

Ex - 14.3

- Q1.** 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

Sol.(i)

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	$n = 68$	

$$n = 68 \text{ gives } \frac{n}{2} = 34$$

So, we have the median class (125-145)

$$\ell = 125, n = 68, f = 20, cf = 22, h = 20$$

$$\begin{aligned} \text{Median} &= \ell + \left\{ \frac{\frac{n}{2} - cf}{f} \right\} \times h \\ &= 125 + \left\{ \frac{34 - 22}{20} \right\} \times 20 = 137 \text{ units.} \end{aligned}$$

- (ii) Modal class is (125 – 145) having maximum frequency $f_m = 20$, $f_1 = 13$, $f_2 = 14$, $\ell = 125$ and $h = 20$

$$\begin{aligned} \text{Mode} &= \ell + \left\{ \frac{f_m - f_1}{2f_m - f_1 - f_2} \right\} \times h \\ &= 125 + \left\{ \frac{20 - 13}{40 - 13 - 14} \right\} \times 20 = 125 + \frac{7 \times 20}{13} \\ &= 125 + \frac{140}{13} = 125 + 10.76 = 135.76 \text{ units} \end{aligned}$$

(iii) $n = 68$, $a = 135$, $h = 20$ and $\Sigma f_i u_i = 7$

Monthly consumption (in units)	Number of consumers f_i	Class mark x_i	$u_i = \frac{x_i - 135}{20}$	$f_i \times u_i$
65-85	4	75	-3	-12
85-105	5	95	-2	-10
105-125	13	115	-1	-13
125-145	20	135=a	0	0
145-165	14	155	1	14
165-185	8	175	2	16
185-205	4	195	3	12
Total	$n = 68$			7

$n = 68$, $a = 135$, $h = 20$ and $\Sigma f_i u_i = 7$

By step-deviation method.

$$\text{Mean} = a + h \times \frac{1}{n} \times \Sigma f_i u_i = 135 + 20 \times \frac{1}{68} \times 7$$

$$= 135 + \frac{35}{17} = 135 + 2.05 = 137.05 \text{ units}$$

Q2. If the median of the distribution given below is 28.5, find the values of x and y .

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	60	

Sol. Median = 28.5 lies in the class-interval (20-30).

Then median class is (20-30).

So, we have $\ell = 20$, $f = 20$, $cf = 5 + x$, $h = 10$, $n = 60$

$$\text{Median} = \ell + \left\{ \frac{\frac{n}{2} - cf}{f} \right\} \times h = 28.5 \quad 28.5 = 20 + \left\{ \frac{30 - (5+x)}{20} \right\} \times 10$$

$$\Rightarrow 8.5 = \frac{25-x}{2} \Rightarrow 17 = 25 - x \Rightarrow x = 8$$

Find the given table, we have

$$\text{i.e., } x + y + 45 = 60 \text{ or } x + y = 15$$

$$\Rightarrow y = 15 - x = 15 - 8 = 7, \quad \text{i.e., } y = 7$$

- Q3.** 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 year.

Age (in years)	No. 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

Sol.

Age (in years)	Number of policy holders f_i	Cumulative frequency
Below 20	$2 = 2$	2
20-25	$(6-2) = 4$	6
25-30	$(24-6) = 18$	24
30-35	$(45-24) = 21$	45
median class 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	$n = 100$	

Here, $\ell = 35$, $n = 100$, $f = 33$, $cf = 45$, $h = 5$

$$\begin{aligned}
 \text{Median} &= \ell + \left\{ \frac{\frac{n}{2} - cf}{f} \right\} \times h \\
 &= 35 + \left\{ \frac{50 - 45}{33} \right\} \times 5 \\
 &= 35 + \frac{25}{33} \\
 &= 35 + 0.76 \\
 &= 35.76 \text{ years.}
 \end{aligned}$$

Q4.

Length (in mm)	No. of leaves
118-126	3
127-135	5
136-144	9
145-153	12
154-162	5
163-171	4
172-180	2

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

Sol. The given series is in inclusive form. We may prepare the table in exclusive form and prepare the cumulative frequency table as given below :

Length (in mm)	No. 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
	$N = 40$	

Here, $N = 40$

$$\therefore \frac{N}{2} = 20$$

The cumulative frequency just greater than 20 is 29 and the corresponding class is 144.5-153.5.

So, the median class is 144.5-153.5.

$$\therefore \ell = 144.5, N = 40, C = 17, f = 12 \text{ and } h = 9$$

$$\text{Therefore, median} = \ell + \left\{ \frac{\frac{N}{2} - C}{f} \right\} \times h$$

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

$$= 144.5 + 2.25 = 146.75$$

Hence, median length of leaves is 146.75 mm.

Q5. The following table gives the distribution of the life time of 400 neon lamps :

Life Time (in hours)	No. of lamps
1500-2000	14
2000-2500	56
2500-3000	60
3000-3500	85
3500-4000	74
4000-4500	62
4500-5000	48

Find the median life time of a lamp.

Sol .

Life time (in hrs.)	No. of lamps (f_i)	Cf
1500-2000	14	14
2000-2500	56	70
2500-3000	60	130
3000-3500	85	215
3500-4000	74	289
4000-4500	62	351
4500-5000	48	399

$$\frac{N}{2} = \frac{399}{2} = 199.5$$

Median class = 3000 – 3500

$$\begin{aligned} \text{Median} &= \ell + \left\{ \frac{\frac{N}{2} - C}{f} \right\} \times h \\ &= 3000 + \left\{ \frac{199.5 - 130}{85} \right\} \times 500 = 3408.82 \end{aligned}$$

Hence, median life time of a lamp 3408.82 hrs.

Q6. 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	No. of Surnames
1-4	6
4-7	30
7-10	40
10-13	16
13-16	4
16-19	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.

Sol.

	Number of letters	Number of surnames f_i	Cumulative frequency
Median class	1-4	6	6=6
	4-7	30	6+30=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	$n = 100$	

(i) Here,

$$\ell = 7, n = 100, f = 40, cf = 36, h = 3$$

$$\text{Median} = \ell + \left\{ \frac{\frac{n}{2} - cf}{f} \right\} \times h$$

$$= 7 + \left\{ \frac{50 - 36}{40} \right\} \times 3 = 7 + \frac{21}{20} = 8.05$$

(ii) Modal class is (7 - 10).

$$\ell = 7, f_m = 40, f_1 = 30, f_2 = 16, h = 3$$

$$\text{Mode} = \ell + \left\{ \frac{f_m - f_1}{2f_m - f_1 - f_2} \right\} \times h$$

$$= 7 + \left\{ \frac{40 - 30}{80 - 30 - 16} \right\} \times 3 = 7 + \frac{30}{34} = 7.88$$

(iii) Here, $a = 8.5, h = 3, n = 100$ and $\sum f_i u_i = -6$.

Number of letters	f_i	Class mark x_i	$u_i = \frac{x_i - 8.5}{3}$	$f_i \times u_i$
1-4	6	2.5	-2	-12
4-7	30	5.5	-1	-30
7-10	40	8.5=a	0	0
10-13	16	11.5	1	16
13-16	4	14.5	2	8
16-19	4	17.5	3	12
Total	$n = 100$			-6

$$\text{Mean} = a + h \times \frac{1}{n} \times \sum f_i u_i = 8.5 + 3 \times \frac{1}{100} \times (-6) = 8.5 - \frac{18}{100} = 8.5 - 0.18 = 8.32$$

Q7. The distribution below gives the weights of 30 students of a class. Find the median weight of the students.

Weight (in kg)	No. of students
40-45	2
45-50	3
50-55	8
55-60	6
60-65	6
65-70	3
70-75	2

Sol.

Weight (in kg)	No. of students	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

$$\frac{N}{2} = \frac{30}{2} = 15$$

Median class = 55 – 60

$$\text{Median} = \ell + \left\{ \frac{\frac{N}{2} - C}{f} \right\} \times h$$

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

$$= 56.67$$