13 CHAPTER

Statistics

Level - 1 CORE SUBJECTIVE QUESTIONS

MULTIPLE CHOICE QUESTIONS (MCQs) (1 Mark)

1. Option (C) is correct

Explanation: Frequency Distribution with Cumulative Frequency.

Class	Frequency	Cumulative Frequency
0 – 10	5	5
10 – 20	9	14
20 – 30	15	29
30 – 40	10	39
40 – 50	6	45

As, total frequency is 45.

$$\Rightarrow \quad \frac{N}{2} = \frac{45}{2} = 22.5$$

Now, cumulative frequency greater than or equal to 22.5 lies in class 20-30.

So, Median class is 20-30

$\therefore$ Upper limit of median class is 30.

2. Option (D) is correct

Explanation:

$$\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Sigma f_i x_i - \bar{x}\Sigma f_i = 0$$

$$\Rightarrow \quad \Sigma f_i (x_i - \bar{x}) = 0$$

Thus,

3. Option (A) is correct

Explanation: In this case, if the value of each observation is increased by 2, the median of the new data will increase by 2.

4. Option (B) is correct

Explanation: Median is the value of middle most observation (s).

The mode is the most frequently occurring observation.

Mean is found by adding all the values of the observations and dividing it by the total number of observations.

$\therefore$ Median is the correct answer.

5. Option (B) is correct

Explanation: If each observation of the data is increased by 3, then their mean is increased by 3. Consider the following example: Let the terms be a, b, c, d.

$$\therefore \quad \text{Mean} = \frac{a+b+c+d}{4}$$

After an increment of 3 in each term,

$$\text{New mean} = \frac{a+3+b+3+c+3+d+3}{4}$$

$$= \frac{a+b+c+d+12}{4} = \frac{a+b+c+d}{4} + 3$$

Hence, the mean also increases by 3.

6. Option (D) is correct

Explanation: Given that mode = 7 and mean = 7

We know that mode = 3 median –2 mean

$$\Rightarrow \quad \text{median} = \frac{\text{mode} + 2 \text{ mean}}{3}$$

$$\therefore \quad \text{median} = \frac{7+2(7)}{3} = \frac{7+14}{3} = \frac{21}{3} = 7$$

7. Option (A) is correct

8. Option (D) is correct

Explanation: Given:

Mean = 7.2

Median = 7.1

Substitute these values into the formula:

Mode = 3 Median – 2 mean

Mode = 3 × 7.1 – 2 × 7.2

Mode = 21.3 – 14.4 = 6.9

Thus, the mode is 6.9,

9. Option (B) is correct

Explanation: Given:

Mean = 12

Median = 15

Substitute these values into the formula :

Mode = 3 Median – 2 Mean

Mode = 3 × 15 – 2 × 12

Mode = 45 – 24 = 21

Thus, the mode is 21.

10. Option (C) is correct

Explanation: Modal class has the highest frequency, which is 100 – 115 (frequency = 15), so its lower limit is 100.

Median class is found using cumulative frequency.

C I	*f*	*c.f.*
100 – 115	15	15

115 – 130	13	28
130 – 145	11	39
145 – 160	10	49
160 – 175	11	60

The total is 60, and the 30th observation lies in the class 130 – 145, so its upper limit is 145.
The sum of the lower limit of the modal class and the upper limit of the median class is:
100 + 145 = 245

11. Option (C) is correct
Explanation: Given:
Mean = 43
Median = 43.4
Substitute these values into the formula:
Mode = 3 Median – 2 Mean
Mode = 3 × 43.4 – 2 × 43
Mode = 130.2 – 86 = 44.2
Thus, the mode is 44.2

12. Option (C) is correct
Explanation:

Marks (Less than)	Cumulative Frequency	Frequency (Number of Students)
Less than 10	3	3
Less than 20	12	12 – 3 = 9
Less than 30	27	27 – 12 = 15
Less than 40	57	57 – 27 = 30
Less than 50	75	75 – 57 = 18
Less than 60	80	80 – 75 = 5

Now, we observe that the highest frequency is 30, which corresponds to the class 30 – 40.

13. Option (B) is correct
Explanation: As highest frequency is 19 which corresponds to the class 145-155.
Now, we can see that Nitesh blood pressure falls in modal class 145-155

ASSERTION-REASON QUESTIONS (1 Mark)

1. Option (B) is correct
Explanation: Total students in Section A = 1 + 1 + 10 + 11 + 5 + 2 = 30
Total students in Section B = 2 + 1 + 9 + 11 + 4 + 3 = 30
Let's calculate cumulative frequencies for each class interval to find the median class.

Section A (Cumulative Frequency)

Mark Range	Frequency	Cumulative Frequency
20 – 29	1	1
30 – 39	1	2
30 – 49	10	12
50 – 59	11	23
60 – 69	5	28
70 – 79	2	30

Half of total students in section A = $\frac{30}{2} = 15$

The cumulative frequency just exceeding 15 is 23, so the median class for Section A is 50 – 59.

Section B (Cumulative Frequency)

Mark Range	Frequency	Cumulative Frequency
20 – 29	2	2
30 – 39	1	3
40 – 49	9	12
50 – 59	11	23
60 – 69	4	27
70 – 79	3	30

Half of total students in Section B = $\frac{30}{2} = 15$

The cumulative frequency just exceeding 15 is 23 so the median class for Section B is 50-59.
As, median mark of both sections are equal so, Assertion in true. Also, cumulative frequency and the preceding class are same for both the sections, so Reason is also true.
Thus, Both (A) and (R) are true, but (R) is not the correct explanation for (A).

2. Option (A) is correct
Explanation: Given Information:
Mean = 169
Median = 170
By using the the formula provided in Reason (R),
Mode = 3 × Median – 2 × Mean,
Substitute the given values:
Mode = 3 × 170 – 2 × 169
= 510 – 338
= 172
Thus, Both (A) and (R) are true, and (R) is the correct explanation for (A).

VERY SHORT ANSWER TYPE QUESTIONS (2 Marks)

1. Given:
The median of the data is 35 .
N = 45, so $\frac{N}{2} = 22.5$.

$$\text{Median} = L + \left(\frac{\frac{N}{2} - CF}{f}\right) \times h$$

Since the median is 35, the median class is 30 – 40
We have,

L = 30 (Lower limit of the median class),

$\frac{N}{2} = 22.5$

CF = 5 + A (cumulative frequency of the class before the median class),

$f = 5$ (Frequency of the median class)

$h = 10$ (Class interval)

Substituting the known values,

$$35 = 30 + \left(\frac{22.5 - (5 + A)}{5}\right) \times 10$$

$$35 = 30 + \left(\frac{22.5 - 5 - A}{5}\right) \times 10$$

$$35 = 30 + \left(\frac{17.5 - A}{5}\right) \times 10$$

$$35 - 30 = \left(\frac{17.5 - A}{5}\right) \times 10$$

$$5 = 2 \times (17.5 - A)$$

$$2.5 = 17.5 - A$$

$$A = 17.5 - 2.5 = 15$$

2. As, the class 45-55 has maximum frequency.

$\therefore$ Modal class is 45-55

$$\text{Mode} = i + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$$

Where $l = 45$ $f_2 = 14$

$f_1 = 23$ $h = 10$

$f_0 = 22$

$$\text{Mode} = 45 + \left(\frac{23 - 22}{2 \times 23 - 22 - 14}\right) \times 10$$

$$\text{Mode} = 45 + \left(\frac{1}{46 - 36}\right) \times 10$$

$$\text{Mode} = 45 + \left(\frac{1}{10}\right).10$$

$$= 45 + 1 = 46$$

3. Given, Mode = 75

Modal class = 65 – 80

Frequency of the class preceding the modal class, $f_0 = 6$

Frequency of class succeeding the modal class, $f_2 = 8$

Here, the lower limit of modal class, $l = 65$ and class size = 15

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

$$\Rightarrow \quad 75 = 65 + \left(\frac{f_1 - 6}{2f_1 - 6 - 8}\right) \times h$$

$$\Rightarrow \quad 10 = \frac{f_1 - 6}{2f_1 - 14} \times 15$$

$$\Rightarrow \quad 20f_1 - 140 = 15f_1 - 90$$

$$\Rightarrow \quad 5f_1 = 50$$

$$\Rightarrow \quad f_1 = 10$$

Hence, the frequency of modal class (f_1) is 10.

4.

Class	Frequency	Midpoint (x_i)	f_ix_i
1-5	4	3	12
5-9	8	7	56
9-13	7	11	77
13-17	6	15	90
	$\Sigma f_i = 25$		$\Sigma f_ix_i = 235$

$$\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{235}{25} = 9.4$$

5. Here modal class = 40-50, as it has maximum frequency.

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

$$\text{Mode} = 40 + \left(\frac{17 - 12}{(17 - 12) + (17 - 4)}\right) \times 10$$

$$= 40 + \left(\frac{5}{5 + 13}\right) \times 10$$

$$= 40 + \frac{5}{18} \times 10$$

$$= 40 + 2.78 = 42.78$$

The mode of the given frequency distribution is approximately 42.78.

6.

Class Interval	Frequency (f)	Cumulative Frequency
0 – 10	5	5
10 – 20	7	c
20 – 30	a	18
30 – 40	5	d
40 – 50	b	30

Find *c*: The cumulative frequency for the class interval 10 - 20 is the sum of frequencies of the 0 - 10 and 10 - 20

$$c = 5 + 7 = 12$$

Find *a*: The cumulative frequency for the class interval 20 – 30 is 18. As calculated above $c = 12$:

$$12 + a = 18$$

$$a = 18 - 12 = 6$$

Find *d*: The cumulative frequency for the class interval 30 – 40 which, is the sum of the frequencies of the 0 – 10, 10 – 20, 20 – 30, and 30 - 40 class intervals.

$$d = 18 + 5 = 23$$

Find *b*: The cumulative frequency for the class interval 40 - 50 is 30. Given $d = 23$:

$$23 + b = 30$$

$$b = 30 - 23 = 7$$

Therefore,

Class Interval	Frequency	Comulative Frequency
0 – 10	5	5
10 – 20	7	12
20 – 30	6	18
30 – 40	5	23
40 – 50	7	30

Therefore, the values are:

$$a = 6, b = 7, c = 12, d = 23$$

7. Here 240 lies in class interval 200 – 300 So, the modal class is 200 – 300

Lower limit (l) = 200

$$h = 100, f_1 = 270, f_0 = 230 \text{ and } f_2 = x$$

$$\text{Formula of mode } = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right)h$$

Putting the values in this formula

$$240 = 200 + \left(\frac{270 - 230}{2(270) - 230 - x}\right)100$$

$$240 - 200 = \frac{270 - 230}{2 \times 270 - 230 - x} \times 100$$

$$40 = \frac{40}{310 - x} \times 100$$

$$40\,(310 - x) = 40 \times 100$$

$$310 - x = 100$$

$$x = 310 - 100 = 210$$

$$40 = \frac{40}{310 - x} \times 100$$

$$40\,(30 - x) = 40 \times 100$$

$$310 - x = 100$$

$$x = 310 - 100 - 210$$

The missing frequency x for the class interval 300 – 400 is 210.

8. The maximum frequency is 78 so the modal calss is 18 – 20

Therefore,

$$l = 18$$
$$h = 2$$
$$f_1 = 78$$
$$f_0 = 50$$
$$f_2 = 46$$

$$\text{Mode} = l + \frac{f - f_1}{2f - f_1 - f_2} \times h$$

$$= 18 + \frac{78 - 50}{156 - 50 - 46} \times 2$$

$$= 18 + \frac{28}{60} \times 2$$

$$= 18 + \frac{14}{15}$$

$$= 18 + 0.93$$

$$= 18.93$$

9.

Class Interval	Frequency (f_1)	Midpoint (x_1)	f_ix_i
0 – 4	3	2	6
4 – 8	p	6	$6p$
8 – 12	5	10	50
12 – 16	8	14	112
16 – 20	2	18	36
	$\Sigma f_i = 18 + p$		$\Sigma f_ix_i = 204 + 6p$

$$\text{Mean} = \frac{\bullet\ f_ix_i}{\bullet\ f_i}$$

$$10.8 = \frac{204 + 6p}{18 + p}$$

$$10.8\,(18 + p) = 204 + 6p$$

$$10.8p + 194.4 = 204 + 6p$$

$$10.8p - 6p = 204 - 194.4$$

$$4.8p = 9.6$$

$$p = 2$$

10. d

Age (Year)	Class	No. of persons (frequency)	Cumulative frequency less than
Less than 10	0-10	3	3
Less than 20	10-20	10-3 = 7	10
Less than 30	20-30	22-10 = 12	22
Less than 40	30-40	40-22 = 18	40
Less than 50	40-50	54-40 = 14	54
Less than 60	50-60	71 – 54 = 17	71

Here N = 71

$\frac{N}{2} = 35.5$ and $h = 10$ the number 35.5 is in the class 30 – 40, hence it is the median class.

The cumulative frequency of its preceding class, if = 22, L = 30, $f = 18$

$$\text{Median} = L + \left(\frac{\frac{N}{2} - cf}{f}\right) \times h$$

$$= 30 + \left(\frac{35.5 - 22}{18}\right) \times 10$$

$$= 30 + \frac{13.5}{18} \times 10$$

$$= 30 + 7.5$$

$$= 37.5$$

∴ The median age of the person visiting the museum is 37.5 years

SHORT ANSWER TYPE QUESTIONS (3 Marks)

1.

Marks Interval	Midpoint (x_i)	Frequency (f_i)	$f_i \cdot x_i$
0-10	5	12	$5 \times 12 = 60$
10 - 20	15	23	$15 \times 23 = 345$
20 - 30	25	34	$25 \times 34 = 850$
30 - 40	35	25	$35 \times 25 = 875$
40 - 50	45	6	$45 \times 6 = 270$

$N = \Sigma f_i = 100\ \Sigma f_i x_i = 2400$

$\text{Mean} = \frac{\Sigma fixi}{N} = \frac{2400}{100} = 24$

2.

Class	Frequency (f_i)	Class Mark (x_i)	$x_i \times f_i$
0-10	5	5	25
10 - 20	18	15	270
20 - 30	15	25	375
30 - 40	f	35	$35f$
40 - 50	6	45	270
Total	$\Sigma f_i = 44 + f$		$\Sigma x_i f_i = 940 + 35f$

Now, Mean $(\bar{x}) = \frac{\Sigma x_i f_i}{\Sigma f_i}$

$\therefore \quad 25 = \frac{940 + 35f}{44 + f}$

$\Rightarrow \quad 1100 + 25f = 940 + 35f$

$\Rightarrow \quad 35f - 25f = 1100 - 940$

$\Rightarrow \quad 35f - 25f = 1100 - 940$

$\Rightarrow \quad 10f = 160$

$\Rightarrow \quad f = \frac{160}{10}$

$\Rightarrow \quad f = 16$

3. Let us first construct the table for $d_i \times f_i$ where $d_i = x_i - A$ (Assumed mean), as shown below:

Class	Mid point (x_i)	Frequency (f_i)	$d_i = x_i - A$	$d_i \times f_i$
0-5	2.5	8	–10	–80
5 - 10	7.5	7	–5	–35
10 – 15	$12.5 = A$	10	0	0
15 – 20	17.5	13	5	65
20 – 25	22.5	12	10	120
		$\Sigma f_i = 50$		$\Sigma f_i d_i = 70$

Let $A = 12.5$

Then $\Sigma f_i d_i = 70$

Now, the required mean

$\left(\bar{X}\right) = A + \frac{\Sigma f_i d_i}{\Sigma f_i}$

$= 12.5 + \frac{70}{50}$

$= 12.5 + 1.4$

$= 13.9$

4. Let us first construct the table of cumulative frequency as shown below:

Height (in cm)	Number of sutdents (f_i)	Cumulative Frequency ($c.f$)
130 – 135	4	4
135 – 140	11	15
140 – 145	12	27
145 – 150	7	34
150 – 155	10	44
155 – 160	6	50
Total	$\Sigma f_i = 50$	

Here, $\frac{N}{2} = \frac{50}{2} = 25$, which lies in cumulative frequency of 27

$\therefore$ The median class is 140 – 145

So, L = 140, c.f. = 15, $f = 12$ and $h = 5$

Now, $\text{median } (M_e) = L + \frac{\frac{N}{2} - c.f}{f} \times h$

$\therefore$ Required median $= 140 + \frac{25 - 15}{12} \times 5$

$= 140 + \frac{10}{12} \times 5$

$= 140 + 4.17$

$= 144.17$

5.

Class Interval	Midpoint (x)	Frequency (f)	$f.x$
25 - 30	27.5	14	$27.5 \times 14 = 385$
30 - 35	32.5	22	$32.5 \times 22 = 715$
35 - 40	37.5	16	$37.5 \times 16 = 600$
40 - 45	42.5	6	$42.5 \times 6 = 255$
45 - 50	47.5	5	$47.5 \times 5 = 237.5$
50 - 55	52.5	3	$52.5 \times 3 = 157.5$
55 - 60	57.5	4	$57.5 \times 4 = 230$
		$\Sigma f = 70$	$\Sigma fx = 2580$

$\text{Mean} = \frac{\Sigma(f.x)}{N} = \frac{2580}{70} = 36.86$

6.

Daily Expenditure	No. of employees (f_i)	Midpoint x_i	d_i	$f_i d_i$
100 – 120	8	110	–40	–320
120 – 140	3	130	–20	–60
140 – 160	8	$A = 150$	0	0
160 – 180	6	170	20	120
180 – 200	5	190	40	200

Let Assumed Mean A be 150

$$\text{Mean } (\overline{X}) = A + \frac{\Sigma f_i d_i}{\Sigma f_i}$$

$$= 150 + \frac{(-60)}{30} = 150 - 148$$

$\therefore$ Mean $(\overline{X}) = 148$

7.

$$\text{Median} = L + \left(\frac{\frac{N}{2} - CF}{f}\right).h$$

Class	Frequency
0 – 15	17
15 – 30	35
30 – 45	40
45 – 60	18
60 – 75	m
75 – 90	2

The total frequency N is:

$N = 17 + 35 + 40 + 18 + m + 2 = 112 + m$

Since the median is given as 33, it means that the median class is 30 – 45 because 33 lies within this range. Calculate the cumulative frequencies till the median class:

Class	Frequency	Cumulative Frequency
0 – 15	17	17
15 – 30	35	52
30 – 45	40	92
45 – 60	18	110
60 – 75	m	$110 + m$
75 – 90	2	$112 + m$

Here, Median = 33,

$c.f. = 52$, $N = 112 + m$, $l = 30$, $h = 15$ and $f = 40$

$$\text{Median} = 30 + \left(\frac{\frac{112+m}{2} - 52}{40}\right) \times 15$$

$$33 = 30 + \frac{120 + 15m}{80}$$

$$33 = 30 + \frac{15(8+m)}{80}$$

$$33 = 30 + \frac{3(8+m)}{16}$$

$$33 = 30 + \frac{24 + 3m}{16}$$

$$3 \times 16 = 24 + 3m$$

$$48 = 24 + 3m$$

$$24 = 3m$$

$$m = 8$$

8. Mean $(\overline{X}) = A + \frac{\Sigma f.d}{\Sigma f}$

Assumed Mean A: Let's A = 75 (the midpoint of the class 70 – 80)

Class Interval	Midpoint (x)	Frequency (f)	$d = x - A$	$f.d$
50 – 60	55	7	–20	$7 + (-20) = -140$
60 – 70	65	12	–10	$12 \times (-10) = -120$
70 – 80	75	11	0	$11 \times 0 = 0$
80 – 90	85	8	10	$8 \times 10 = 80$
90 – 100	95	2	20	$2 \times 20 = 40$

$\Sigma f = 40$

$\Sigma(f.d) = -140$

$$\text{Mean} = A + \frac{\Sigma(f.d)}{\Sigma f}$$

$$= 75 + \frac{-140}{40}$$

$$= 75 - 3.5$$

$$= 71.5$$

9. Mean of 25 observations is 48 , so the total sum of these 25 observations is:

$25 \times 48 = 1200$

Mean of the first 13 observations is 42 , so the total sum of the first 13 observations is:

$13 \times 42 = 546$

Mean of the last 13 observations is 53 , so the total sum of the last 13 observations is:

$13 \times 53 = 689$

Since the 13th observation is included in both the first 13 observations and the last 13 observations, it is counted twice in the total of 1200 . We can use this fact to find its value.

Let the 13th observation be x. Then:

$546 + 689 - x = 1200$

$x = 1235 - 1200 = 35$

The 13th observation is 35.

LONG ANSWER TYPE QUESTIONS (5 Marks)

1.

Number of cars	Frequency	*c.f.*
0 - 10	7	7
10 – 20	14	21
20 – 30	13	34
30 – 40	12	46
40 – 50	20	66
50 – 60	11	77
60 – 70	15	92
70 – 80	8	100

$$N = 100 \Rightarrow \frac{N}{2} = 50$$

$\therefore$ Median class = 40 – 50

Here, $l = 40, f = 20$, *c.f.* $= 46, h = 10$

$$\text{Median} = l + \left(\frac{\frac{N}{2} - c.f.}{f}\right) \times h$$

$$= 40 + \left(\frac{50 - 46}{20}\right) \times 10$$

$$= 40 + \frac{4}{20} \times 10$$

$$= 40 + 2 = 42$$

Modal class = 40 – 50

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

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

$$= 40 + \frac{20 - 12}{2 \times 20 - 12 - 11} \times 10$$

$$= 40 + \frac{8}{17} \times 10$$

$$= 40 + 4.7 = 44.7$$

Mode = 3 Median – 2 Mean

$44.7 = 3 \times (42) - 2$ Mean

2 Mean $= 126 - 44.7$

$$\text{Mean} = \frac{81.3}{2} = 40.6$$

Hence, Mean = 40.6, Mode = 44.7, Median = 42

2. Let the assumed mean A be 145.

Class interval $h = 10$

Class	Frequency (f_i)	Mid values (x_i)	$u_i = (x_i - A/h)$	$f_i u_i$	*c.f.*
120 – 130	2	125	–2	–4	2
130 – 140	8	135	–1	–8	10
140 – 150	12	145 = A	0	0	22
150 – 160	20	155	1	20	42
160 – 170	8	165	2	16	50
	N = 50			$\Sigma(f_i u_i) = 24$	

(i) Mean $(\bar{X}) = A + \left(\frac{\Sigma f_i d_i}{N}\right) \times h$

$$= 145 + \left(\frac{24}{50}\right) \times 10$$

$= 145 + 4.8 = 149.8$

(ii) N = 50, N/2 = 25

Cumulative frequency just after 25 is 42

Median class is 150-160

$l = 150, h = 10$, N = 50, $cf = 22, f = 20$

Therefore,

$$\text{Median} = l + \left(\frac{\frac{N}{2} - cf.}{f}\right) h$$

$$= 150 + \frac{25 - 22}{20} \times 10$$

$$= 150 + \frac{3}{20} \times 10 = 150 + 1.5$$

$= 151.5$

(iii) Mode = 3 median – 2 mean

$= 3 \times 151.5 - 2 \times 149.8$

$= 454.5 - 299.6 = 154.9$

3. Given, Total number of families = 200

$\Rightarrow$ $x = 200 - 172 = 28$

Monthly expenditure (in ₹) (C.I)	Number of families (f_i)	Mid value (x_i)	$x_i f_i$	*c.f.*
1000 - 1500	24	1250	30,000	24
1500 – 2000	40	1750	70,000	64
2000 – 2500	33	2250	74,250	97
2500 – 3000	28	2750	77,000	125
3000 – 3500	30	3250	97,500	155
3500 – 4000	22	3750	82500	177
4000 – 4500	16	4250	68,000	193
4500 – 5000	7	4750	33,250	200
	$N = \Sigma f_i = 200$		$\Sigma x_i f_i =$ 5,32,500	

$$\text{Mean} = \frac{\Sigma x_i f_i}{\Sigma f_i}$$

$$= \frac{5,32,500}{200}$$

$= ₹\ 2662.5$

Now, $\frac{N}{2} = \frac{200}{2} = 100$

100^{th} observation lies in class 2500 – 3000, which is known as median class

l = lower limit of median class = 2500

N = number of families = 200

f = frequency of median class = 28

c.f. = cumulative frequency of the class preceding the median class = 97

h = class size = 500

$$\text{Median} = l + \frac{\left(\frac{N}{2} - c.f.\right)}{f} \times h$$

$$\text{Median} = 2500 + \frac{\left(\frac{200}{2} - 97\right)}{28} \times 500$$

$$= 2500 + \frac{100 - 97}{28} \times 500$$

$$= 2500 + \frac{3}{7} \times 125$$

$$= 2500 + 53.571$$

$$= ₹\ 2553.57$$

4. Calculate the Midpoint (x) for each class interval: The midpoint for each class can be calculated as:

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

Class Interval	Midpoint (x)	Frequency (f)	fx
11 - 13	12	7	84
13 - 15	14	6	84
15 - 17	16	9	144
17 - 19	18	13	234
19 - 21	20	20	400
21 - 23	22	5	110
22 - 25	24	4	96
		$\Sigma f = 64$	$\Sigma fx = 1152$

$$\text{Mean} = \frac{\Sigma fx}{N} = \frac{1152}{64} = 18$$

Calculate the Cumulative Frequency (*c.f.*):

Class Interval	Frequency (f)	Cumulative Frequency (*c.f.*)
11 - 13	7	7
13 - 15	6	13
15 - 17	9	22
17 - 19	13	35
19 - 21	20	55
21 - 23	5	60
22 - 25	4	64

$$\text{Median Position} = \frac{64}{2} = 32$$

The cumulative frequency just greater than 32 is 35, which corresponds to the clas interval 17 - 19.

Using the formula for the median:

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

$$\text{Median} = 17 + \left(\frac{32 - 22}{13}\right) \times 2$$

$$= 17 + \left(\frac{10}{13}\right) \times 2$$

$$= 17 + \frac{20}{13} \approx 17 + 1.54 \approx 18.54$$

5.

Marks	Number of students (Cumulative frequency)	Freq-uency	Cumulative frequency (less than type)
0 -10	80	3	3
10 - 20	77	5	8
20 - 30	72	7	15
30 - 40	65	10	25
40 - 50	55	12	37
50 - 60	43	15	52
60 - 70	28	12	64
70 - 80	16	6	70
80 - 90	10	2	72
90 - 100	8	8	80

$$N = 80 \Rightarrow \frac{N}{2} = 40$$

$\therefore$ 50 – 60 is the median class

$$\text{Median} = 50 + \frac{40 - 37}{15} \times 10 = 52$$

Here, 50 – 60 is the modal class

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

Here, $l = 50$

$f_1 = 15$ (modal class frequency)

$f_0 = 12$ (preceding class: 40 – 50)

$f_2 = 12$ (succeeding class: 60 – 70)

$h = 10$

$$\text{Mode} = 50 + \frac{15 - 12}{2 \times 15 - 12 - 12} \times 10 = 55$$

6.

Class	x_i	f_i	$f_i x_i$
0 - 30	15	12	180
30 - 60	45	21	945
60 - 90	75	x	$75x$
90 - 120	105	52	5460

120 - 150	135	y	$135y$
150 - 180	165	11	1815
	Total	$\Sigma f_i = x + y + 96 = 150$	$\Sigma f_i x_i = 8400 + 75x + 135y$

Now, $96 + x + y = 150$

Therefore, $x + y = 54$ ...(i)

$$x = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

$$\Rightarrow \quad 91 = \frac{8400 + 75x + 135y}{150}$$

$$\Rightarrow \quad 13650 = 8400 + 75x + 135y$$

$$\Rightarrow \quad 75x + 135y = 5250$$

$$\Rightarrow \quad 5x + 9y = 350 \quad ...(ii)$$

Solving (i) and (ii), we get

$x = 34$ and $y = 20$

7.

Height interval (cm)	Number of Student (f)	Cumulative Frequency
145 - 150	5	5
150 - 155	15	20
155 - 160	25	45
160 - 165	30	75
165 - 170	15	90
170 - 175	10	100

(i) Median position:

$$N = 100 \Rightarrow \frac{N}{2} = 50$$

The cumulative frequency just greater than 50 is 75, which corresponds to the height interval 160 - 165 cm. Therefore, the median class is 160 - 165 cm.

$$\text{Median} = 160 + \left(\frac{50 - 45}{30}\right) \times 5$$

$$= 160 + \left(\frac{5}{30}\right) \times 5$$

$$= 160 + \left(\frac{1}{6}\right) \times 5$$

$$= 160 + \frac{5}{6} \approx 160 + 0.83$$

$$= 160.83 \text{ cm}$$

(ii) Modal Class

The modal class is the class with the highest frequency.

From the frequency table, the highest frequency is 30, which corresponds to the height interval 160-165 cm.

8. (a) As, the maximum frequency is 23

So the most highly affected age group is 35-44.

(b) Converting the series into exclusive form, we get:

Class	Frequency (f_i)	Mid values (x_i)	$u_i = \frac{x_i - A}{h}$	$(f_i u_i)$
4.5 - 14.5	6	9.5	–2	–12
14.5 - 24.5	11	19.5	–1	–11
24.5-34.5	21	$29.5 = A$	0	0
34.5-44.5	23	39.5	1	23
44.5-54.5	14	49.5	2	28
54.5-64.5	5	59.5	3	15
Total	$\Sigma(f_i) = 80$			$\Sigma(f_i u_i) = 43$

Now,

$A = 29.5$, $h = 10$, $\Sigma(f_i) = 80$ $\Sigma(f_i u_i) = 43$

Therefore,

$$\text{Mean} = A + \left(\frac{\Sigma f_i u_i}{\Sigma f_i}\right) h$$

$$= 29.5 + \frac{43}{80} \times 10$$

$$= 29.5 + 5.375$$

$$= 34.875$$

Therefore, $x = 34.875$

Therefore, the average age of the patients is 34.87 year.

Level - 2 ADVANCED COMPETENCY FOCUSED QUESTIONS

MULTIPLE CHOICE QUESTIONS (MCQs) (1 Mark)

1. Option (D) is correct

Explanation: Let's denote the unknown frequency in the class 140 – 150 mm as n.

We'll apply the assumed mean method formula:

$$\bar{x} = a + \frac{\sum f_i u_i}{\sum f_i} \times h$$

Class (mm)	f_i	x_i	$u_i = \frac{x_i - 145}{10}$	$f_i u_i$
110–120	10	115	–3	–30
120–130	18	125	–2	–36
130–140	12	135	–1	–12
140–150	n	145	0	0
150–160	26	155	1	26
160–170	11	165	2	22
170–180	19	175	3	57

$$\Sigma f_i u_i = -30 - 36 - 12 + 0 + 26 + 22 + 57$$

$$= 27$$

$$\Sigma f_i = 10 + 18 + 12 + n + 26 + 11 + 19$$

$$= 96 + n$$

Using the mean formula:

$$\text{Mean} = A + \left(\frac{\Sigma f_i u_i}{\Sigma f_i}\right)h$$

$$\bar{x} = 145 + \frac{27}{96+n} \times 10 = 147.25$$

$$\Rightarrow 145 + \frac{270}{96+n} = 147.25$$

$$\Rightarrow \frac{270}{96+n} = 2.25$$

$$\Rightarrow 270 = 2.25(96 + n)$$

$$\Rightarrow 270 = 216 + 2.25n$$

$$\Rightarrow 54 = 2.25n$$

$$\Rightarrow n = \frac{54}{2.25} = 24$$

So, $n = 24$

Hence, there are a greater number of cucumbers of length (140 – 150) mm, i.e. 24, than of length (130 – 140) mm, which are 12.

2. Option (B) is correct

Explanation: Total number of students $= 40$

So, $1 + 2 + 4 + k + 10 + 8 + 3 = 40$

$\Rightarrow 28 + k = 40$

$\Rightarrow k = 12$

Class (min)	f_i	x_i	$u_i = \frac{x_i - 34}{4}$	$f_i u_i$
20–24	1	22	–3	–3
24–28	2	26	–2	–4
28–32	4	30	–1	–4
32–36	12	34	0	0
36–40	10	38	1	10
40–44	8	42	2	16
44–48	3	46	3	9
Total	40	—	—	**24**

$$\bar{x} = 4 + \left(\frac{\Sigma f_i u_i}{\Sigma f_i}\right) \times h$$

$$\bar{x} = 34 + \left(\frac{24}{40}\right) \times 4 = 34 + 2.4 = 36.4 \text{ minutes}$$

3. Option (B) is correct

Explanation: $x + 24 + 32 + 21 + y + 5 = 100$

$x + y + 82 = 100$

$x + y = 18$ ...(i)

The median class will be where cumulative frequency reaches or exceeds $\frac{N}{2} = \frac{100}{2} = 50$

Class	Frequency (f)	Cumulative Frequency ($c.f.$)
0 – 10	x	x
10 – 20	24	$x + 24$
20 – 30	32	$x + 56$
30 – 40	21	$x + 77$
40 – 50	y	$x + y + 77$
50 – 60	5	$x + y + 82$

Since $\frac{N}{2} = 50$, and $x + 24 < 50$,

but $x + 56 \geq 50$, the median class is 20 – 30.

$$\text{Median} = l + \left(\frac{\frac{N}{2} - CF}{f}\right) \times h$$

$$26.25 = 20 + \left(\frac{50 - (x+24)}{32}\right) \times 10$$

$$26.25 - 20 = \left(\frac{50 - x - 24}{32}\right) \times 10$$

$$6.25 = \left(\frac{26 - x}{32}\right) \times 10$$

$$\frac{26 - x}{32} = \frac{6.25}{10}$$

$$\frac{26 - x}{32} = 0.625$$

$$26 - x = 0.625 \times 32$$

$$26 - x = 20$$

$$x = 6$$

Now from equation (i):

$x + y = 18$

$\Rightarrow 6 + y = 18$

$\Rightarrow y = 12$

Now we have: $x = 6$

(students exercising 0 – 10 minutes)

$y = 12$

(students exercising 40 – 50 minutes)

$y = 2x$

So, there are twice as many students who exercise 40 – 50 minutes as compared to 0 – 10 minutes.

4. Option (D) is correct

Explanation:

Class Interval (Time in sec)	Frequency (f)	Mid Mark (x)	fx
18 – 20	3	$\frac{(18+20)}{2} = 19$	$3 \times 19 = 57$
20 – 22	18	$\frac{(20+22)}{2} = 21$	$18 \times 21 = 378$
22 – 24	26	$\frac{(22+24)}{2} = 23$	$26 \times 23 = 598$
24 – 26	19	$\frac{(24+26)}{2} = 25$	$19 \times 25 = 475$
26 – 28	9	$\frac{(26+28)}{2} = 27$	$9 \times 27 = 243$
28 – 30	5	$\frac{(28+30)}{2} = 29$	$5 \times 29 = 145$

$\Sigma f = 3 + 18 + 26 + 19 + 9 + 5 = 80$

$\Sigma fx = 57 + 378 + 598 + 475 + 243 + 145 = 1896$

$$\text{Mean} = \frac{1896}{80} = 23.7$$

ASSERTION-REASON QUESTIONS (1 Mark)

1. Option (A) is correct

   Explanation: Assertion is true because when there are extreme values (outliers), the mean gets pulled toward those extremes, while the median stays stable and reflects the central tendency more accurately.

   Reason is also true because median is not affected by extreme values, while mean is influenced by extreme observations.

   Both assertion and reason are true and reason correctly explains the assertion.

2. Option (A) is correct

   Explanation: Assertion is true because mode is the value that occurs most frequently. So, if the company wants to know the most common (frequent) travel time, mode is the correct measure.

   Reason is also true because this is the correct definition of mode.

   Both assertion and reason are true and reason correctly explains the assertion.

3. Option (A) is correct

   Explanation: Assertion is true because for grouped data, especially when class intervals and frequencies are given, the assumed mean method is often used to simplify calculations and avoid handling large numbers.

   Reason is also true because the purpose of assuming a mean near the middle is to reduce deviations and make calculations easier.

   Both Assertion and Reason are true, and reason is the correct explanation of assertion.

4. Option (A) is correct

   Explanation: Assertion is true because the mean takes into account all data points equally; each value contributes to the total sum, so every premium amount affects the mean calculation.

   Reason is also true because Mean is affected by extreme values (outliers), which can pull the mean higher or lower if there are very high or very low premiums.

   Both Assertion and Reason are true, and reason is the correct explanation of assertion.

VERY SHORT ANSWER TYPE QUESTIONS (2 Marks)

1.

Class Interval	f_i	x_i
10 – 20	5	15
20 – 30	8	25
30 – 40	10	35
40 – 50	4	45
50 – 60	3	55

Let assumed mean A be 35.

x_i	f_i	$d_i = \frac{(x_i - 35)}{10}$	$f_i d_i$
15	5	−2	−10
25	8	−1	−8
35	10	0	0
45	4	1	4
55	3	2	6

$$\bar{X} = A + \left(\frac{\sum f_i d_i}{\sum f_i}\right) \times h$$

$$\sum f_i = 5 + 8 + 10 + 4 + 3 = 30$$

$$\sum f_i d_i = -10 - 8 + 0 + 4 + 6 = -8$$

$$\bar{X} = 35 + \left(\frac{-8}{30}\right) \times 10$$

$$\bar{X} = 35 - \frac{80}{30}$$

$$\bar{X} = 35 - 2.67$$

$$\bar{X} \approx 32.33 \text{ litres}$$

The mean is approximately 32.33 litres.

The farmer's claim that the average production is about 32 litres is correct.

2.

Class Interval	f_i	c.f.
0 – 100	8	8
100 – 200	12	20
200 – 300	18	38
300 – 400	7	45
400 – 500	5	50

$$\frac{N}{2} = \frac{50}{2} = 25$$

The cumulative frequency just greater than 25 is 38, so the median class is:

200 – 300.

$$\text{Median} = L + \left(\frac{\frac{N}{2} - CF}{f}\right) \times h$$

$$\text{Median} = 200 + \left(\frac{25 - 20}{18}\right) \times 100$$

$$= 200 + \left(\frac{5}{18}\right) \times 100$$

$$= 200 + \frac{500}{18}$$

$$= 200 + 27.78$$

$$\text{Median} \approx 227.78 \text{ units}$$

3. The class with the highest frequency is: 40 – 60 (frequency 24) So, the modal class is 40 – 60.

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

$$\text{Mode} = 40 + \left(\frac{24 - 14}{2 \times 24 - 14 - 10}\right) \times 20$$

$$= 40 + \left(\frac{10}{48 - 14 - 10}\right) \times 20$$

$$= 40 + \left(\frac{10}{24}\right) \times 20$$

$$= 40 + \left(\frac{10 \times 20}{24}\right)$$

$$= 40 + \frac{200}{24}$$

$$= 40 + 8.33$$

$$\approx 48.33 \text{ minutes}$$

4. The class with the highest frequency is: 30 – 40 (frequency 18). So, modal class = 30 – 40

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

$$\text{Mode} = 30 + \left(\frac{18 - 15}{2 \times 18 - 15 - 6}\right) \times 10$$

$$= 30 + \left(\frac{3}{36 - 15 - 6}\right) \times 10$$

$$= 30 + \left(\frac{3}{15}\right) \times 10$$

$$= 30 + (0.2 \times 10)$$

$$= 30 + 2$$

$$= 32 \text{ minutes}$$

5.

Class Interval	f_i	x_i	$f_i \times x_i$
50 – 55	5	52.5	262.5
55 – 60	10	57.5	575
60 – 65	12	62.5	750
65 – 70	8	67.5	540
70 – 75	5	72.5	362.5

$$\Sigma f_i = 5 + 10 + 12 + 8 + 5 = 40$$

$$\Sigma f_i x_i = 262.5 + 575 + 750 + 540 + 362.5$$

$$= 2490$$

$$\bar{X} = \frac{\Sigma(f_i \times x_i)}{\Sigma f_i}$$

$$\bar{X} = \frac{2490}{40} = 62.25 \text{ kg}$$

6.

Class Interval	f_i	Cumulative Frequency (*c.f.*)
5 – 15	8	8
15 – 25	14	22
25 – 35	18	40
35 – 45	12	52
45 – 55	8	60

Total number of observations (N) = 60

$$\frac{N}{2} = \frac{60}{2} = 30$$

The cumulative frequency just greater than 30 is 40, so the median class is 25 – 35.

$$\text{Median} = L + \left(\frac{\frac{N}{2} - CF}{f}\right)$$

$$\text{Median} = 25 + \left(\frac{30 - 22}{18}\right) \times 10$$

$$\text{Median} = 25 + \left(\frac{8}{18}\right) \times 10$$

$$\text{Median} = 25 + (0.4444) \times 10$$

$$\text{Median} = 25 + 4.444$$

$$\text{Median} = 29.44 \, kl$$

SHORT ANSWER TYPE QUESTIONS (3 Marks)

1. (i) Let the assumed mean, A be 35

Salary (₹ 000)	x_i	f_i	d_i	u_i	$f_i \times u_i$
10 – 20	15	8	–20	–2	–16
20 – 30	25	14	–10	–1	–14
30 – 40	35	18	0	0	0
40 – 50	45	12	10	1	12
50 – 60	55	8	20	2	16

$$\bar{X} = A + \left(\frac{\Sigma(f_i \times u_i)}{\Sigma f_i}\right) \times h$$

$$\Sigma(f_i \times u_i) = -16 - 14 + 0 + 12 + 16 = -2$$

$$\Sigma f_i = 60$$

$$\bar{X} = 35 + \left(\frac{-2}{60}\right) \times 10$$

$$\bar{X} = 35 + (-0.333)$$

$$\bar{X} = 34.67$$

The mean salary is ₹ 34,670.

(ii) The average salary of ₹ 34,670 shows that the majority of employees earn in the mid-salary range. HR can use this data to assess the balance between junior and senior employees, to plan increments for lower-paid employees to bring them closer to the average, and for budget planning for future salary hikes.

2. (i)

Class Interval	f_i	Cumulative Frequency (*cf*)
0 – 20	5	5
20 – 40	10	15
40 – 60	15	30
60 – 80	12	42
80 – 100	8	50

$$N = 50 \Rightarrow \frac{N}{2} = 25$$

Here, *c.f.* for class 40 – 60 is 30

$\Rightarrow$ Median class = 40 – 60

$$\text{Median} = L + \left(\frac{\frac{N}{2} - CF}{f}\right) \times h$$

$$\text{Median} = 40 + \left(\frac{25 - 15}{15}\right) \times 20$$

$$\text{Median} = 40 + \left(\frac{10}{15}\right) \times 20$$

$$\text{Median} = 40 + \left(\frac{200}{15}\right)$$

Median = 40 + 13.33

Median = 53.33 minutes

(ii) The median exercise time is approximately 53.33 minutes, which is less than 1 hour (60 minutes). Therefore, most members exercise for less than an hour.

3. Modal class is the class with the highest frequency. Here, the highest frequency is 15 for the class 35 – 45. Thus, modal class = 35 – 45.

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

$$\text{Mode} = 35 + \left(\frac{15 - 10}{2 \times 15 - 10 - 8}\right) \times 10$$

$$\text{Mode} = 35 + \left(\frac{5}{30 - 18}\right) \times 10$$

$$\text{Mode} = 35 + \left(\frac{5}{12}\right) \times 10$$

$$\text{Mode} = 35 + \left(\frac{50}{12}\right)$$

Mode = 35 + 4.17

Mode = 39.17 minutes

(ii) The mode of 39.17 minutes suggests that most deliveries are completed in approximately 39 minutes. This indicates that the company's typical delivery time is slightly under 40 minutes. It reflects good delivery efficiency, assuming that their target delivery time is around 40 minutes or less.

4. (i)

Marks	f_i	*c.f.*
40 – 50	5	5
50 – 60	7	12
60 – 70	15	27
70 – 80	10	37
80 – 90	8	45
90 – 100	5	50

$N = 50 = \frac{N}{2} = 25$. Cumulative frequency just greater than 25 is 27, so the median class is 60 – 70.

$$\text{Median} = L + \left(\frac{\frac{N}{2} - CF}{f}\right) \times h$$

$$\text{Median} = 60 + \left(\frac{25 - 12}{15}\right) \times 10$$

$$\text{Median} = 60 + \left(\frac{13}{15}\right) \times 10$$

$$\text{Median} = 60 + \left(\frac{130}{15}\right)$$

Median = 60 + 8.67

Median = 68.67

(ii) The median mark is about 68.67, which means that 50% of students scored below 68.67 and 50% scored above it. This suggests that overall student performance is reasonably good, with most students scoring around 68–70 marks. The teacher can conclude that the class is performing around an average-to-good level, but there may still be scope for improvement to push more students into higher score ranges.

5. (i)

Class Interval	f_i	x_i	$f_i \times x_i$
100 – 200	12	150	1800
200 – 300	20	250	5000
300 – 400	25	350	8750
400 – 500	15	450	6750
500 – 600	8	550	4400

$$\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i}$$

First, calculate total:

$\Sigma f_i x_i$ = 1800 + 5000 + 8750 + 6750 + 4400

= 26,700

Σf_i = 12 + 20 + 25 + 15 + 8 = 80

$$\text{Mean} = \frac{26{,}700}{80} = 333.75$$

Mean electricity consumption is 333.75 units.

(ii) On average, each household is consuming about 334 units of electricity per month.

The management can use this information to plan total electricity requirements, forecast future demand, promote energy-saving measures if the consumption seems high compared to benchmarks.

6. (i) The class with the highest frequency is Modal class = 200 – 250 (since maximum frequency $f_1 = 16$)

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

$$\text{Mode} = 200 + \left(\frac{16 - 10}{2 \times 16 - 10 - 12}\right) \times 50$$

$$\text{Mode} = 200 + \left(\frac{6}{10}\right) \times 50$$

Mode = 200 + 30 = 230

(ii) Mode indicates the most common pocket money amount received by the majority of students. Since the modal pocket money is ₹ 230, it reflects the financial situation of most families.

The school can use this information to identify students who may need financial support if their pocket money is much lower than ₹ 230, set reasonable budgets for events, excursions, or programs based on students' typical affordability, and design scholarship schemes or fee concessions keeping in mind the common financial capacity.

CASE BASED QUESTIONS (4 Marks)

1. (i) Since the modal class is the class with the highest frequency.

Rainfall (mm)	Number of sub-divisions
200 - 400	2
400 - 600	4
600 - 800	7
800 - 1000	4
1000 - 1200	2
1200 - 1400	3
1400 - 1600	1
1600 1800	1

In the given question, class "600 - 800" has the highest frequency. As, 7 sub divisions are experiencing this rainfall.

Hence, class "600 - 800" is the modal class.

(ii) (a) Median Rainfall:

Rainfall (mm)	Number of sub-divisions	Cum. Numbers
200 - 400	2	2
400 - 600	4	6
600 - 800	7	13
800 - 1000	4	17
1000 - 1200	2	19
1200 - 1400	3	22
1400 - 1600	1	23
1600 - 1800	1	24
Total	24	

As, total frequency = 24 $\Rightarrow \frac{N}{2} = \frac{24}{2} = 12$

Now, cumulative frequency greater than or equal to 12 lies in class internal 600 – 800.

So median class = 600 – 800.

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

Here:

L = Lower boundary of the median class = 600

n = Total number of sub-divisions = 24

c.f. = Cumulative frequency of the class before the median class = 6

f = Frequency of the median class = 7

h = Class width = 800-600 = 200

$$\text{hence, Median} = 600 + \left[\frac{\frac{24}{2} - 6}{7}\right] \times 200$$

$$= 600 + [(12 - 6)] \times \frac{200}{7}$$

$$= 600 + \frac{1200}{7}$$

$\Rightarrow$ 600 + 171.428

$\Rightarrow$ 771.43 mm

Therefore, Median = 771.43 mm

OR

(b) Mean Rainfall :

Rainfall (mm)	Midpoint (x)	Number of Sub division (f)	fx
200 - 400	300	2	600
400 - 600	500	4	2000
600 - 800	700	7	4900
800 - 1000	900	4	3600
1000 - 1200	1100	2	2200
1200 - 1400	1300	3	3900
1400 - 1600	1500	1	1500
1600 - 1800	1700	1	1700
Total		$\Sigma f = 24$	Σfx = 20,400

Mean of grouped data $= \left(\frac{\Sigma fx}{\Sigma f}\right)$

Therefore, Mean $= \frac{20400}{24} = 850$

Hence, the mean rainfall in the season is 850 mm

(iii) Sub-divisions with Good Rainfall:

Given that sub-divisions with at least 1000 mm rainfall are considered to have good rainfall. Thus, the frequencies of the classes from 1000 - 1200 mm to 1600 - 1800 mm. are added up.

$\Rightarrow$ Good rainfall sub - divisions = 2 + 3 + 1 + 1 = 7

Therefore, 7 sub-division had good rainfall during the monsoon season.

2. (i)

Age Group	No. of People (f)	$c.f.$
15 - 25	8	8
25 - 35	10	18
35 - 45	15	33
45 - 55	25	58
55 - 65	40	98
65 - 75	24	122
75 - 85	18	140
	$\Sigma f = 140$	

Here N = $\Sigma f = 140$

So, $\frac{N}{2} = 70$

Therefore, median class = 55 – 65

Lower limit of median class, L = 55

Class size, $h = 10$

Cumulative frequency of preceding class, $c.f.$ = 58

Frequency of median class, $f = 40$

$\therefore$ Median $= L + \left(\frac{\frac{N}{2} - c.f}{40}\right) \times h$

$= 55 + \left(\frac{70 - 58}{40}\right) \times 10$

$= 55 + \frac{12}{4}$

$= 55 + 3$

$= 58$

Thus the median age of people enrolled for the camp is 58.

(ii)

Age group	Midpoint (x)	Frequency	$f_i x_i$
15 - 25	20	8	160
25 - 35	30	10	300
35 - 45	40	15	600
45 - 55	50	25	1250
55 - 65	60	40	2400
65 - 75	70	24 + x	1680 + 70x
75 - 85	80	18	1440
		$\Sigma f_i = 140 + x$	$\Sigma f_i x_i = 7830 + 70x$

Mean $= \frac{\Sigma f_i x_i}{\Sigma f_i}$

$\Rightarrow 58 = \frac{7830 + 70x}{140 + x}$

$\Rightarrow 58(140 + x) = 7830 + 70x$

$\Rightarrow 8120 + 58x = 7830 + 70x$

$\Rightarrow 12x = 290$

$\Rightarrow x = 24.16 \sim 24$ ...(Approx)

3. (i) The modal class is the class interval with the highest frequency.

Here, maximum frequency is 30, corresponding to class 200 – 250 litres.

Modal class = 200 – 250 litres.

(ii) Cumulative frequency up to and including the class 250 – 300 litres:

100 – 150 $\rightarrow$ 8

150 – 200 $\rightarrow$ 8 + 15 = 23

200 – 250 $\rightarrow$ 23 + 30 = 53

250 – 300 $\rightarrow$ 53 + 25 = 78

Cumulative frequency = 78

(iii) (a)

Class Interval	f_i	Midpoint (x_i)	$d_i = \frac{(x_i - A)}{h}$	$f_i d_i$
100 – 150	8	125	–3	–24
150 – 200	15	175	–2	–30
200 – 250	30	225	–1	–30
250 – 300	25	275 = A	0	0
300 – 350	12	325	1	12
350 – 400	10	375	2	20

$\Sigma f_i = 100, \Sigma f_i d_i = -52$

Mean, $\bar{X} = A + \left(\frac{\Sigma f_i d_i}{\Sigma f_i}\right) \times h$

$\bar{X} = 275 + \left(\frac{-52}{100}\right) \times 50$

$\bar{X} = 275 - 26 = 249$

Mean daily water consumption is 249 litres.

OR

(b) The mean consumption is 249 litres, which is just below 250 litres. This suggests that most houses are consuming slightly below 250 litres per day. The organisation may suggest guidelines close to

250 litres as an optimal target for conservation.

4. (i) The class interval 40 – 60 minutes contains the maximum number of members.

(ii) Cumulative frequency up to and including the class 40 – 60:

0 – 20 → 8

20 – 40 → 8 + 15 = 23

40 – 60 → 23 + 20 = 43

The cumulative frequency for the class 40 – 60 is 43.

(iii) (a)

Class Interval	f_i	Midpoint (x_i)	$d_i = \frac{(x_i - A)}{h}$	$f_i d_i$
0 – 20	8	10	–3	–24
20 – 40	15	30	–2	–30
40 – 60	20	50	–1	–20
60 – 80	10	70 = A	0	0
80 – 100	5	90	1	5
100 – 120	2	110	2	4

$\Sigma f_i = 60, \Sigma f_i d_i = -65$

$$\bar{X} = A + \left(\frac{\Sigma f_i d_i}{\Sigma f_i}\right) \times h$$

$$\bar{X} = 70 + \left(\frac{-65}{60}\right) \times 20$$

$$\bar{X} = 70 - \left(\frac{1300}{60}\right)$$

$\bar{X} = 70 - 21.67 \approx 48.33$

The mean daily exercise time is approximately 48.33 minutes.

OR

(b) The mean exercise time is around 48 minutes, so most members typically exercise for 40 – 60 minutes. The fitness centre can design training programs lasting 45 to 60 minutes to match members' usual routine. Since very few members exercise for longer durations (above 80 minutes), the centre may introduce advanced sessions for those who want longer workouts. Short sessions (20 minutes) can also be offered for beginners to encourage regular participation.

LONG ANSWER TYPE QUESTIONS (5 Marks)

1. (i) Let the assumed mean, A be 55.

Class Interval	f_i	Midpoint (x_i)	$d_i = \frac{(x_i - A)}{h}$	$f_i d_i$
20 – 30	6	25	–3	–18
30 – 40	10	35	–2	–20
40 – 50	24	45	–1	–24
50 – 60	20	55	0	0
60 – 70	12	65	1	12
70 – 80	8	75	2	16

$\Sigma f_i = 80, \Sigma f_i d_i = (-18 - 20 - 24 + 0 + 12 + 16)$

$= -34$

$$\bar{X} = A + \left(\frac{\Sigma f_i d_i}{\Sigma f_i}\right) \times h$$

$$\bar{X} = 50 + \left(\frac{-34}{80}\right) \times 10$$

$$\bar{X} = 50 + \frac{340}{80}$$

$\bar{X} = 50 - 4.25$

$\bar{X} = 45.75$

The mean daily yield is 45.75 kg.

(ii) The class with the highest frequency is 40 – 50 (frequency 24). So, Modal class = 40 – 50.

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

$$\text{Mode} = 40 + \left(\frac{24 - 10}{2 \times 24 - 10 - 20}\right) \times 10$$

$$\text{Mode} = 40 + \left(\frac{14}{48 - 30}\right) \times 10$$

$$\text{Mode} = 40 + \left(\frac{14}{18}\right) \times 10$$

Mode = 40 + (0.7777) × 10

Mode = 40 + 7.78 = 47.78

(iii) Both mean and mode are very close. This suggests that the majority of fields have yields around 46–48 kg, indicating consistency in daily yield.

The company can standardise their yield expectations around 46 – 48 kg/ day. They can focus on improving low-yield fields (especially those in 20–40 kg range). They may introduce better fertilisers, irrigation or training to improve consistency further. Overall, the data shows stable production, so storage, transport and market planning can be done assuming average yield around 46–48 kg/day.

2. (i)

Class Interval	f_i	Cumulative Frequency (*c.f.*)
10 – 20	5	5
20 – 30	8	13
30 – 40	15	28
40 – 50	20	48
50 – 60	7	55
60 – 70	5	60

$$N = \frac{60}{2} = 30$$

The cumulative frequency just greater than 30 is 48 (in class 40 – 50), so: median class is 40 – 50.

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

$$\text{Median} = 40 + \left(\frac{30 - 28}{20}\right) \times 10$$

$$\text{Median} = 40 + \left(\frac{2}{20}\right) \times 10$$

$$\text{Median} = 40 + 1 = 41$$

(ii)

Class Interval	f_i	Midpoint (x_i)	$f_i x_i$
10 – 20	5	15	75
20 – 30	8	25	200
30 – 40	15	35	525
40 – 50	20	45	900
50 – 60	7	55	385
60 – 70	5	65	325

$$\Sigma f_i x_i = 75 + 200 + 525 + 900 + 385 + 325 = 2410$$

$$\Sigma f_i = 60$$

$$\bar{X} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{2410}{60} = 40.17$$

The mean hours spent is approximately 40.17 hours per month.

(iii) Mean ≈ 40.17 hours, Median = 41 hours.

Both measures are quite close, suggesting the data is fairly symmetrical and consistent. On average, members are spending about 40 – 41 hours per month, approximately 10 hours per week. This indicates a moderate level of gym activity.

The gym has reasonably active members but still has scope for improvement in engagement.

3. (i) Let assumed mean, A be 175.

Class Interval	f_i	Midpoint x_i	$d_i = \frac{(x_i - A)}{h}$	$f_i \times d_i$
50 – 100	15	75	$\frac{(75-175)}{50} = -2$	–30
100 – 150	25	125	$\frac{(125-175)}{50} = -1$	–25
150 – 200	35	175	$\frac{(175-175)}{50} = 0$	0
200 – 250	20	225	$\frac{(225-175)}{50} = 1$	20
250 – 300	15	275	$\frac{(275-175)}{50} = 2$	30
300 – 350	10	325	$\frac{(325-175)}{50} = 3$	30

$$\Sigma f_i d_i = -30 - 25 + 0 + 20 + 30 + 30 = 25$$

$$\bar{X} = A + \left(\frac{\Sigma f_i d_i}{N}\right) \times h$$

$$\bar{X} = 175 + \left(\frac{25}{120}\right) \times 50$$

$$\bar{X} = 175 + \left(\frac{1250}{120}\right)$$

$$\bar{X} = 175 + 10.42 = 185.42$$

The mean electricity consumption is approximately 185.42 kWh.

(ii) The highest frequency is 35, corresponding to class 150 – 200. So, modal class is 150 – 200.

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

$$\text{Mode} = 150 + \left(\frac{35 - 25}{2 \times 35 - 25 - 20}\right) \times 50$$

$$\text{Mode} = 150 + \left(\frac{10}{70 - 45}\right) \times 50$$

$$\text{Mode} = 150 + \left(\frac{10}{25}\right) \times 50$$

$$\text{Mode} = 150 + (0.4 \times 50)$$

$$\text{Mode} = 150 + 20 = 170$$

(iii) The mean consumption (185.42 kWh) and mode (170 kWh) show that most households consume between 150 – 200 kWh. Majority of consumption lies within moderate usage, but significant number of households are nearing higher consumption levels (200 – 350 kWh).

The agency can promote awareness about energy-saving appliances, encourage the use of LED lighting, energy-efficient air conditioners, refrigerators, and smart meters.