

CBSE Class-10 Mathematics

NCERT solution

Chapter - 14

Statistics - Exercise 14.3

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

Ans. 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.

∴ Median class = 125 – 145

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

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

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

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

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

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

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

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

$$= 135 + 2.04 = 137.04$$

For Mode:

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

∴ Modal class = 125 – 145

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

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

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

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

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

$$= 125 + 10.76923$$

$$= 125 + 10.77$$

$$= 135.77$$

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

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

Ans.

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 $h = 10$

$\therefore 45 + x + y = 60$

$\Rightarrow x + y = 15$ (i)

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

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

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

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

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

$$\Rightarrow 57.0 = 65 - x$$

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

$$\Rightarrow x = 8$$

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.

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

Ans.

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.

∴ Median class = 35 - 40

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

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

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

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

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

$$= 35 + 0.7575$$

$$= 35 + 0.76 \text{ (approx.)}$$

$$= 35.76$$

Hence median age of given data is 35.76 years.

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

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

Length (in mm)	Number of leaves (f_i)	Cumulative Frequency
117.5 – 126.5	3	3
126.5 – 135.5	5	8
135.5 – 144.5	9	17
144.5 – 153.5	12	29
153.5 – 162.5	5	34
162.5 – 171.5	4	38
171.5 – 180.5	2	40
Total	$\sum f_i = n = 40$	

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

∴ Median class = 144.5 – 153.5

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

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

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

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

$$= 144.5 + 2.25$$

$$= 146.75$$

Hence median length of the leaves is 146.75 mm.

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)

Ans.

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.

∴ Median class = 3000 – 3500

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

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

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

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

$$= 3000 + 406.9767441$$

$$= 3000 + 406.98 \text{ (approx.)}$$

$$= 3406.98$$

Hence median life time of a lamp is 3406.98 hours.

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 $h = 3$

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

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

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

$$= 7 + 1.05$$

$$= 8.05$$

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 $h = 3$

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

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

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

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

$$= 7 + 0.88 \text{ (approx.)}$$

$$= 7.88$$

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

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

Ans.

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.

∴ Median class = 55 – 60

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

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

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

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

$$= 55 + 1.66666$$

$$= 5 + 1.67 \text{ (approx.)}$$

$$= 56.67$$

Hence median weight of the students are 56.67 kg.