

Mathematics

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(Chapter - 14) (Statistics)

(Class - 10)

Exercise 14.2

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.

Answer 1:

To find the class marks (x_i), the following relation is used.

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

Taking 30 as assumed mean (a), d_i and $f_i d_i$ are calculated 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

From the table, we obtain

$$\sum f_i = 80, \sum f_i d_i = 430 \text{ and } a = 30$$

$$\text{mean } (\bar{x}) = a + \frac{\sum f_i d_i}{\sum f_i} = 30 + \left(\frac{430}{80}\right) = 30 + 5.375 = 35.375 = 35.38$$

Mean of this data is 35.38. It represents that on an average, the age of a patient admitted to hospital was 35.38 years. It can be observed that the maximum class frequency is 23 belonging to class interval 35 - 45.

Modal class = 35 - 45

Lower limit (l) of modal class = 35

Frequency (f_1) of modal class = 23

Class size (h) = 10

Frequency (f_0) of class preceding the modal class = 21

Frequency (f_2) of class succeeding the modal class = 14

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 35 + \left(\frac{23 - 21}{2 \times 23 - 21 - 14}\right) \times 10 = 35 + \frac{2}{11} \times 10 = 35 + 1.81 = 36.81$$

Mode is 36.8. It represents 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.

Answer 2:

From the data given above, it can be observed that the maximum class frequency is 61, belonging to class interval 60 - 80.

Therefore, modal class = 60 - 80

Lower class limit (l) of modal class = 60

Frequency (f_1) of modal class = 61

Frequency (f_0) of class preceding the modal class = 52

Frequency (f_2) of class succeeding the modal class = 38

Class size (h) = 20

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 60 + \left(\frac{61 - 52}{2 \times 61 - 52 - 38}\right) \times 20 = 60 + \frac{9}{32} \times 20 = 60 + 5.625 = 65.625$$

Therefore, modal lifetime of electrical components is 65.625 hours.

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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 ₹)	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

Answer 3:

It can be observed from the given data that the maximum class frequency is 40, belonging to 1500 - 2000 intervals.

Therefore, modal class = 1500 - 2000

Lower limit (l) of modal class = 1500

Frequency (f_1) of modal class = 40

Frequency (f_0) of class preceding modal class = 24

Frequency (f_2) of class succeeding modal class = 33

Class size (h) = 500

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h = 1500 + \left(\frac{40 - 24}{2 \times 40 - 24 - 33} \right) \times 500 = 1500 + \frac{16}{23} \times 500 = 1500 + 347.826 = 1847.83$$

Therefore, modal monthly expenditure was ₹1847.83.

To find the class mark, the following relation is used.

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

Class size (h) of the given data = 500.

Taking 2750 as assumed mean (a), d_i , u_i , and $f_i u_i$ are calculated as follows.

Expenditure (in ₹)	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

From the table, we obtain

$$\sum f_i = 200, \sum f_i u_i = -35, a = 2750 \text{ and } h = 500$$

$$\text{mean } (\bar{x}) = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h = 2750 + \left(\frac{-35}{200} \right) \times 500 = 2750 - 87.5 = 2662.50$$

Therefore, mean monthly expenditure was ₹ 2662.50.

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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

Answer 4:

It can be observed from the given data that the maximum class frequency is 10 belonging to class interval 30 - 35.

Therefore, modal class = 30 - 35

Class size (h) = 5

Lower limit (l) of modal class = 30

Frequency (f_1) of modal class = 10

Frequency (f_0) of class preceding modal class = 9

Frequency (f_2) of class succeeding modal class = 3

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h = 30 + \left(\frac{10 - 9}{2 \times 10 - 9 - 3} \right) \times 5 = 30 + \frac{1}{8} \times 5 = 30 + 0.625 = 30.625$$

It represents that most of the states/U.T have a teacher-student ratio as 30.6.

To find the class marks, the following relation is used.

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

Taking 32.5 as assumed mean (a), d_i , u_i , and $f_i u_i$ are 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

From the table, we obtain

$$\sum f_i = 35, \sum f_i u_i = -23, a = 32.5 \text{ and } h = 5$$

$$\text{mean } (\bar{x}) = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) h = 32.5 + \left(\frac{-23}{35} \right) \times 5 = 32.5 - \frac{23}{7} = 32.5 - 3.28 = 29.22$$

Therefore, mean of the data is 29.2.

It represents that on an average, teacher-student ratio was 29.2.

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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.

Answer 5:

From the given data, it can be observed that the maximum class frequency is 18, belonging to class interval 4000 - 5000.

Therefore, modal class = 4000 - 5000

Lower limit (l) of modal class = 4000

Frequency (f_1) of modal class = 18

Frequency (f_0) of class preceding modal class = 4

Frequency (f_2) of class succeeding modal class = 9

Class size (h) = 1000

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h = 4000 + \left(\frac{18 - 4}{2 \times 18 - 4 - 9} \right) \times 1000 = 4000 + 608.695 = 4608.695$$

Therefore, 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

Answer 6:

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

Lower limit (l) of modal class = 40

Frequency (f_1) of modal class = 20

Frequency (f_0) of class preceding modal class = 12

Frequency (f_2) of class succeeding modal class = 11

Class size = 10

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h = 40 + \left(\frac{20 - 12}{2 \times 20 - 12 - 11} \right) \times 10 = 40 + \frac{8}{17} \times 10 = 40 + 4.7 = 44.7$$

Therefore, mode of this data is 44.7 cars.