Chapter 13 Statistics NCERT Solutions Class 10 Maths: Clear, Concise Answers

Ex 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?

Answer.

Since, number of plants and houses are small in their values, so we use direct method.

Number of plants	Number of houses (f_i)	Class Marks (x_i)	$f_i x_i$
0 – 2	1	1	1
2 – 4	2	3	6
4 – 6	1	5	5
6 – 8	5	7	35
8 – 10	6	9	54
10 – 12	2	11	22
12 – 14	3	13	39
Total	$\sum f_i = 20$		$\sum f_i x_i = 162$

Mean $(\bar{x}) = \dfrac{\sum f_i x_i}{\sum f_i} = \dfrac{162}{20} = 8.1$

Hence mean number of plants per house is 8.1.

Ex 13.1 Question 2.

Consider the following distribution of daily wages of 50 workers of a factory.

Daily wages (in Rs.)	500 – 520	520 – 540	540 – 560	560 – 580	580 – 600
Number of workers	12	14	8	6	10

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

Answer.

Daily wages (in Rs.)	No. of workers (f_i)	Class Marks (x_i)	$u_i = \dfrac{x_i - a}{h}$	$f_i u_i$
500 – 520	12	110	-2	-24
520 – 540	14	130	-1	-14
540 – 560	8	150	0	0
560 – 580	6	170	1	6
580 – 600	10	190	2	20
	$\sum f_i = 50$			$\sum f_i u_i = -12$

From given data, Assume mean $(a) = 150$, Width of the class $(h) = 20$

$\therefore \bar{u} = \dfrac{\sum f_i u_i}{\sum f_i} = \dfrac{-12}{50} = -0.24$

Using formula, Mean $(\bar{x}) = a + h\bar{u} = 150 + 20(-0.24) = 150 - 4.8 = 145.2$

Hence mean daily wages of the workers of factory is Rs. 145.20.

Ex 13.1 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
Number of houses	7	6	9	13	f	5	4

Answer

Daily pocket allowance (in Rs.)	No. of children (f_i)	Class Marks (x_i)	$d_i = x_i - a$	$f_i d_i$
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
	$\sum f_i = 44 + f$			$\sum f_i d_i = 2f - 40$

From given data, Assume mean $(a) = 18$

$$\therefore (x) = a + \frac{\sum f_i d_i}{\sum f_i}$$

$$\Rightarrow 18 = 18 + \frac{2f - 40}{44 + f}$$

$$\Rightarrow \frac{2f - 40}{44 + f} = 0$$

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

$$\Rightarrow 2f = 40$$

$$\Rightarrow f = 20$$

Hence missing frequency is 20 .

Ex 13.1 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:

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

Answer:

No. of heart beats per min.	No. of women (f_i)	Class Marks (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
65 – 68	2	66.5	– 3	– 6
68 – 71	4	69.5	– 2	– 8
71 – 74	3	72.5	– 1	– 3
74 – 77	8	75.5	0	0
77 – 80	7	78.4	1	7
80 – 83	4	81.5	2	8
83 – 86	2	84.5	3	6
	$\sum f_i = 30$			$\sum f_i u_i = 4$

(in the class interval 77-80, 78.4 changes to 78.5)

From given data, Assume mean $(a) = 75.5$, Width of the class $(h) = 3$

$$\therefore \bar{u} = \frac{\sum f_i u_i}{\sum f_i} = \frac{4}{30} = 0.13 \text{ (approx.)}$$

Using formula, Mean $(x) = a + h\bar{u} = 75.5 + 3(0.13) = 75.5 + 0.39 = 75.89$

Hence mean heart beat per minute for women is 75.89 .

Ex 13.1 Question 5.

In a retail market, fruit vendors were selling mangoes kept in packing boxes. These boxes contained varying number 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	12	14	8	6	10

\{change the frequency in above table as: $50 - 52$ (15) 53-55 (110) 56-58 (135) 59-61 (115) $62- 64(25)$\}

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

Answer.

Since value of number of mangoes and number of boxes are large numerically. So we use step-deviation method

we convert the class interval firstly into exclusive form given as

True Class Interval	No. of boxes (fi)	Class mark (xi)	$u_i = \frac{x_i - a}{h}$	fiui
49.5-52.5	15	51	-2	-30
52.5-55.5	110	54	-1	-110
55.5-58.5	135	57	0	0
58.5-61.5	115	60	1	115
61.5-64.5	25	63	2	50
	$\sum f_i = 400$			$\sum f_i u_i = 25$

From given data, Assume mean $(a) = 57$, Width of the class $(h) = 3$

$$\therefore \bar{u} = \frac{\sum f_i u_i}{\sum f_i} = \frac{25}{400} = 0.0625 \text{ (approx.)}$$

Using formula, Mean $(x) = a + h\bar{u} = 57 + 3(0.0625) = 57 + 0.1875 = 57.1875 = 57.19 \text{ (approx.)}$

Hence mean number of mangoes kept in a packing box is 57.19.

Ex 13.1 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.

Answer.

Daily expenditure	No. of households (f_i)	Class Marks (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
100 – 150	4	125	– 2	– 8
150 – 200	5	175	– 1	– 5
200 – 250	12	225	0	0
250 – 300	2	275	1	2
300 – 350	2	325	2	4
	$\sum f_i = 25$			$\sum f_i u_i = -7$

From given data, Assume mean $(a) = 225$, Width of the class $(h) = 50$

$$\therefore \bar{u} = \frac{\sum f_i u_i}{\sum f_i} = \frac{-7}{25} = -0.28$$

Using formula, Mean $(\bar{x}) = a + h\bar{u} = 225 + 50(-0.28) = 225 - 14 = 211$ Hence mean daily expenditure on food is Rs. 211.

Ex 13.1 Question 7.

To find out the concentration of SO_2 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 SO2 (in ppm)	0.00 – 0.04	0.04 – 0.08	0.08 – 0.12	0.12 – 0.16	0.16 – 0.20	0.20 – 0.24
Frequency	4	9	9	2	4	2

Find the mean concentration of SO_2 in the air.

Answer.

Concentration of SO2 (in ppm)	Frequency (f_i)	Class Marks (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
0.00 – 0.04	4	0.02	– 2	– 8
0.04 – 0.08	9	0.06	– 1	– 9
0.08 – 0.12	9	0.10	0	0
0.12 – 0.16	2	0.14	1	2
0.16 – 0.20	4	0.18	2	8
0.20 – 0.24	2	0.20	3	6
	$\sum f_i = 30$			$\sum f_i u_i = -1$

From given data, Assume mean $(a) = 0.10$, Width of the class $(h) = 0.04$

$$\therefore \bar{u} = \frac{\sum f_i u_i}{\sum f_i} = \frac{-1}{30} = -0.033 \text{ (approx.)}$$

Using formula, Mean $(\bar{x}) = a + h\bar{u} = 0.10 + 0.04(-0.033) = 0.10 - 0.0013 = 0.0987$ (approx.) Hence mean concentration of SO_2 in air is 0.0987ppm.

Ex 13.1 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
Number of students	11	10	7	4	4	3	1

Answer

Number of days	No. of students (f_i)	Class Marks (x_i)	$d_i = x_i - a$	$f_i d_i$
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
	$\sum f_i = 40$			$\sum f_i d_i = -181$

From given data, Assume mean $(a) = 17$

$$\therefore (\bar{x}) = a + \frac{\sum f_i d_i}{\sum f_i} = 17 + \frac{(-181)}{40} = 17 - 4.52 = 12.48$$

Hence mean 12.48 number of days a student was absent.

Ex 13.1 Question 9.

The following table gives the literacy rate (in percentage) of 35 cities. Find the mean literacy rate.

Literacy rate (in percentage)	45 – 55	55 – 65	65 – 75	75 – 85	85 – 95
Number of cities	3	10	11	8	3

Answer

Literacy rate (in %)	No. of cities (f_i)	Class Marks (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
45 – 55	3	50	– 2	– 6
55 – 65	10	60	– 1	– 10
65 – 75	11	70	0	0
75 – 85	8	80	1	8
85 – 95	3	90	2	6
	$\sum f_i = 35$			$\sum f_i u_i = -2$

From given data, Assume mean $(a) = 70$, Width of the class $(h) = 10$

$$\therefore a = \frac{\sum f_i u_i}{\sum f_i} = \frac{-2}{35} = -0.057$$

Using formula, Mean $(\bar{x}) = a + h\bar{u} = 70 + 10(-0.057) = 70 - 0.57 = 69.43$

Hence mean literacy rate is 69.43%.

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Ex 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.

Answer.

For Mode: In the given data, maximum frequency is 23 and it corresponds to the class interval $35 - 45$.

$\therefore$ Modal class $= 35 - 45$

And $l = 35, f_1 = 23, f_0 = 21, f_2 = 14$ and $h = 10$

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

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

$$= 35 + \frac{2}{46 - 35} \times 10$$

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

$$= 35 + 1.8$$

$$= 36.8$$

For Mean:

Age (in years)	No. of patients (f_i)	Class Marks (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
5 – 15	6	10	– 2	– 12
15 – 25	11	20	– 1	– 11
25 – 35	21	30	0	0
35 – 45	23	40	1	23
45 – 55	14	50	2	28
45 – 65	5	60	3	15
	$\sum f_i = 80$			$\sum f_i u_i = 43$

From given data, Assume mean $(a) = 30$, Width of the class $(h) = 10$

$$\therefore u = \frac{\sum f_i u_i}{\sum f_i} = \frac{43}{80} = 0.5375$$

Using formula, Mean $(x) = a + hu = 30 + 10(0.5375) = 30 + 5.375 = 35.37$

Hence mode of given data is 36.8 years and mean of the given data is 35.37 years.

Also, it is clear from above discussion that average age of a patient admitted in the hospital is 35.37 years and maximum number of patients admitted in the hospital are of age 36.8 years.

Ex 13.2 Question 2.

The following data gives the information on the observed lifetimes (in hours) of 225 electrical components:

Life times (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.

Given: Maximum frequency is 61 and it corresponds to the class interval $60 - 80$.

$\therefore$ Modal class $= 60 - 80$

And $l = 60, f_1 = 61, f_0 = 52, f_2 = 38$ and $h = 20$

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

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

$$= 60 + \frac{9}{122 - 52 - 38} \times 20$$

$$= 60 + \frac{9}{32} \times 20$$

$$= 60 + 5.625$$

$$= 65.625$$

Hence modal lifetimes of the components is 65.625 hours.

Ex 13.2 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

Answer.

For Mode: Here, Maximum frequency is 40 and it corresponds to the class interval 1500 -2000 .

$\therefore$ Modal class $= 1500 - 2000$

And $l = 1500, f_1 = 40, f_0 = 24, f_2 = 33$ and $h = 500$

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

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

$$= 1500 + \frac{16}{80 - 24 - 33} \times 500$$

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

$$= 1500 + 347.83$$

$$= 1847.83$$

For Mean:

Expenditure (in Rs.)	No. of families (f_i)	Class Marks (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
1000 – 1500	24	1250	– 3	– 72
1500 – 2000	40	1750	– 2	– 80
2000 – 2500	33	2250	– 1	– 33
2500 – 3000	28	2750	0	0
3000 – 3500	30	3250	1	30
3500 – 4000	22	3750	2	44
4000 – 4500	16	4250	3	48
4500 – 5000	7	4750	4	28
	$\sum f_i = 200$			$\sum f_i u_i = -35$

From given data, Assume mean $(a) = 2750$, Width of the class $(h) = 500$

$$\therefore u = \frac{\sum f_i u_i}{\sum f_i} = \frac{-35}{200} = -0.175$$

Using formula, Mean $(x) = a + hu = 2750 + 500(-0.175) = 2750 - 87.50 = 2662.50$

Hence the modal monthly expenditure of family is Rs. 1847.83 and the mean monthly expenditure is Rs. 2662.50 .

Ex 13.2 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.

No. 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

Ans. For Mode: Here, Maximum frequency is 10 and it corresponds to the class interval 30 35.

$\therefore$ Modal class $= 30 - 35$

And $l = 30, f_1 = 10, f_0 = 9, f_2 = 3$ and $h = 5$

$\because$ Mode $= l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h = 30 + \left[\frac{10-9}{2(10)-9-3}\right] \times 5$

$= 30 + \frac{1}{20-12} \times 5 = 30 + \frac{5}{8} = 30 + 0.625 = 30.63$ (approx.)

For Mean:

Expenditure (in Rs.)	No. of families (f_i)	Class Marks (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
15 – 20	3	17.5	– 3	– 9
20 – 25	8	22.5	– 2	– 16
25 – 30	9	27.5	– 1	– 9
30 – 35	10	32.5	0	0
35 – 40	3	37.5	1	3
40 – 45	0	42.5	2	0
45 – 50	0	47.5	3	0
50 – 55	2	52.5	4	8
	$\sum f_i = 35$			$\sum f_i u_i = -23$

From given data, Assume mean $(a) = 32.5$, Width of the class $(h) = 5$

$\therefore u = \frac{\sum f_i u_i}{\sum f_i} = \frac{-23}{35} = -0.65$

Using formula, Mean $(\bar{x}) = a + h\bar{u} = 32.5 + 5(-0.65) = 32.5 - 3.25 = 29.25$ (approx.)

Hence mode and mean of given data is 30.63 and 29.25. Also from above discussion, it is clear that states/U.T. have students per teacher is 30.63 and on average, this ratio is 29.25 .

Ex 13.2 Question 5.

The given distribution shows the number of runs scored by some top batsmen of the world in one-day 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 mode of the data.

Answer.

In the given data, maximum frequency is 18 and it corresponds to the class interval $4000 - 5000$.

$\therefore$ Modal class $= 4000 - 5000$

And $l = 4000, f_1 = 18, f_0 = 4, f_2 = 9$ and $h = 1000$

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

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

$= 4000 + \frac{14}{36 - 13} \times 1000$

$= 4000 + \frac{14000}{23}$

$= 4000 + 608.6956$

$= 4608.7$ (approx.)

Hence, mode of the given data is 4608.7 runs.

Ex 13.2 Question 6.

A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarized it in the table given below:

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

Find the mode of the data.

Answer.

In the given data, maximum frequency is 20 and it corresponds to the class interval 40 50.

$\therefore$ Modal class $= 40 - 50$

And $l = 40, f_1 = 20, f_0 = 12, f_2 = 11$ and $h = 10$

$\because$ Mode $= l + \left(\dfrac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$

$= 40 + \left[\dfrac{20 - 12}{2(20) - 12 - 11} \right] \times 10$

$= 40 + \dfrac{8}{40 - 23} \times 10$

$= 40 + \dfrac{80}{17} = 40 + 4.70588 = 44.7 \text{ (approx.)}$

Hence, mode of the given data is 44.7 cars.

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Ex 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

Answer.

For Median:

Monthly consumption (in units)	Number of consumers (f_i)	Cumulative Frequency
65 – 85	4	4
85 – 105	5	9
105 – 125	13	22
125 – 145	20	42
145 – 165	14	56
165 – 185	8	64
185 – 205	4	68
Total	$\sum f_i = n = 68$	

Here, $\sum f_i = n = 68$, then $\frac{n}{2} = \frac{68}{2} = 34$, which lies in interval $125 - 145$.

$\therefore$ Median class $= 125 - 145$

So, $l = 125, n = 68, f = 20, cf = 22$ and $h = 20$

Now, Median $= l + \left[\dfrac{\frac{n}{2} - cf}{f}\right] \times h$

$= 125 + \left[\dfrac{\frac{68}{2} - 22}{20}\right] \times 20$

$= 125 + \dfrac{34 - 22}{20} \times 20 = 125 + 12 = 137$

For Mean:

Monthly consumption (in units)	No. of consumers (f_i)	Class Marks (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
65 – 85	4	75	– 3	– 12
85 – 105	5	95	– 2	– 10
105 – 125	13	115	– 1	– 13
125 – 145	20	135	0	0
145 – 165	14	155	1	14
165 – 185	8	175	2	16
185 – 205	4	195	3	12
	$\sum f_i = 68$			$\sum f_i u_i = 7$

From given data, Assume mean $(a) = 135$, Width of the class $(h) = 20$

$$\therefore u = \frac{\sum f_i u_i}{\sum f_i}$$

$$= \frac{7}{68} = 0.102$$

Using formula, Mean $(x) = a + hu = 135 + 20\,(0.102)$

$$= 135 + 2.04 = 137.04$$

For Mode:

In the given data, maximum frequency is 20 and it corresponds to the class interval 125 145.

$\therefore$ Modal class $= 125 - 145$

And $l = 125, f_1 = 20, f_0 = 13, f_2 = 14$ and $h = 20$

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

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

$$= 125 + \frac{7}{40 - 27} \times 20$$

$$= 125 + \frac{140}{13}$$

$$= 125 + 10.76923$$

$$= 125 + 10.77$$

$$= 135.77$$

Hence, median, mean and mode of given data is 137 units, 137.04 units and 135.77 units.

Ex 13.3 Question 2.

If the median of the distribution given below is 28.5, then find the values of x and y.

Class interval	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	Total
Frequency	5	x	20	15	y	5	60

Answer

Monthly consumption (in units)	Number of consumers (f_i)	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	$\sum f_i = n = 60$	

Here, $\sum f_i = n = 60$, then $\frac{n}{2} = \frac{60}{2} = 30$, also, median of the distribution is 28.5, which lies in interval $20 - 30$.

$\therefore$ Median class $= 20 - 30$

So, $l = 20, n = 60, f = 20, cf = 5 + x$ and $h = 10$

$\because 45 + x + y = 60$

$\Rightarrow x + y = 15$

Now, Median $= l + \left[\dfrac{\frac{n}{2} - cf}{f}\right] \times h$

$$\Rightarrow 28.5 = 20 + \left[\frac{30 - (5 + x)}{20}\right] \times 10$$

$$\Rightarrow 28.5 = 20 + \frac{30 - 5 - x}{2}$$

$$\Rightarrow 28.5 = \frac{40 + 25 - x}{2}$$

$$\Rightarrow 2(28.5) = 65 - x$$

$$\Rightarrow 57.0 = 65 - x$$

$$\Rightarrow x = 65 - 57 = 8$$

$$\Rightarrow x = 8$$

Putting the value of x in eq. (i), we get,

$8 + y = 15$

$\Rightarrow y = 7$

Hence the value of x and y are 8 and 7 respectively.

Ex 13.3 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 only given to persons having age 18 years onwards but less than 60 years.

Ages (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

Answer

Ages (in years)	Cumulative Frequency	Number of consumers (f_i)
Below 20	2	2
20 – 25	6	6 – 2 = 4
25 – 30	24	24 – 6 = 18
30 – 35	45	45 – 24 = 21
35 – 40	78	78 – 45 = 33
40 – 45	89	89 – 78 = 11
45 – 50	92	92 – 89 = 3
50 – 55	98	98 – 92 = 6
55 – 60	100	100 – 98 = 2
Total		$\sum f_i = n = 100$

Here, $\sum f_i = n = 100$, then $\frac{n}{2} = \frac{100}{2} = 50$, which lies in interval $35 - 40$.

$\therefore$ Median class $= 35 - 40$

So, $l = 35, n = 100, f = 33, cf = 45$ and $h = 5$

Now, Median $= l + \left[\frac{\frac{n}{2} - cf}{f}\right] \times h$

$= 35 + \left[\frac{\frac{100}{2} - 45}{33}\right] \times 5$

$= 35 + \frac{50 - 45}{33} \times 5$

$= 35 + \frac{25}{33}$

$= 35 + 0.7575$

$= 35 + 0.76$ (approx.)

$= 35.76$

Hence median age of given data is 35.76 years.

Ex 13.3 Question 4.

The lengths of 40 leaves of a plant are measured correct to the nearest millimeter and data obtained is represented in the following table. Find the median length of the leaves.

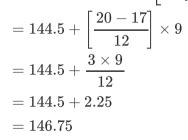| Length (in mm)	Number of leaves
118 – 126	3
127 – 135	5
136 – 144	9
145 – 153	12
154 – 162	5
163 – 171	4
172 – 180	2

Answer.

Since the frequency distribution is not continuous, so firstly we shall make it continuous.

Here, $\sum f_i = n = 40$, then $\frac{n}{2} = \frac{40}{2} = 20$, which lies in interval $144.5 - 153.5$.

$\therefore$ Median class $= 144.5 - 153.5$

So, $l = 144.5, n = 40, f = 12, cf = 17$ and $h = 9$

Now, Median $= l + \left[\frac{\frac{n}{2} - cf}{f}\right] \times h$

$= 144.5 + \left[\frac{20 - 17}{12}\right] \times 9$

$= 144.5 + \frac{3 \times 9}{12}$

$= 144.5 + 2.25$

$= 146.75$

Hence median length of the leaves is 146.75 mm.

Ex 13.3 Question 5.

The following table gives the distribution of the life time of 400 neon lamps. Find the median life time of the lamps.

Life time (in hours)	Number of lamps
1500 – 2000	14
2000 – 2500	56
2500 – 3000	60
3000 – 3500	85
3500 – 4000	74
4000 – 4500	62
4500 – 5000	48

(change the frequency of class interval 3000-3500 from 85 to 86)

Answer.

Life time (in hours)	Number of lamps (f_i)	Cumulative Frequency
1500 – 2000	14	14
2000 – 2500	56	70
2500 – 3000	60	130
3000 – 3500	86	216
3500 – 4000	74	290
4000 – 4500	62	352
4500 – 5000	48	400
Total	$\sum f_i = n = 400$	

Here, $\sum f_i = n = 400$, then $\frac{n}{2} = \frac{400}{2} = 200$, which lies in interval $3000 - 3500$.

$\therefore$ Median class $= 3000 - 3500$

So, $l = 3000, n = 400, f = 86, cf = 130$ and $h = 500$

Now, Median $= l + \left[\frac{\frac{n}{2} - cf}{f}\right] \times h$

$= 3000 + \left[\frac{200 - 130}{86}\right] \times 500$

$= 3000 + \frac{70 \times 500}{86}$

$= 3000 + 406.9767441$

$= 3000 + 406.98$ (approx.)

$= 3406.98$

Hence median life time of a lamp is 3406.98 hours.

Ex 13.3 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:

No. of letters	1 – 4	4 – 7	7 – 10	10 – 13	13 – 16	16 – 19
No. 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.

Ans. For Median:

No. of letters	Number of surnames (f_i)	Cumulative Frequency
1 – 4	6	6
4 – 7	30	36
7 – 10	40	76
10 – 13	16	92
13 – 16	4	96
16 – 19	4	100
Total	$\sum f_i = n = 100$	

Here, $\sum f_i = n = 100$, then $\frac{n}{2} = \frac{100}{2} = 50$, which lies in interval 7 -10 .

$\therefore$ Median class $= 7 - 10$

So, $l = 7, n = 100, f = 40, cf = 36$ and $h = 3$

Now, Median $= l + \left[\frac{\frac{n}{2} - cf}{f}\right] \times h$

$= 7 + \left[\frac{50 - 36}{40}\right] \times 3$

$= 7 + \frac{14 \times 3}{40}$

$= 7 + 1.05$

$= 8.05$

For Mean:

No. of letters	(f_i)	Class Marks (x_i)	$u_i = \frac{x_i - a}{h}$	$f_i u_i$
1 – 4	6	2.5	– 2	– 12
4 – 7	30	5.5	– 1	– 30
7 – 10	40	8.5	0	0
10 – 13	16	11.5	1	16
13 – 16	4	14.5	2	8
16 - 19	4	17.5	3	12
	$\sum f_i = 100$			$\sum f_i u_i = -6$

From given data, Assume mean $(a) = 8.5$, Width of the class $(h) = 3$

$\therefore \bar{u} = \frac{\sum f_i u_i}{\sum f_i} = \frac{-6}{100} = 0.06$

Using formula, Mean $(\bar{x}) = a + h\bar{u} = 8.5 + 3(-0.06) = 8.5 - 0.18 = 8.32$

For Mode:

In the given data, maximum frequency is 40 and it corresponds to the class interval $7 - 10$.

$\therefore$ Modal class $= 7 - 10$

And $l = 7, f_1 = 40, f_0 = 30, f_2 = 16$ and $h = 3$

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

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

$= 7 + \frac{10}{80 - 46} \times 3$

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

$= 7 + 0.88$ (approx.)

$= 7.88$

Hence, median, mean and mode of given data is 8.05 letters, 8.32 letters and 7.88 letters respectively.

Ex 13.3 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
No. of students	2	3	8	6	6	3	2

Answer

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

Here, $\sum f_i = n = 30$, then $\frac{n}{2} = \frac{30}{2} = 15$, which lies in interval $55 - 60$.

$\therefore$ Median class $= 55 - 60$

So, $l = 55, n = 30, f = 6, cf = 13$ and $h = 5$

Now, Median $= l + \left[\frac{\frac{n}{2} - cf}{f}\right] \times h$

$= 55 + \left[\frac{15 - 13}{6}\right] \times 5$

$= 55 + \frac{2 \times 5}{6}$

$= 55 + 1.66666$

$= 5 + 1.67$ (approx.)

$= 56.67$

Hence median weight of the students are 56.67 kg.