p**	**25**	**31**
f:	**3**	**10**	**25**	**7**	**5**

Solution:

x_i	f_i	$x_i f_i$
10	3	30
15	10	150
P	25	25p
25	7	175
31	5	175
Total	$\Sigma f_i = N = 50$	$\Sigma f_i x_i = 530 + 25p$

Mean score = $\Sigma f_i x_i / \Sigma f_i$
20.6 = 530 + 25p/50
530 + 25 p = 20.6 x 50
25 p = 1030 – 530
p = 500/25
p = 20

8. If the mean of the following data is 15, find p.

x:	5	10	15	20	25
f:	6	p	6	10	5

Solution:

x_i	f_i	$x_i f_i$
5	6	30
10	P	10p
15	6	90
20	10	200
25	5	125
Total	$\Sigma f_i = 27 + p$	$\Sigma f_i x_i = 445 + 10p$

Mean score = $\Sigma f_i x_i / \Sigma f_i$

15 = 445 + 10p/27 + p

445 + 10 p = 405 + 15p

5 p = 445 – 405

p = 40/5

p = 8

9. Find the value of p for the following distribution whose mean is 16.6

x:	8	12	15	p	20	25	30
f:	12	16	20	24	16	8	4

Solution:

x_i	f_i	$x_i f_i$
8	12	96
12	16	192
15	20	300
P	24	24p
20	16	320
25	8	200
30	4	120
Total	$\Sigma f_i = N = 100$	$\Sigma f_i x_i = 1228 + 24p$

Mean score = $\Sigma f_i x_i / \Sigma f_i$

16.6 = 1228 + 24p/100
1228 + 24 p = 16.6 x 100
24 p = 1660 – 1228
p = 432/24
p = 18

10. Find the missing value of p for the following distribution whose mean is 12.58

x:	5	8	10	12	p	20	25
f:	2	5	8	22	7	4	2

Solution:

x_i	f_i	$x_i f_i$
5	2	10
8	5	40
10	8	80
12	22	264
P	7	7p
20	4	80
25	2	50
Total	$\Sigma f_i = N = 50$	$\Sigma f_i x_i = 524 + 7p$

Mean score = $\Sigma f_i x_i / \Sigma f_i$
12.58 = 524 + 7p/50
524 + 7 p = 12.58 x 50
7 p = 629 – 524
p = 105/7
p = 15

11. Find the missing frequency (p) for the following distribution whose mean is 7.68

x:	3	5	7	9	11	13
f:	6	8	15	p	8	4

Solution:

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

Mean score = $\Sigma f_i x_i / \Sigma f_i$

$7.68 = 303 + 9p/41 + p$

$303 + 9 p = 314.88 + 7.68p$

$1.32 p = 314.88 – 303$

$p = 11.88/1.32$

$p = 9$

12. Find the value of p, if the mean of the following distribution is 20

x:	15	17	19	20 + p	23
f:	**2**	**3**	**4**	**5p**	**6**

Solution:

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

Mean score = $\Sigma f_i x_i / \Sigma f_i$

$20 = [(295 + (20 + p) 5p)]/ 15 + 5p$

$295 + 100 p + 5p^2 = 300 + 100p$

$5p^2 = 300 – 295$

$5p^2 = 5$

$p^2 = 1$

$p = 1$

EXERCISE 23.3 PAGE NO: 23.16

Find the median of the following data (1 – 8)
1. 83, 37, 70, 29, 45, 63, 41, 70, 34, 54

Solution:
First we have to arrange given data into ascending order,
29, 34, 37, 41, 45, 54, 63, 70, 70, 83
Given number of observations, n = 10 (even)
Therefore median = $(n/2)^{th}$ term + $((n + 1)/2)^{th}$ term
Median = (value of 5^{th} term + value of 6^{th} term)/2
= (45 + 54)/2
= 49.5
Hence median for given data = 49.5

2. 133, 73, 89, 108, 94,104, 94, 85, 100, 120

Solution:
First we have to arrange given data into ascending order,
73, 85, 89, 94, 100, 104, 108, 120, 133
Given number of observations, n = 10 (even)
Therefore median = $(n/2)^{th}$ term + $((n + 1)/2)^{th}$ term
Median = (value of 5^{th} term + value of 6^{th} term)/2
= (94 + 100)/2
= 97
Hence median for given data = 97

3. 31, 38, 27, 28, 36, 25, 35, 40

Solution:
First we have to arrange given data into ascending order
25, 27, 28, 31, 35, 36, 38, 40
Given number of observations, n = 8 (even)
Therefore median = $(n/2)^{th}$ term + $((n + 1)/2)^{th}$ term
Median = (value of 4^{th} term + value of 5^{th} term)/2
= (31 + 35)/2

= 33
Hence median for given data = 33

4. 15, 6, 16, 8, 22, 21, 9, 18, 25

Solution:
First we have to arrange given data into ascending order
6, 8, 9, 15, 16, 18, 21, 22, 25
Given number of observations, n = 9 (odd)
Therefore median = $((n+1)/2)^{th}$ term
Median = value of 5^{th} term
= 16

5. 41, 43,127, 99, 71, 92, 71, 58, 57

Solution:
First we have to arrange given data into ascending order
41, 43, 57, 58, 71, 71, 92, 99, 127
Given number of observations, n = 9 (odd)
Therefore median = $((n+1)/2)^{th}$ term
Median = value of 5^{th} term
= 71

6. 25, 34, 31, 23, 22, 26, 35, 29, 20, 32

Solution:
First we have to arrange given data into ascending order,
20, 22, 23, 25, 26, 29, 31, 32, 34, 35
Given number of observations, n = 10 (even)
Therefore median = $(n/2)^{th}$ term + $((n + 1)/2)^{th}$ term
Median = (value of 5^{th} term + value of 6^{th} term)/2
= (26 + 29)/2
= 27.5
Hence median for given data = 27.5

7. 12, 17, 3, 14, 5, 8, 7, 15

Solution:
First we have to arrange given data into ascending order,
3, 5, 7, 8, 12, 14, 15, 17
Given number of observations, n = 8 (even)
Therefore median = $(n/2)^{th}$ term + $((n+1)/2)^{th}$ term
Median = (value of 4^{th} term + value of 5^{th} term)/2
= (8 + 12)/2
= 10
Hence median for given data = 10

8. 92, 35, 67, 85, 72, 81, 56, 51, 42, 69

Solution:
First we have to arrange given data into ascending order,
35, 42, 51, 56, 67, 69, 72, 81, 85, 92
Given number of observations, n = 10 (even)
Therefore median = $(n/2)^{th}$ term + $((n + 1)/2)^{th}$ term
Median = (value of 5^{th} term + value of 6^{th} term)/2
= (67 + 69)/2
= 68
Hence median for given data = 68

9. Numbers 50, 42, 35, 2x +10, 2x – 8, 12, 11, 8, 6 are written in descending order and their median is 25, find x.

Solution:
Here, the number of observations n is 9.
Since n is odd, the median is the n+12th observation, i.e., the 5^{th} observation.
As the numbers are arranged in the descending order, we therefore observe from the last.
Median = 5^{th} observation.
=> 25 = 2x – 8
=> 2x = 25 + 8
=> 2x = 33
=> x = (33/2)
x = 16.5

10. Find the median of the following observations: 46, 64, 87, 41, 58, 77, 35, 90, 55, 92, 33. If 92 is replaced by 99 and 41 by 43 in the above data, find the new median?

Solution:
Arranging the given data in ascending order, we have:
33, 35, 41, 46, 55, 58, 64, 77, 87, 90, 92
Here, the number of observations n is 11 (odd).
Since the number of observations is odd, therefore,
Therefore median = $((n+1)/2)^{th}$ term
Median = value of 5^{th} term
= 58.
Hence, median = 58.
If 92 is replaced by 99 and 41 by 43, then the new observations arranged in ascending order are:
33, 35, 43, 46, 55, 58, 64, 77, 87, 90, 99
New median = Value of the 6^{th} observation = 58.

11. Find the median of the following data: 41, 43, 127, 99, 61, 92, 71, 58, 57, If 58 is replaced by 85, what will be the new median?

Solution:
Arranging the given data in ascending order, we have:
41, 43, 57, 58, 61, 71, 92, 99,127
Here, the number of observations, n, is 9(odd).
Therefore median = $((n+1)/2)^{th}$ term
Median = value of 5^{th} term
Hence, the median = 61.
If 58 is replaced by 85, then the new observations arranged in ascending order are:
41, 43, 57, 61, 71, 85, 92, 99, 12
New median = Value of the 5^{th} observation = 71.

12. The weights (in kg) of 15 students are: 31, 35, 27, 29, 32, 43, 37, 41, 34, 28, 36, 44, 45, 42, 30. Find the median. If the weight 44 kg is replaced by 46 kg and 27 kg by 25 kg, find the new median.

Solution:
Arranging the given data in ascending order, we have:

27, 28, 29, 30, 31, 32, 34, 35, 36, 37, 41, 42, 43, 44, 45
Here, the number of observations n is 15(odd).
Since the number of observations is odd, therefore,
Therefore median = $((n+1)/2)^{th}$ term
Median = value of 8^{th} term
Hence, median = 35 kg.
If 44 kg is replaced by 46 kg and 27 kg by 25 kg, then the new observations arranged in ascending order are:
25, 28, 29, 30, 31, 32, 34, 35, 36, 37, 41, 42, 43, 45, 46
∴ New median = Value of the 8^{th} observation = 35 kg.

13. The following observations have been arranged in ascending order. If the median of the data is 63, find the value of x: 29, 32, 48, 50, x, x + 2, 72, 78, 84, 95

Solution:
Here, the number of observations n is 10. Since n is even,
Therefore median = $(n/2)^{th}$ term + $((n + 1)/2)^{th}$ term
Median = (value of 5^{th} term + value of 6^{th} term)/2
63 = x + (x + 2)/2
63 = (2x + 2)/2
63 = 2 (x + 1)/2
63 = x + 1
x = 63 – 1
x = 62

EXERCISE 23.4 PAGE NO: 23.20

1. Find the mode and median of the data: 13, 16, 12, 14, 19, 12, 14, 13, 14
By using the empirical relation also find the mean.

Solution:
Arranging the data in ascending order such that same numbers are put together, we get:
12, 12, 13, 13, 14, 14, 14, 16, 19
Here, n = 9.
Therefore median = $((n+1)/2)^{th}$ term
Median = value of 5^{th} term
Median = 14
Here, 14 occurs the maximum number of times, i.e., three times. Therefore, 14 is the mode of the data.
Now,
Mode = 3 Median – 2 Mean
14 = 3 x 14 – 2 Mean
2 Mean = 42 – 14 = 28
Mean = 28 ÷ 2
= 14.

2. Find the median and mode of the data: 35, 32, 35, 42, 38, 32, 34

Solution:
Arranging the data in ascending order such that same numbers are put together, we get:
32, 32, 34, 35, 35, 38, 42
Here, n = 7
Therefore median = $((n+1)/2)^{th}$ term
Median = value of 4^{th} term
Median = 35
Here, 32 and 35, both occur twice. Therefore, 32 and 35 are the two modes.

3. Find the mode of the data: 2, 6, 5, 3, 0, 3, 4, 3, 2, 4, 5, 2, 4

Solution:
Arranging the data in ascending order such that same values are put together, we get:

0, 2, 2, 2, 3, 3, 3, 4, 4, 4, 5, 5, 6
Here, 2, 3 and 4 occur three times each. Therefore, 2, 3 and 4 are the three modes.

4. The runs scored in a cricket match by 11 players are as follows:
6, 15, 120, 50, 100, 80, 10, 15, 8, 10, 10
Find the mean, mode and median of this data.

Solution:
Arranging the data in ascending order such that same values are put together, we get:
6, 8, 10, 10, 15, 15, 50, 80, 100, 120
Here, n = 11
Therefore median = $((n+1)/2)^{th}$ term
Median = value of 6^{th} term
Median = 15
Here, 10 occur three times. Therefore, 10 is the mode of the given data.
Now,
Mode = 3 Median – 2 Mean
10 = 3 x 15 – 2 Mean
2 Mean = 45 – 10 = 35
Mean = 35 ÷ 2
= 17.5

5. Find the mode of the following data:
12, 14, 16, 12, 14, 14, 16, 14, 10, 14, 18, 14

Solution:
Arranging the data in ascending order such that same values are put together, we get:
10, 12, 12, 14, 14, 14, 14, 14, 14, 16, 18
Here, clearly, 14 occurs the most number of times.
Therefore, 14 is the mode of the given data.

6. Heights of 25 children (in cm) in a school are as given below:
168, 165, 163, 160, 163, 161, 162, 164, 163, 162, 164, 163, 160, 163, 163, 164, 163, 160, 165, 163, 162
What is the mode of heights?
Also, find the mean and median.

Solution:

Arranging the data in tabular form, we get:

Height of Children (cm)	Tally marks	Frequency
160	|||	3
161	|	1
162	||||	4
163	~~||||~~ ~~||||~~	10
164	|||	3
165	|||	3
168	|	1
Total		25

Therefore median = $((n+1)/2)^{th}$ term

Median = value of 13^{th} term

Median = 163 cm

Here, clearly, 163 cm occurs the most number of times. Therefore, the mode of the given data is 163 cm.

Mode = 3 Median – 2 Mean

163 = 3 x 163 – 2 Mean

2 Mean = 326

Mean = 163 cm.

7. The scores in mathematics test (out of 25) of 15 students are as follows:
19, 25, 23, 20, 9, 20, 15, 10, 5, 16, 25, 20, 24, 12, 20
Find the mode and median of this data. Are they same?

Solution:

Arranging the data in ascending order such that same values are put together, we get:

5, 9, 10, 12, 15, 16, 19, 20, 20, 20, 20, 23, 24, 25, 25

Here, n = 15

Therefore median = $((n+1)/2)^{th}$ term

Median = value of 8^{th} term

Median = 20

Here, clearly, 20 occurs most number of times, i.e., 4 times. Therefore, the mode of the given data is 20.

Yes, the median and mode of the given data are the same.

8. Calculate the mean and median for the following data:

Marks	10	11	12	13	14	16	19	20
Number of students	3	5	4	5	2	3	2	1

Using empirical formula, find its mode.

Solution:

Calculation of mean

Mean = $\Sigma f_i x_i / \Sigma f_i$

= 332/25

= 13.28

Here, n = 25, which is an odd number. Therefore,

Therefore median = $((n+1)/2)^{th}$ term

Median = value of 13^{th} term

Median = 13

Now, by using empirical formula we have,

Mode = 3Median – 2 Mean

Mode = 3 (13) – 2 (13.28)

Mode = 39 – 26.56

Mode = 12.44.

9. The following table shows the weights of 12 persons.

Weight (in kg)	48	50	52	54	58
Number of persons	4	3	2	2	1

Find the median and mean weights. Using empirical relation, calculate its mode.

Solution:

x_i	f_i	$x_i f_i$
48	4	192
50	3	150
52	2	104
54	2	108
58	1	58
Total	$\Sigma f_i = 12$	$\Sigma f_i x_i = 612$

Calculation of mean

Mean = $\Sigma f_i x_i / \Sigma f_i$

= 612/12

= 51 kg

Here n = 12

Therefore median = $(n/2)^{th}$ term + $((n + 1)/2)^{th}$ term
Median = (value of 6^{th} term + value of 7^{th} term)/2
= (50 + 50)/2
= 50
Now by empirical formula we have,
Now,
Mode = 3 Median – 2 Mean
Mode = 3 x 50 – 2 x 51
Mode = 150 – 102
Mode = 48 kg.
Thus, Mean = 51 kg, Median = 50 kg and Mode = 48 kg.