Chapter 13: Statistics

Class 10 Math Chapter 13 Solutions (English Medium)

Exercise 13.1

Q 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?

We will use the **Direct Method** because the numerical values of x_i and f_i are small.

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

Number of plants (Class)	Number of houses (f_i)	Class mark (x_i)	$f_i \times x_i$
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 $\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$

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

Hence, the mean number of plants per house is 8.1.

Q 2. Consider the following distribution of daily wages of 50 workers of a factory.

Daily wages (in ₹)	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.

We will use the **Step-deviation Method** as the values of x_i are large.

Let assumed mean $a = 550$ and class size $h = 20$.

Daily wages	Number of workers (f_i)	Class mark (x_i)	$u_i = \frac{x_i - 550}{20}$	$f_i u_i$
500 - 520	12	510	-2	-24
520 - 540	14	530	-1	-14
540 - 560	8	**550 (a)**	0	0
560 - 580	6	570	1	6
580 - 600	10	590	2	20
Total	$\sum f_i = 50$			$\sum f_i u_i = -12$

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

$\bar{x} = 550 + \left(\frac{-12}{50}\right) \times 20$

$\bar{x} = 550 - \frac{24}{5} = 550 - 4.8 = 545.2$

Hence, the mean daily wages of the workers is ₹ 545.20.

Q 3. The following distribution shows the daily pocket allowance of children of a locality. The mean pocket allowance is ₹ 18. Find the missing frequency f .

Daily pocket allowance (in ₹)	11 - 13	13 - 15	15 - 17	17 - 19	19 - 21	21 - 23	23 - 25
Number of children	7	6	9	13	f	5	4

We will use the **Assumed Mean Method**. Let assumed mean $a = 18$.

Daily pocket allowance	Number of children (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 (a)**	0	0
19 - 21	f	20	2	$2f$
21 - 23	5	22	4	20
23 - 25	4	24	6	24
Total	$\sum f_i = 44 + f$			$\sum f_i d_i = 2f - 40$

Given, Mean $\bar{x} = 18$

Mean $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$

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

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

$2f = 40 \Rightarrow f = 20$

Hence, the missing frequency f is 20.

Q 4. Thirty women were examined in a hospital by a doctor and the number of heartbeats per minute were recorded and summarised as follows. Find the mean heartbeats per minute for these women, choosing a suitable method.

Number of heartbeats 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

We will use the **Step-deviation Method**. Let assumed mean $a = 75.5$ and class size $h = 3$.

Number of heartbeats	Number of women (f_i)	Class mark (x_i)	$u_i = \frac{x_i - 75.5}{3}$	$f_i u_i$
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 (a)**	0	0
77 - 80	7	78.5	1	7
80 - 83	4	81.5	2	8
83 - 86	2	84.5	3	6
Total	$\sum f_i = 30$			$\sum f_i u_i = 4$

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

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

$\bar{x} = 75.5 + \frac{4}{10} = 75.5 + 0.4 = 75.9$

Hence, the mean heartbeats per minute for these women is 75.9.

Q 5. In a retail market, fruit vendors were selling mangoes kept in packing boxes. These boxes contained 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?

The given class intervals are not continuous. We will make them continuous by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit of each class.

Continuous class intervals: 49.5 - 52.5, 52.5 - 55.5, ...

We will use the **Step-deviation Method**. Let assumed mean $a = 57$ and class size $h = 3$.

Number of mangoes (Continuous)	Number of boxes (f_i)	Class mark (x_i)	$u_i = \frac{x_i - 57}{3}$	$f_i u_i$
49.5 - 52.5	15	51	-2	-30
52.5 - 55.5	110	54	-1	-110
55.5 - 58.5	135	**57 (a)**	0	0
58.5 - 61.5	115	60	1	115
61.5 - 64.5	25	63	2	50
Total	$\sum f_i = 400$			$\sum f_i u_i = 25$

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

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

$\bar{x} = 57 + \frac{1}{16} \times 3 = 57 + \frac{3}{16} = 57 + 0.1875 \approx 57.19$

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

Q 6. The table below shows the daily expenditure on food of 25 households in a locality.

Daily expenditure (in ₹)	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.

We will use the **Step-deviation Method**. Let assumed mean $a = 225$ and class size $h = 50$.

Daily expenditure	Number of households (f_i)	Class mark (x_i)	$u_i = \frac{x_i - 225}{50}$	$f_i u_i$
100 - 150	4	125	-2	-8
150 - 200	5	175	-1	-5
200 - 250	12	**225 (a)**	0	0
250 - 300	2	275	1	2
300 - 350	2	325	2	4
Total	$\sum f_i = 25$			$\sum f_i u_i = -7$

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

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

$\bar{x} = 225 - 7 \times 2 = 225 - 14 = 211$

Hence, the mean daily expenditure on food is ₹ 211.

Q 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 SO_2 (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.

We will use the **Direct Method** as the numerical values of x_i and f_i are small.

Concentration of SO_2	Frequency (f_i)	Class mark (x_i)	$f_i x_i$
0.00 - 0.04	4	0.02	0.08
0.04 - 0.08	9	0.06	0.54
0.08 - 0.12	9	0.10	0.90
0.12 - 0.16	2	0.14	0.28
0.16 - 0.20	4	0.18	0.72
0.20 - 0.24	2	0.22	0.44
Total	$\sum f_i = 30$		$\sum f_i x_i = 2.96$

Mean $\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$

$\bar{x} = \frac{2.96}{30} = 0.0986... \approx 0.099$

Hence, the mean concentration of SO_2 in the air is 0.099 ppm.

Q 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

Here, the class size is not uniform. So, we will use the **Assumed Mean Method**. Let assumed mean $a = 17$.

Number of days	Number of students (f_i)	Class mark (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** (a)	0	0
20 - 28	4	24	7	28
28 - 38	3	33	16	48
38 - 40	1	39	22	22
Total	$\sum f_i = 40$			$\sum f_i d_i = -181$

Mean $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$

$\bar{x} = 17 + \frac{-181}{40} = 17 - 4.525 = 12.475 \approx 12.48$

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

Q 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

We will use the **Step-deviation Method**. Let assumed mean $a = 70$ and class size $h = 10$.

Literacy rate	Number of cities (f_i)	Class mark (x_i)	$u_i = \frac{x_i - 70}{10}$	$f_i u_i$
45 - 55	3	50	-2	-6
55 - 65	10	60	-1	-10
65 - 75	11	**70 (a)**	0	0
75 - 85	8	80	1	8
85 - 95	3	90	2	6
Total	$\sum f_i = 35$			$\sum f_i u_i = -2$

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

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

$\bar{x} = 70 - \frac{20}{35} = 70 - \frac{4}{7} = 70 - 0.57 = 69.43$

Hence, the mean literacy rate is 69.43%.

Exercise 13.2

Q 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.

Finding the Mode:

The maximum class frequency is 23, belonging to the class interval 35 - 45.

So, the modal class is 35 - 45.

$l = 35$ (lower limit of modal class)

$f_1 = 23$ (frequency of the modal class)

$f_0 = 21$ (frequency of the class preceding the modal class)

$f_2 = 14$ (frequency of the class succeeding the modal class)

$h = 10$ (class size)

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

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

$= 35 + \left(\frac{2}{46-35}\right) \times 10 = 35 + \frac{20}{11} = 35 + 1.81 = 36.81$ years

Finding the Mean:

We can use the Direct Method.

Age (Class)	No. of patients (f_i)	Class mark (x_i)	$f_i x_i$
5 - 15	6	10	60
15 - 25	11	20	220
25 - 35	21	30	630
35 - 45	23	40	920
45 - 55	14	50	700
55 - 65	5	60	300
Total	$\sum f_i = 80$		$\sum f_i x_i = 2830$

Mean $\bar{x} = \frac{\sum f_i x_i}{\sum f_i} = \frac{2830}{80} = 35.375$ years

Interpretation: Maximum number of patients admitted in the hospital are of the age 36.81 years (Mode), while on an average the age of a patient admitted to the hospital is 35.375 years (Mean).

Q 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.

The maximum frequency is 61, which belongs to the class interval 60 - 80.

Therefore, modal class = 60 - 80

$l = 60$

$f_1 = 61$

$f_0 = 52$

$f_2 = 38$

$h = 20$

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

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

$= 60 + \left(\frac{9}{122-90}\right) \times 20 = 60 + \left(\frac{9}{32}\right) \times 20$

$= 60 + \frac{180}{32} = 60 + 5.625 = 65.625$ hours

Hence, the modal lifetimes of the components is 65.625 hours.

Q 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

Finding the Mode:

Maximum frequency is 40, belonging to the class interval 1500 - 2000.

So, modal class = 1500 - 2000

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

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

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

$= 1500 + \left(\frac{16}{80-57}\right) \times 500 = 1500 + \frac{16}{23} \times 500$

$= 1500 + \frac{8000}{23} = 1500 + 347.826 = 1847.83$ ₹

Finding the Mean: (Step-deviation Method, $a = 2750, h = 500$)

Expenditure	Families (f_i)	x_i	$u_i = \frac{x_i - 2750}{500}$	$f_i u_i$
1000 - 1500	24	1250	-3	-72
1500 - 2000	40	1750	-2	-80
2000 - 2500	33	2250	-1	-33
2500 - 3000	28	**2750 (a)**	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
Total	$\sum f_i = 200$			$\sum f_i u_i = -35$

Mean $\bar{x} = 2750 + \left(\frac{-35}{200}\right) \times 500 = 2750 - \frac{175}{2} = 2750 - 87.5 = 2662.50$ ₹

Hence, the modal monthly expenditure is ₹ 1847.83 and the mean monthly expenditure is ₹ 2662.50.

Q 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

Finding the Mode:

Maximum frequency is 10, so the modal class is 30 - 35.

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

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

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

$= 30 + \left(\frac{1}{20-12}\right) \times 5 = 30 + \frac{5}{8} = 30 + 0.625 = 30.625 \approx 30.6$

Finding the Mean: (Step-deviation Method, $a = 32.5, h = 5$)

Students/teacher	States (f_i)	x_i	$u_i = \frac{x_i - 32.5}{5}$	$f_i u_i$
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 (a)**	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
Total	$\sum f_i = 35$			$\sum f_i u_i = -23$

Mean $\bar{x} = 32.5 + \left(\frac{-23}{35}\right) \times 5 = 32.5 - \frac{23}{7} = 32.5 - 3.28 = 29.22$

Interpretation: Most states/U.T. have a teacher-student ratio of 30.6 (Mode), while on an average, the ratio is 29.2 (Mean).

Q 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.

Maximum frequency is 18, so the modal class is 4000 - 5000.

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

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

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

$= 4000 + \left(\frac{14}{36-13}\right) \times 1000 = 4000 + \frac{14}{23} \times 1000$

$= 4000 + \frac{14000}{23} = 4000 + 608.695\ldots$

$= 4608.7$ (approx)

Hence, the mode of the data is 4608.7 runs.

Q 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

Maximum frequency is 20, so the modal class is 40 - 50.

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

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

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

$= 40 + \left(\frac{8}{40-23}\right) \times 10 = 40 + \frac{80}{17}$

$= 40 + 4.705... = 44.7$ (approx)

Hence, the mode of the number of cars is 44.7 cars.

Exercise 13.3

Q 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)	65 - 85	85 - 105	105 - 125	125 - 145	145 - 165	165 - 185	185 - 205
Number of consumers	4	5	13	20	14	8	4

Finding the Median:

Monthly consumption	Frequency (f)	Cumulative frequency (cf)
65 - 85	4	4
85 - 105	5	9
105 - 125	13	22
125 - 145 (Median class)	**20**	**42**
145 - 165	14	56
165 - 185	8	64
185 - 205	4	68
Total	$n = 68$	

Here $n = 68$, so $\frac{n}{2} = 34$

Cumulative frequency just greater than 34 is 42, which belongs to class 125 - 145.

So, Median class = 125 - 145

$l = 125, cf = 22, f = 20, h = 20$

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

$= 125 + \left(\frac{34-22}{20}\right) \times 20 = 125 + \left(\frac{12}{20}\right) \times 20 = 125 + 12 = 137$ units

Finding the Mode:

Maximum frequency is 20, so modal class = 125 - 145

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

Mode $= 125 + \left(\frac{20-13}{2(20)-13-14}\right) \times 20 = 125 + \left(\frac{7}{40-27}\right) \times 20$

$= 125 + \frac{140}{13} = 125 + 10.76... = 135.76$ units

Finding the Mean: (Assumed mean method, $a = 135, h = 20$)

$\bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right) \times h = 135 + \left(\frac{7}{68}\right) \times 20 = 135 + \frac{140}{68} = 135 + 2.05... = 137.05$ units

Hence, Median is 137 units, Mode is 135.76 units, and Mean is 137.05 units. All three measures are approximately the same.

Q 2. If the median of the distribution given below is 28.5, 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

Class interval	Frequency (f)	Cumulative frequency (cf)
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	$n = 60$	

Total frequency $n = 60$ is given.

So, $45 + x + y = 60 \Rightarrow x + y = 15$ ... (Equation 1)

Median is 28.5, which lies in the interval 20 - 30.

So, Median class = 20 - 30

Here $l = 20$, $n/2 = 30$, $cf = 5 + x$ (cumulative frequency of preceding class), $f = 20, h = 10$

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

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

$8.5 = \frac{25 - x}{2}$

$17 = 25 - x$

$x = 25 - 17 = 8$

Putting the value of x in Equation 1:

$8 + y = 15 \Rightarrow y = 7$

Hence, $x = 8$ and $y = 7$.

Q 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

The given table is a 'less than' type cumulative frequency table. Let's convert it to class intervals:

Age (Class interval)	Frequency (f)	Cumulative frequency (cf)
15 - 20	2	2
20 - 25	$6-2=4$	6
25 - 30	$24-6=18$	24
30 - 35 (Median class)	$45-24=21$	**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

Here $n=100$, so $\frac{n}{2}=50$

Cumulative frequency just greater than 50 is 78, so median class is 35 - 40.

Here $l=35$, $cf=45$, $f=33$, $h=5$

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

$=35+\left(\frac{50-45}{33}\right)\times 5=35+\left(\frac{5}{33}\right)\times 5=35+\frac{25}{33}$

$=35+0.757\ldots=35.76$ years

Hence, the median age is 35.76 years.

Q 4. The lengths of 40 leaves of a plant are measured correct to the nearest millimetre, and the data obtained is represented in the following table:

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

Find the median length of the leaves.

The given class intervals are not continuous. We will make them continuous by subtracting 0.5 from the lower limit and adding 0.5 to the upper limit.

Length (Continuous)	Frequency (f)	Cumulative frequency (cf)
117.5 - 126.5	3	3
126.5 - 135.5	5	8
135.5 - 144.5	9	17
144.5 - 153.5 (Median class)	**12**	**29**
153.5 - 162.5	5	34
162.5 - 171.5	4	38
171.5 - 180.5	2	40

Here $n = 40$, so $\frac{n}{2} = 20$

Cumulative frequency just greater than 20 is 29, so median class is 144.5 - 153.5.

$l = 144.5$, $cf = 17$, $f = 12$, $h = 9$ (Since 153.5 - 144.5 = 9)

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

$= 144.5 + \left(\frac{20-17}{12}\right) \times 9 = 144.5 + \left(\frac{3}{12}\right) \times 9$

$= 144.5 + \frac{27}{12} = 144.5 + 2.25 = 146.75$ mm

Hence, the median length of the leaves is 146.75 mm.

Q 5. The following table gives the distribution of the life time of 400 neon lamps:

Life time (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.

Life time	Frequency (f)	Cumulative frequency (cf)
1500 - 2000	14	14
2000 - 2500	56	70
2500 - 3000	60	130
3000 - 3500 (Median class)	**86**	**216**
3500 - 4000	74	290
4000 - 4500	62	352
4500 - 5000	48	400

Here $n = 400$, so $\frac{n}{2} = 200$

Cumulative frequency just greater than 200 is 216, so median class is 3000 - 3500.

$l = 3000$, $cf = 130$, $f = 86$, $h = 500$

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

$= 3000 + \left(\frac{200-130}{86}\right) \times 500 = 3000 + \frac{70 \times 500}{86}$

$= 3000 + \frac{35000}{86} = 3000 + 406.976... = 3406.98$ (approx)

Hence, the median life time of a lamp is 3406.98 hours.

Q 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.

Finding the Median:

Number of letters	Frequency (f)	Cumulative frequency (cf)
1 - 4	6	6
4 - 7	30	36
7 - 10 (Median class)	**40**	**76**
10 - 13	16	92
13 - 16	4	96
16 - 19	4	100

$n = 100 \Rightarrow \frac{n}{2} = 50$. So, median class is 7 - 10.

$l = 7, cf = 36, f = 40, h = 3$

Median $= 7 + \left(\frac{50-36}{40}\right) \times 3 = 7 + \frac{14 \times 3}{40} = 7 + \frac{42}{40} = 7 + 1.05 = 8.05$ letters

Finding the Mode:

Maximum frequency is 40, so modal class is 7 - 10.

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

Mode $= 7 + \left(\frac{40-30}{2(40)-30-16}\right) \times 3 = 7 + \left(\frac{10}{80-46}\right) \times 3 = 7 + \frac{30}{34} = 7 + 0.88 = 7.88$ letters

Finding the Mean: (Direct Method)

$\bar{x} = \frac{\sum f_i x_i}{\sum f_i} = \frac{(6\times2.5)+(30\times5.5)+(40\times8.5)+(16\times11.5)+(4\times14.5)+(4\times17.5)}{100}$

$\bar{x} = \frac{15+165+340+184+58+70}{100} = \frac{832}{100} = 8.32$ letters

Hence, Median is 8.05 letters, Mode is 7.88 letters, and Mean is 8.32 letters.

Q 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

Weight (in kg)	Frequency (f)	Cumulative frequency (cf)
40 - 45	2	2
45 - 50	3	5
50 - 55	8	13
55 - 60 (Median class)	**6**	**19**
60 - 65	6	25
65 - 70	3	28
70 - 75	2	30

Here $n = 30$, so $\frac{n}{2} = 15$

Cumulative frequency just greater than 15 is 19, so median class is 55 - 60.

$l = 55$, $cf = 13$, $f = 6$, $h = 5$

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

$= 55 + \left(\frac{15-13}{6}\right) \times 5 = 55 + \frac{2}{6} \times 5$

$= 55 + \frac{10}{6} = 55 + 1.666... = 56.67$ kg (approx)

Hence, the median weight of the students is 56.67 kg.