

Chapter 13: Statistics

NCERT · Class 10 · Maths

Exercise 13.1

Question 1

A survey was conducted by a group of students as a part of their environment awareness programme, in which they collected the following data regarding the number of plants in 20 houses in a locality. Find the mean number of plants per house.

Number of Plants	0 – 2	2 – 4	4 – 6	6 – 8	8 – 10	10 – 12	12 – 14
Number of Houses	1	2	1	5	6	2	3

Which method did you use for finding the mean, and why?

Solution

Ans: The number of houses denoted by

$$x_i$$

.

The mean can be found as given below:

$$\bar{X} = \frac{\sum f_i x_i}{\sum f_i}$$

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

$$x_i$$

and

$$f_i x_i$$

can be calculated as follows:

Number of Plants	Number of houses f_i	x_i	$f_i x_i$
0 – 2	1	1	$1 \times 1 = 1$
2 – 4	2	3	$2 \times 3 = 6$
4 – 6	1	5	$1 \times 5 = 5$
6 – 8	5	7	$5 \times 7 = 35$
8 – 10	6	9	$6 \times 9 = 54$
10 – 12	2	11	$2 \times 11 = 22$
12 – 14	3	13	$3 \times 13 = 39$
Total	20		162

From the table, it can be observed that

$$\sum f_i = 20$$

$$\sum f_i x_i = 162$$

Substituting the value of

$$f_i x_i$$

and f_i in the formula of mean we get:

Mean number of plants per house

$$(\bar{X})$$

:

$$\bar{X} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\bar{X} = \frac{162}{20} = 8.1$$

Therefore, the mean number of plants per house is

$$8.1$$

.

In this case, we will use the direct method because the value of

$$x_i$$

and f_i .

Question 2

Consider the following distribution of daily wages of

$$50$$

workers of a factory.

Daily Wages (in Rs)	100 – 120	120 - 140	140 - 160	160 - 180	180 - 200
Number of Workers	12	14	8	6	10

Find the mean daily wages of the workers of the factory by using an appropriate method.

Solution

Ans: Let the class size of the data be h .

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Take the assured mean

$$(a)$$

of the given data

$$a = 150$$

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (

$$h$$

) of this data is:

$$h = 120 - 100$$

$$h = 20$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be evaluated as follows:

Daily Wages (In Rs)	Number of Workers (f_i)	x_i	$d_i = x_i - 150$	$u_i = \frac{d_i}{20}$	$f_i u_i$
100 – 120	12	110	–40	–2	–24
120 - 140	14	130	–20	–1	–14
140 - 160	8	150	0	0	0
160 - 180	6	170	20	1	6
180 - 200	10	190	40	2	20
Total	50				–12

From the table, it can be observed that

$$\sum f_i = 50$$

and

$$\sum f_i u_i = -12$$

Substituting the value of

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean we get:

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

$$\Rightarrow \bar{X} = 150 + \left(\frac{-12}{50} \right) 20$$

$$\Rightarrow \bar{X} = 150 - \frac{24}{5}$$

$$\Rightarrow \bar{X} = 150 - 4.8$$

$$\bar{X} = 145.2$$

Hence, the mean daily wage of the workers of the factory is Rs

$$145.20$$

.

Question 3

The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is Rs.

$$18$$

. Find the missing frequency

$$f$$

.

Daily Pocket Allowance (in Rs)	11 - 13	13 - 15	15 - 17	17 - 19	19 - 21	21 - 23	23 - 25
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Number of Workers	7	6	9	13	f	5	4
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Solution

Ans: Let the class size of the data be h .

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Suppose the assured mean (a) of the data is 18

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

It is given that, mean pocket allowance,

$$\bar{X} = Rs\ 18$$

Class size (

$$h$$

) of this data is:

$$h = 13 - 11$$

$$h = 2$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be evaluated as follows:

Daily Pocket Allowance (in Rs)	Number of Workers (f_i)	Class Mark x_i	$d_i = x_i - 18$	$f_i d_i$
11 – 13	7	12	–6	–42
13 - 15	6	14	–4	–24
15 - 17	9	16	–2	–18
17 - 19	13	18	0	0
19 - 21	f	20	2	$2f$
21 - 23	5	22	4	20
23 - 25	4	24	6	24
Total	$\sum f_i = 44 + f$			$2f - 40$

From the table, it can be observed that

$$\sum f_i = 44 + f$$

$$\sum f_i u_i = 2f - 40$$

Substituting the value of

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean we get:

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i d_i}{\sum f_i} \right) h$$

$$\Rightarrow 18 = 18 + \left(\frac{2f-40}{44+f} \right) 2$$

$$\Rightarrow 0 = \left(\frac{2f-40}{44+f} \right)$$

$$\Rightarrow 2f - 40 = 0$$

$$\Rightarrow f = 20$$

Hence, the value of frequency

$$f_i$$

is

$$20$$

.

Question 4

Thirty women were examined in a hospital by a doctor and the number of heart beats per minute were recorded and summarized as follows. Find the mean heart beats per minute for these women, choosing a suitable method.

Number of Heart Beats Per Minute	65 - 68	68 - 71	71 - 74	74 - 77	77 - 80	80 - 83	83 - 86

Number of Women	2	4	3	8	7	4	2
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Solution

Ans: Let the class size of the data be h .

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Suppose the assured mean (a) of the data is 75.5

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (

$$h$$

) of this data is:

$$h = 68 - 65$$

$$h = 3$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be evaluated as follows:

Number of Heart Beats Per Minute	Number of Women f_i	x_i	$d_i = x_i - 75.5$	$u_i = \frac{d_i}{3}$	$f_i u_i$
65 - 68	2	66.5	-9	-3	-6
68 - 71	4	69.5	-6	-2	-8
71 - 74	3	72.5	-3	-1	-3
74 - 77	8	75.5	0	0	0
77 - 80	7	78.5	3	1	7
80 - 83	4	81.5	6	2	8
83 - 86	2	84.5	3	3	6
Total	30				4

From the table, it can be observed that

$$\sum f_i = 30$$

$$\sum f_i u_i = 4$$

Substituting the value of

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean we get:

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

$$\Rightarrow \bar{X} = 75.5 + \left(\frac{4}{30} \right) 3$$

$$\Rightarrow \bar{X} = 75.5 + 0.4$$

$$\Rightarrow \bar{X} = 75.9$$

Therefore, mean heart beats per minute for these women are

$$75.9$$

beats per minute.

Question 5

In a retail market, fruit vendors were selling mangoes kept in packing boxes. These boxes contained a varying number of mangoes. The following was the distribution of mangoes according to the number of boxes.

Number of Mangoes	50-52	53 – 55	56 – 58	59 – 61	62 – 64
Number of Boxes	15	110	135	115	25

Find the mean number of mangoes kept in a packing box. Which method of finding the mean did you choose?

Solution

Ans:

Number of Mangoes	Number of Boxes f_i
50-52	15
53 – 55	110
56 – 58	135
59 – 61	115
62 – 64	25

It can be noticed that class intervals are not continuous in the given data. There is a gap of

1

between two class intervals. Therefore, we have to subtract $\frac{1}{2}$ to lower class and have to add $\frac{1}{2}$ to upper to make the class intervals continuous.

Let the class size of the data be h .

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Suppose the assured mean (a) of the data is 57.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (

$$h$$

) of this data is:

$$h = 52.5 - 49.5$$

$$h = 3$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be calculated as follows:

Class Interval	f_i	x_i	$d_i = x_i - 57$	$u_i = \frac{d_i}{3}$	$f_i u_i$
49.5 – 52.5	15	51	–6	–2	–30

52.5 – 55.5	110	54	–3	–1	–110
55.5 – 58.5	135	57	0	0	0
58.5 – 61.5	115	60	3	1	115
61.5 – 64.5	25	63	6	2	50
Total	400				25

It can be observed that from the above table

$$\sum f_i = 400$$

$$\sum f_i u_i = 25$$

Substituting the value of

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean we get:

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

$$\Rightarrow \bar{X} = 57 + \left(\frac{25}{400} \right) 3$$

$$\Rightarrow \bar{X} = 57 + \frac{3}{16}$$

$$\Rightarrow \bar{X} = 57.1875$$

Hence, mean number of mangoes kept in a packing box is 57.1875.

In the above case, we used step deviation method as the values of

$$f_i, d_i$$

are large and the class interval is not continuous.

Question 6

The table below shows the daily expenditure on food of

25

households in a locality.

Daily Expenditure (In Rs)	100 – 150	150 – 200	200 – 250	250 – 300	300 – 350
Number of Households	4	5	12	2	2

Find the mean daily expenditure on food by a suitable method.

Solution

Ans: Let the class size of the data be h .

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Suppose the assured mean (a) of the data is

$$225$$

.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (

$$h$$

) of this data is:

$$h = 150 - 100$$

$$h = 50$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be calculated as follows:

Daily expenditure (in Rs)	f_i	x_i	$d_i = x_i - 225$	$u_i = \frac{d_i}{50}$	$f_i u_i$
100 – 150	4	125	−100	−2	−8

150 – 200	5	175	–6	–1	–5
200 – 250	12	225	0	0	0
250 – 300	2	275	50	1	2
300 – 350	2	325	100	2	4
Total	25				–7

It can be observed that from the above table

$$\sum f_i = 25$$

$$\sum f_i u_i = -7$$

Substituting the value of

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean we get:

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$$

$$\Rightarrow \bar{X} = 225 + \left(\frac{-7}{25}\right) \times 50$$

$$\Rightarrow \bar{X} = 221$$

Hence, mean daily expenditure on food is Rs

211

Question 7

To find out the concentration of

SO₂

in the air (in parts per million, i.e., ppm), the data was collected for

30

localities in a certain city and is presented below:

Concentration of SO ₂ (in ppm)	Frequency
0.00 – 0.04	4
0.04 – 0.08	9
0.08 – 0.12	9
0.12 – 0.16	2
0.16 – 0.20	4
0.20 – 0.24	2

Find the mean concentration of



in the air.

Solution

Ans: Let the class size of the data be h .

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Suppose the assured mean (a) of the data is

$$0.14$$

.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (

$$h$$

) of this data is:

$$h = 0.04 - 0.00$$

$$h = 0.04$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be calculated as follows:

Concentration of SO ₂ (in ppm)	Frequency f_i	Class mark x_i	$d_i = x_i - 0.14$	$u_i = \frac{d_i}{0.04}$	$f_i u_i$
0.00 – 0.04	4	0.02	–0.12	–3	–12
0.04 – 0.08	9	0.06	–0.08	–2	–5
0.08 – 0.12	9	0.10	–0.10	–1	–9
0.12 – 0.16	2	0.14	0	0	0
0.16 – 0.20	4	0.18	0.04	1	4
0.20 – 0.24	2	0.22	0.08	2	4
Total					–31

It can be observed that from the above table

$$\sum f_i = 30$$

$$\sum f_i u_i = -31$$

Substituting the value of

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean we get:

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$$

$$\bar{X} = 0.14 + \left(\frac{-31}{30} \right) \times (0.04)$$

$$\bar{X} = 0.14 - 0.04133$$

$$\bar{X} = 0.09867$$

$$\bar{X} = 0.099 \text{ ppm}$$

Hence, the mean concentration of



in the air is 0.099ppm.

Question 8

A class teacher has the following absentee record of

40

students of a class for the whole term. Find the mean number of days a student was absent.

Number of Days	0 – 6	6 – 10	10 – 14	14 – 20	20 – 28	28 – 38	38 – 40
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Number of Students	11	10	7	4	4	3	1
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Solution

Ans: Let the class size of the data be h .

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right)$$

Suppose the assured mean (a) of the data is

$$17$$

.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be calculated as follows:

Number of Days	Number of Students f_i	x_i	$d_i = x_i - 17$	$f_i d_i$
0 – 6	11	3	–14	–154
6 – 10	10	8	–9	–90
10 – 14	7	12	–5	–35
14 – 20	4	17	0	0
20 – 28	4	24	7	28
28 – 38	3	33	16	48
38 – 40	1	39	22	22
Total	40			–181

It can be observed that from the above table

$$\sum f_i = 40$$

$$\sum f_i u_i = -181$$

Substituting the value of

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean we get:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right)$$

$$\Rightarrow \bar{X} = 17 + \left(\frac{-181}{40} \right)$$

$$\Rightarrow \bar{X} = 17 - 4.525$$

$$\Rightarrow \bar{X} = 12.475$$

Hence, the mean number of days is 12.48 days for which a student was absent.

Question 9

The following table gives the literacy rate (in percentage) of

35

cities. Find the mean literacy rate.

Literacy Rate (in)	45 – 55	55 – 65	65 – 75	75 – 85	85 – 95

Number of Cities	3	10	11	8	3
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Solution

Ans: Let the class size of the data be h .

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right)$$

Suppose the assured mean (a) of the data is

$$70$$

.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (

$$h$$

) of this data is:

$$h = 55 - 45$$

$$h = 10$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be calculated as follows:

Literacy Rate (in)	Number of Cities f_i	x_i	$d_i = x_i - 70$	$u_i = \frac{d_i}{10}$	$f_i u_i$
45 – 55	3	50	–20	–2	–6
55 – 65	10	60	–10	–1	–10
65 – 75	11	70	0	0	0
75 – 85	8	80	10	1	8
85 – 95	3	90	20	2	6
Total	35				–2

It can be observed that from the above table

$$\sum f_i = 35$$

$$\sum f_i u_i = -2$$

Substituting the value of

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean we get:

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$$

$$\Rightarrow \bar{X} = 70 + \left(\frac{-2}{35} \right) \times 10$$

$$\Rightarrow \bar{X} = 70 - \frac{20}{35}$$

$$\Rightarrow \bar{X} = 69.43$$

Therefore, the mean literacy rate of cities is 69.43.

Exercise 13.2

Question 1

The following table shows the ages of the patients admitted in a hospital during a year:

Age (in years)	5 – 15	15 – 25	25 – 35	35 – 45	45 – 55	55 – 65
Number of patients	6	11	21	23	14	5

Find the mode and the mean of the data given above. Compare and interpret the two measures of central tendency.

Solution

Ans: The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right)$$

Suppose the assured mean (a) of the data is

$$30$$

.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be evaluated as follows:

Age (in years)	Number of Patients f_i	Class Mark x_i	$d_i = x_i - 30$	$f_i d_i$

5 – 15	6	10	–20	–120
15 – 25	11	20	–10	–110
25 – 35	21	30	0	0
35 – 45	23	40	10	230
45 – 55	14	50	20	280
55 – 65	5	60	30	150
Total	80			430

It can be observed that from the above table

$$\sum f_i = 80$$

$$\sum f_i d_i = 430$$

Substituting the value of

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean we get:

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right)$$

$$\bar{X} = 30 + \left(\frac{430}{80} \right)$$

$$\bar{X} = 30 + 5.375$$

$$\bar{X} = 35.38$$

Hence, the mean of this data is 35.38. It demonstrates that the average age of a patient admitted to hospital was 35.38 years.

Mode can be calculated as,

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where

$$l =$$

Lower limit of modal class

f_1 = Frequency of modal class

$$f_0 =$$

Frequency of class preceding the modal class

$$f_2 =$$

Frequency of class succeeding the modal class

$$h =$$

Class size

It can be noticed that the maximum class frequency is

$$23$$

belonging to class interval

$$35 - 45$$

.

Modal class

$$= 35 - 45$$

The values of unknowns is given as below as per given data:

$$l = 35$$

$$f_1 = 23$$

$$h = 15 - 5 = 10$$

$$f_0 = 21$$

$$f_2 = 14$$

Substituting these values in the formula of mode we get:

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$M = 35 + \left(\frac{23 - 21}{2(23) - 21 - 14} \right) \times 10$$

$$M = 35 + \left[\frac{2}{46 - 35} \right] \times 10$$

$$M = 35 + \frac{20}{11}$$

$$M = 35 + 1.81$$

$$M = 36.8$$

Hence, the Mode of the data is 36.8. It demonstrates that the age of maximum number of patients admitted in hospital was 36.8 years.

Question 2

The following data gives the information on the observed lifetimes (in hours) of

225

electrical components:

LifeTimes (in hours)	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100	100 – 120
Frequency	10	35	52	61	38	29

Determine the modal lifetimes of the components.

Solution

Ans: Mode can be calculated as,

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where

$$l =$$

Lower limit of modal class

f_1 = Frequency of modal class

$$f_0 =$$

Frequency of class preceding the modal class

$$f_2 =$$

Frequency of class succeeding the modal class

$$h =$$

Class size

From the data given above, it can be noticed that the maximum class frequency is

$$61$$

belongs to class interval

$$60 - 80$$

.

Therefore, Modal class

$$= 60 - 80$$

The values of unknowns are given as below as per given data:

$$l = 60$$

$$f_1 = 61$$

$$h = 20$$

$$f_0 = 52$$

$$f_2 = 38$$

Substituting these values in the formula of mode we get:

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$M = 60 + \left(\frac{61 - 52}{2(61) - 52 - 38} \right) \times 20$$

$$M = 60 + \left[\frac{9}{122-90} \right] \times 20$$

$$M = 60 + \left(\frac{9 \times 20}{32} \right)$$

$$M = 60 + \frac{90}{16} = 60 + 5.625$$

$$M = 65.625$$

Hence, the modal lifetime of electrical components is

65.625

hours.

Question 3

The following data gives the distribution of total monthly household expenditure of

200

families of a village. Find the modal monthly expenditure of the families. Also, find the mean monthly expenditure.

Expenditure (in Rs)	Number of Families
1000 – 1500	24
1500 – 2000	40
2000 – 2500	33
2500 – 3000	28
3000 – 3500	30
3500 – 4000	22

4000 – 4500	16
4500 – 5000	7

Solution

Ans: For mode

Mode can be calculated as,

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where

$$l =$$

Lower limit of modal class

f_1 = Frequency of modal class

$$f_0 =$$

Frequency of class preceding the modal class

$$f_2 =$$

Frequency of class succeeding the modal class

$$h =$$

Class size

It can be observed from the given data that the maximum class frequency is

$$40$$

,

Belongs to

$$1500 - 2000$$

intervals.

Therefore, modal class

$$= 1500 - 2000$$

The values of unknowns are given as below as per given data:

$$l = 1500$$

$$f_1 = 40$$

$$f_0 = 24$$

$$f_2 = 33$$

$$h = 500$$

Substituting these values in the formula of mode we get:

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$M = 1500 + \left(\frac{40 - 24}{2(40) - 24 - 33} \right) \times 500$$

$$M = 1500 + \left[\frac{16}{80 - 57} \right] \times 500$$

$$M = 1500 + \frac{8000}{23}$$

$$M = 1500 + 347.826$$

$$M = 1847.826$$

$$M \approx 1847.83$$

Therefore, modal monthly expenditure was Rs

$$1847.83$$

.

For mean,

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Suppose the assured mean (a) of the data is

$$2750$$

.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

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

Class size (

$$h$$

) of this data is:

$$h = 1500 - 1000$$

$$h = 500$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be evaluated as follows:

Expenditure (in Rs)	Number of families f_i	x_i	$d_i = x_i - 2750$	$u_i = \frac{d_i}{500}$	$f_i u_i$
1000 – 1500	24	1250	–1500	–3	–72
1500 – 2000	40	1750	–1000	–2	–80
2000 – 2500	33	2250	–500	–1	–33
2500 – 3000	28	2750	0	0	0
3000 – 3500	30	3250	500	1	30
3500 – 4000	22	3750	1000	2	44
4000 – 4500	16	4250	1500	3	48
4500 – 5000	7	4750	2000	4	28
Total	200				–35

It can be observed from the above table

$$\sum f_i = 200$$

$$\sum f_i u_i = -35$$

Substituting

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$$

$$\bar{X} = 2750 + \left(\frac{-35}{200} \right) \times (500)$$

$$\bar{X} = 2750 - 87.5$$

$$\bar{X} = 2662.5$$

Hence, the mean monthly expenditure is Rs2662.5 .

Question 4

The following distribution gives the state-wise teacher-student ratio in higher secondary schools of India. Find the mode and mean of this data. Interpret the two Measures.

Number of Students Per Teacher	Number of States/U.T
15 – 20	3

20 – 25	8
25 – 30	9
30 – 35	10
35 – 40	3
40 – 45	0
45 – 50	0
50 – 55	2

Solution

Ans: For mode

Mode can be calculated as,

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where

$$l =$$

Lower limit of modal class

f_1 = Frequency of modal class

$$f_0 =$$

Frequency of class preceding the modal class

$$f_2 =$$

Frequency of class succeeding the modal class

$$h =$$

Class size

It can be observed from the given data that the maximum class frequency is

$$10$$

which belongs to class interval

$$30 - 35$$

.

Therefore, modal class

$$= 30 - 35$$

$$h = 5$$

$$l = 30$$

$$f_1 = 10$$

$$f_0 = 9$$

$$f_2 = 3$$

Substituting these values in the formula of mode we get:

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$M = 30 + \left(\frac{10 - 9}{2(10) - 9 - 3} \right) \times 5$$

$$M = 30 + \left(\frac{1}{20 - 12} \right) \times 5$$

$$M = 30.6$$

Hence, the mode of the given data is 30.6. It demonstrates that most of the states/U.T have a teacher-student ratio of 30.6 .

For mean,

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Suppose the assured mean (a) of the data is

$$32.5$$

.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

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

Class size (

$$h$$

) of this data is:

$$h = 20 - 15$$

$$h = 5$$

$$d_i, u_i, \text{ and } f_i u_i$$

can be calculated as follows:

Number of students per teacher	Number of states /U.T f_i	x_i	$D_i = x_i - 32.5$	$u_i = \frac{d_i}{5}$	$f_i u_i$

15 – 20	3	17.5	–15	–3	–9
20 – 25	8	22.5	–10	–2	–16
25 – 30	9	27.5	–5	–1	–9
30 – 35	10	32.5	0	0	0
35 – 40	3	37.5	5	1	3
40 – 45	0	42.5	10	2	0
45 – 50	0	47.5	15	3	0
50 – 55	2	52.5	20	4	8
Total	35				–23

It can be observed from the above table

$$\sum f_i = 35$$

$$\sum f_i u_i = -23$$

Substituting

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean

The required mean

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$$

$$\bar{X} = 32.5 + \left(\frac{-23}{35} \right) \times 5$$

$$\bar{X} = 32.5 - \frac{23}{7}$$

$$\bar{X} = 29.22$$

Hence, the mean of the data is 29.2 .

It demonstrates that the average teacher–student ratio was 29.2.

Question 5

The given distribution shows the number of runs scored by some top batsmen of the world in one-day international cricket matches.

Runs Scored	Number of Batsmen
3000 – 4000	4
4000 – 5000	18

5000 – 6000	9
6000 – 7000	7
7000 – 8000	6
8000 – 9000	3
9000 – 10000	1
10000 – 11000	1

Find the mode of the data.

Solution

Ans: Mode can be calculated as

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where

$$l =$$

Lower limit of modal class

f_1 = Frequency of modal class

$$f_0 =$$

Frequency of class preceding the modal class

$$f_2 =$$

Frequency of class succeeding the modal class

$$h =$$

Class size

From the given data, it can be observed that the maximum class frequency is 18

Belongs to class interval

$$4000 - 5000$$

.

Therefore, modal class =

$$4000 - 5000$$

$$l = 4000$$

$$f_1 = 18$$

$$f_0 = 4$$

$$f_2 = 9$$

$$h = 1000$$

Substituting these values in the formula of mode we get:

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$M = 4000 + \left(\frac{18 - 4}{2(18) - 4 - 9} \right) \times 1000$$

$$M = 4000 + \left(\frac{14000}{23} \right)$$

$$M = 4608.695$$

Hence, the mode of the given data is

$$4608.7$$

runs.

Question 6

A student noted the number of cars passing through a spot on a road for

100

periods each of

3

minutes and summarised it in the table given below. Find the mode of the data:

Number of cars	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Frequency	7	14	13	12	20	11	15	8

Solution

Ans: Mode can be calculated as

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where

$$l =$$

Lower limit of modal class

f_1 = Frequency of modal class

$$f_0 =$$

Frequency of class preceding the modal class

$$f_2 =$$

Frequency of class succeeding the modal class

$$h =$$

Class size

From the given data, it can be observed that the maximum class frequency is 20,

Belonging to

$$40 - 50$$

class intervals.

Therefore, modal class =

$$40 - 50$$

$$l = 40$$

$$f_1 = 20$$

$$f_0 = 12$$

$$f_2 = 11$$

$$h = 10$$

Substituting these values in the formula of mode we get:

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$M = 40 + \left(\frac{20 - 12}{2(20) - 12 - 11} \right) \times 10$$

$$M = 40 + \left(\frac{80}{40 - 23} \right)$$

$$M = 44.7$$

Hence, the mode of this data is 44.7 cars.

Exercise 13.3

Question 1

The following frequency distribution gives the monthly consumption of electricity of

68

consumers of a locality. Find the median, mean and mode of the data and compare them.

Monthly Consumption (in units)	Number of Consumers
65 – 85	4
85 – 105	5
105 – 125	13
125 – 145	20
145 – 165	14
165 – 185	8
185 – 205	4

Solution

Ans: The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Suppose the assured mean (a) of the data is

32.5

.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

To find the class mark for each interval, the following relation is used.

Class mark

$$x_i = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (

$$h$$

) of this data is:

$$h = 85 - 65$$

$$h = 20$$

[

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be calculated according to step deviation method as follows:

Monthly consumption (in units)	Number of Consumers f_i	Class Mark x_i	$d_i = x_i - 135$	$u_i = \frac{d_i}{20}$	$f_i u_i$
-----------------------------------	------------------------------	---------------------	-------------------	------------------------	-----------

65 – 85	4	75	–60	–3	–12
85 – 105	5	95	–40	–2	–10
105 – 125	13	115	–20	–1	–13
125 – 145	20	135	0	0	0
145 – 165	14	155	20	1	14
165 – 185	8	175	40	2	16
185 – 205	4	195	60	3	12
Total	68				7

It can be observed from the above table

$$\sum f_i = 68$$

$$\sum f_i u_i = 7$$

Class size

$$(h) = 20$$

Substituting

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean

The required mean:

$$\begin{aligned}\bar{X} &= a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h \\ \Rightarrow \bar{X} &= 135 + \left(\frac{7}{68} \right) \times (20) \\ \Rightarrow \bar{X} &= 135 + \frac{140}{68}\end{aligned}$$

$$\Rightarrow \bar{X} = 137.058$$

Hence, the mean of given data is 137.058.

For Mode

Mode can be calculated as

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where

$$l =$$

Lower limit of modal class

f_1 = Frequency of modal class

$$f_0 =$$

Frequency of class preceding the modal class

$$f_2 =$$

Frequency of class succeeding the modal class

$$h =$$

Class size

From the table, it can be noticed that the maximum class frequency is 20 ,

Belongs to class interval

$$125 - 145$$

.

Modal class =

$$125 - 145$$

$$l = 125$$

Class size

$$h = 20$$

$$f_1 = 20$$

$$f_0 = 13$$

$$f_2 = 14$$

Substituting these values in the formula of mode we get:

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$\Rightarrow M = 125 + \left(\frac{20 - 13}{2(20) - 13 - 14} \right) \times 20$$

$$\Rightarrow M = 125 + \frac{7}{13} \times 20$$

$$\Rightarrow M = 135.76$$

Hence, the value of mode is 135.76

For Median

We can calculate the median as given below:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Where

$$l =$$

Lower limit of median class

$$h =$$

Class size

$$f =$$

Frequency of median class

$$cf =$$

cumulative frequency of class preceding median class

To find the median of the given data, cumulative frequency is calculated as follows.

Monthly consumption (in units)	Number of Consumers	Cumulative Frequency
65 – 85	4	4

$85 - 105$	5	$4 + 5 = 9$
$105 - 125$	13	$9 + 13 = 22$
$125 - 145$	20	$22 + 20 = 42$
$145 - 165$	14	$42 + 14 = 56$
$165 - 185$	8	$56 + 8 = 64$
$185 - 205$	4	$64 + 4 = 68$

It can be observed from the given table

$$n = 68$$

$$\frac{n}{2} = 34$$

Cumulative frequency just greater than $\frac{n}{2}$ is 42 , belonging to

interval

$$125 - 145$$

.

Therefore, median class =

$$125 - 145$$

.

$$l = 125$$

$$h = 20$$

$$f = 20$$

$$cf = 22$$

Substituting these values in the formula of median we get:

$$\begin{aligned} m &= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h \\ \Rightarrow m &= 125 + \left(\frac{34 - 22}{20} \right) \times 20 \\ \Rightarrow m &= 125 + 12 \\ \Rightarrow m &= 137 \end{aligned}$$

Hence, median, mode, mean of the given data is

$$137, 135.76,$$

and

$$137.05$$

respectively.

Mean, mode and median are almost equal in this case.

Question 2

If the median of the distribution is given below is

$$28.5$$

, find the values of

x

and

y

.

Class interval	Frequency
0 – 10	5
10 – 20	X
20 – 30	20
30 – 40	15
40 – 50	Y
50 – 60	5
Total	60

Solution

Ans: We can calculate the median as given below:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Where

$$l =$$

Lower limit of median class

$$h =$$

Class size

$$f =$$

Frequency of median class

$$cf =$$

cumulative frequency of class preceding median class

The cumulative frequency for the given data is calculated as follows.

Class interval	Frequency	Cumulative frequency
0 – 10	5	5
10 – 20	X	$5 + x$
20 – 30	20	$25 + x$
30 – 40	15	$40 + x$
40 – 50	Y	$40 + x + y$
50 – 60	5	$45 + x + y$
Total (n)	60	

It is given that the value of n is 60

From the table, it can be noticed that the cumulative frequency of last entry is

$$45 + x + y$$

Equating

$$45 + x + y$$

and n , we get:

$$45 + x + y = 60$$

$$x + y = 15$$

.....(1)

It is given that.

Median of the data is given

$$28.5$$

which lies in interval

$$20 - 30$$

.

Therefore, median class =

$$20 - 30$$

$$l = 20$$

$$cf = 5 + x$$

$$f = 20$$

$$h = 10$$

Substituting these values in the formula of median we get:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

$$\Rightarrow 28.5 = 20 + \left(\frac{\frac{60}{2} - (5+x)}{20} \right) \times 10$$

$$\Rightarrow 8.5 = \left(\frac{25-x}{2} \right)$$

$$\Rightarrow 17 = 25 - x$$

$$\Rightarrow x = 8$$

Substituting $x = 8$ in equation (1), we get:

$$8 + y = 15$$

$$y = 7$$

Hence, the values of

$$x$$

and

$$y$$

are

$$8$$

and

$$7$$

respectively.

Question 3

A life insurance agent found the following data for distribution of ages of

100

policy holders. Calculate the median age, if policies are given only to persons having age

18

years onwards but less than

60

year.

Age (in years)	Number of Policy Holders
Below 20	2
Below 25	6
Below 30	24
Below 35	45
Below 40	78
Below 45	89
Below 50	92
Below 55	98
Below 60	100

Solution

Ans: We can calculate the median as given below:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Where

$$l =$$

Lower limit of median class

$$h =$$

Class size

$$f =$$

Frequency of median class

$$cf =$$

cumulative frequency of class preceding median class

In this case, class width is not the constant. We are not required to adjust the frequencies according to class intervals. The given frequency table is of less than type represented with upper class limits. The policies were given only to persons with age

18

years onwards but less than

60

years. Therefore, class intervals with their respective cumulative frequency can be defined as below.

Age (in years)	Number of Policy Holders (f_i)	Cumulative Frequency (cf)
18 – 20	2	2
20 – 25	$6 - 2 = 4$	6
25 – 30	$24 - 6 = 18$	24
30 – 35	$45 - 24 = 21$	45
35 – 40	$78 - 45 = 33$	78
40 – 45	$89 - 78 = 11$	89
45 – 50	$92 - 89 = 3$	92
50 – 55	$98 - 92 = 6$	98
55 – 60	$100 - 98 = 2$	100

Total (n)		
---------------	--	--

From the table, it can be observed that

$$n = 100$$

.

Thus,

$$\frac{n}{2} = 50$$

Cumulative frequency (

$$cf$$

) just greater than $\frac{n}{2}$ is

$$78$$

,

belongs interval

$$35 - 40$$

.

Therefore, median class =

$$35 - 40$$

$$l = 35$$

$$h = 5$$

$$f = 33$$

$$cf = 45$$

Substituting these values in the formula of median we get:

$$\begin{aligned}m &= l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h \\ \Rightarrow m &= 35 + \left(\frac{50 - 45}{33} \right) \times 5 \\ \Rightarrow m &= 35 + \left(\frac{25}{33} \right) \\ \Rightarrow m &= 35.76\end{aligned}$$

Hence, median age of people who get the policies is

$$35.76$$

years.

Question 4

The lengths of

40

leaves of a plant are measured correct to the nearest millimeter, and the data obtained is represented in the following table:

Length (in mm)	Number of leaves f_i
118 – 126	3
127 – 135	5
136 – 144	9
145 – 153	12
154 – 162	5
163 – 171	4

172 – 180	2
-----------	---

Find the median length of the leaves.

(Hint: The data needs to be converted to continuous classes for finding the median, since the formula assumes continuous classes. The classes then change to

$$117.5 - 126.5, 126.5 - 135.5 \dots 171.5 - 180.5$$

)

Solution

Ans: We can calculate the median as given below:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Where

$$l =$$

Lower limit of median class

$$h =$$

Class size

$$f =$$

Frequency of median class

$$cf =$$

cumulative frequency of class preceding median class

The given data does not have continuous class intervals. It can be noticed that the difference between two class intervals is

$$1$$

. Therefore, we will add 0.5 in the upper class and subtract 0.5 in the lower class.

Continuous class intervals with respective cumulative frequencies can be represented as follows.

Length (in mm)	Number of leaves f_i	Cumulative frequency
----------------	------------------------	----------------------

$117.5 - 126.5$	3	3
$126.5 - 135.5$	5	$3 + 5 = 8$
$135.5 - 144.5$	9	$8 + 9 = 17$
$144.5 - 153.5$	12	$17 + 12 = 29$
$153.5 - 162.5$	5	$29 + 5 = 34$
$162.5 - 171.5$	4	$34 + 4 = 38$
$171.5 - 180.5$	2	$38 + 2 = 40$

It can be observed from the given table

$$n = 40$$

$$\frac{n}{2} = 20$$

From the table, it can be noticed that the cumulative frequency just greater than

$$\frac{n}{2} \text{ is}$$

$$29$$

, Belongs to interval $144.5 - 153.5$.

median class = $144.5 - 153.5$

$$l = 144.5$$

$$h = 9$$

$$f = 12$$

$$cf = 17$$

Substituting these values in the formula of median we get:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

$$m = 144.5 + \left(\frac{20 - 17}{12} \right) \times 9$$

$$m = 144.5 + \left(\frac{9}{4} \right)$$

$$m = 146.75$$

Hence, median length of leaves is

$$146.75$$

mm.

Question 5

The following table gives the distribution of the life time of

400

neon lamps:

Lifetime (in hours)	Number of Lamps
1500 – 2000	14
2000 – 2500	56

2500 – 3000	60
3000 – 3500	86
3500 – 4000	74
4000 – 4500	62
4500 – 5000	48

Find the median life time of a lamp.

Solution

Ans: We can calculate the median as given below:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Where

$$l =$$

Lower limit of median class

$$h =$$

Class size

$$f =$$

Frequency of median class

$$cf =$$

cumulative frequency of class preceding median class

The cumulative frequencies with their respective class intervals are as follows.

Lifetime (in hours)	Number of Lamps	Cumulative Frequency

1500 – 2000	14	14
2000 – 2500	56	$14 + 56 = 70$
2500 – 3000	60	$70 + 60 = 130$
3000 – 3500	86	$130 + 86 = 216$
3500 – 4000	74	$216 + 74 = 290$
4000 – 4500	62	$290 + 62 = 352$
4500 – 5000	48	$352 + 48 = 400$
Total(n)	400	

It can be observed from the given table

$$n = 400$$

$$\frac{n}{2} = 200$$

It can be observed that the cumulative frequency just greater than

$\frac{n}{2}$ is

$$290$$

,Belongs to interval 3000 – 3500 .

Median class = 3000 – 3500

$$l = 3000$$

$$f = 86$$

$$cf = 130$$

$$h = 500$$

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

$$m = 3000 + \left(\frac{200 - 130}{86} \right) \times 500$$

$$m = 3000 + \left(\frac{70 \times 500}{86} \right)$$

$$m = 3406.976$$

Hence, median life time of lamps is

$$3406.98$$

hours.

Question 6

100

surnames were randomly picked up from a local telephone directory and the frequency distribution of the number of letters in the English alphabets in the surnames was obtained as follows:

Number of letters	1 – 4	4 – 7	7 – 10	10 – 13	13 – 16	16 – 19
Number of Surnames	6	30	40	16	4	4

Determine the median number of letters in the surnames. Find the mean number of letters in the surnames? Also, find the modal size of the surnames.

Solution

Ans: For median

We can calculate the median as given below:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Where

$$l =$$

Lower limit of median class

$$h =$$

Class size

$$f =$$

Frequency of median class

$$cf =$$

cumulative frequency of class preceding median class

The cumulative frequencies with their respective class intervals are as follows.

Number of Letters	Number of Surnames	Cumulative Frequency
1 – 4	6	6
4 – 7	30	$30 + 6 = 36$
7 – 10	40	$36 + 40 = 76$
10 – 13	16	$76 + 16 = 92$

13 – 16	4	$92 + 4 = 96$
16 – 19	4	$96 + 4 = 100$
Total(n)	100	

It can be observed from the given table

$$n = 100$$

$$\frac{n}{2} = 50$$

It can be noticed that the cumulative frequency just greater than

$$\frac{n}{2}$$
 is

$$76$$

, Belongs to interval

$$7 - 10$$

.

Median class =

$$7 - 10$$

$$l = 7$$

$$cf = 36$$

$$f = 40$$

$$h = 3$$

Substituting these values in the formula of median we get:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

$$m = 7 + \left(\frac{50 - 36}{40} \right) \times 3$$

$$m = 7 + \left(\frac{14 \times 3}{40} \right)$$

$$m = 8.05$$

Hence, the median number of letters in the surnames is 8.05.

For Mean

The mean can be found as given below:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h$$

Suppose the assured mean (a) of the data is

$$11.5$$

.

Class mark

$$(x_i)$$

for each interval is calculated as follows:

Class mark

$$(x_i) = \frac{\text{Upper class limit} + \text{Lower class limit}}{2}$$

Class size (

$$h$$

) of this data is:

$$h = 4 - 1$$

$$h = 3$$

$$d_i,$$

$$u_i,$$

and

$$f_i u_i$$

can be calculated according to step deviation method as follows:

Number of letters	Number of surnames f_i	x_i	$d_i = x_i - 11.5$	$u_i = \frac{d_i}{20}$	$f_i u_i$
1 – 4	6	2.5	–9	–3	–18
4 – 7	30	5.5	–6	–2	–60
7 – 10	40	8.5	–3	–1	–40
10 – 13	16	11.5	0	0	0
13 – 16	4	14.5	3	1	4
16 – 19	4	17.5	6	2	8
Total	100				–106

It can be observed from the above table

$$\sum f_i u_i = -106$$

$$\sum f_i = 100$$

Substituting

$$u_i,$$

and

$$f_i u_i$$

in the formula of mean

The required mean:

$$\bar{X} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$$

$$\bar{X} = 11.5 + \left(\frac{-106}{100} \right) \times 3$$

$$\Rightarrow \bar{X} = 11.5 - 3.18$$

$$\Rightarrow \bar{X} = 8.32$$

Hence the mean of number of letters in the surnames is 8.32.

For Mode

Mode can be calculated as

$$M = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where

$$l =$$

Lower limit of modal class

f_1 = Frequency of modal class

$$f_0 =$$

Frequency of class preceding the modal class

$$f_2 =$$

Frequency of class succeeding the modal class

$$h =$$

Class size

The data in the given table can be written as

Number of Letters	Frequency (f_i)
1 – 4	6
4 – 7	30
7 – 10	40
10 – 13	16
13 – 16	4
16 – 19	4
Total(n)	100

From the table, it can be observed that the maximum class frequency is

$$40$$

Belongs to

$$7 - 10$$

class intervals.

Therefore, modal class =

$$7 - 10$$

$$l = 7$$

$$h = 3$$

$$f_1 = 40$$

$$f_0 = 30$$

$$f_2 = 16$$

Substituting these values in the formula of mode we get:

$$m = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

$$m = 7 + \left(\frac{40 - 30}{2(40) - 30 - 16} \right) \times 3$$

$$m = 7 + \left(\frac{10}{34} \right) \times 3$$

$$m = 7 + \frac{30}{34}$$

$$m = 7.88$$

Hence, modal size of surname is

$$7.88$$

.

Question 7

The distribution below gives the weights of

$$30$$

students of a class. Find the median weight of the students.

Weight (in kg)	40 – 45	45 – 50	50 – 55	55 – 60	60 – 65	65 – 70	70 – 75
Number of students	2	3	8	6	6	3	2

Solution

Ans: We can calculate the median as given below:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Where

$$l =$$

Lower limit of median class

$$h =$$

Class size

$$f =$$

Frequency of median class

$$cf =$$

cumulative frequency of class preceding median class

The cumulative frequencies with their respective class intervals are as follows :

Weight (in kg)	Number of Students	Cumulative Frequency
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40 – 45	2	2
45 – 50	3	$2 + 3 = 5$
50 – 55	8	$5 + 8 = 13$
55 – 60	6	$13 + 6 = 19$
60 – 65	6	$19 + 6 = 25$
65 – 70	3	$25 + 3 = 28$
70 – 75	2	$28 + 2 = 30$
Total(n)	30	

It can be observed from the given table

$$n = 30$$

$$\frac{n}{2} = 15$$

Cumulative frequency just greater than $\frac{n}{2}$ is

$$19$$

, Belongs to class interval

$$55 - 60$$

.

Median class =

$$55 - 60$$

$$l = 55$$

$$f = 6$$

$$cf = 13$$

$$h = 5$$

Substituting these values in the formula of median we get:

$$m = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

$$m = 55 + \left(\frac{15 - 13}{6} \right) \times 5$$

$$m = 55 + \left(\frac{10}{6} \right)$$

$$m = 56.67$$

Hence, median weight is

$$56.67$$

kg.