Solution

STATISTICS

Class 10 - Mathematics

Section A

1.

(b) 9, 15

Explanation:

Class Interval	**(x_i)**	**Frequency (f_i)**	**Cumulative frequency**
0-100	50	2	2
100-200	150	5	7
200-300	250	f_1	$7 + f_1$
300-400	350	12	$19 + f_1$
400-500	450	17	$36 + f_1$
500-600	550	20	$56 + f_1$
600-700	650	f_2	$56 + f_1 + f_2$
700-800	750	9	$65 + f_1 + f_2$
800-900	850	7	$76 + f_1 + f_2$
900-1000	950	4	$76 + f_1 + f_2$

We have given $n = 100 \Rightarrow 76 + f_1 + f_2 = 100$

$\Rightarrow f_1 + f_2 = 24$ ...(i)

Since median is 525, so median class is 500-600.

Median $= l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h \Rightarrow 525 = 500 + \frac{50-(36+f_1)}{20} \times 100$

$\Rightarrow 25 = (14 - f_1) \times 5 \Rightarrow 25 = 70 - 5f_1 \Rightarrow 5f_1 = 45 \Rightarrow f_1 = 9$

From (i), $9 + f_2 = 24 \Rightarrow f_2 = 24 - 9 = 15$

2.

(c) Mean

Explanation:

Mode is the value with the maximum frequency. Thus, it can be determined from the graph.

Median is the middle value of the data. Thus, it can be determined from the graph.

Mean is the ratio of sum of all data values and the total number of values. Thus, it cannot be determined by graphically.

3.

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

Explanation:

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

4.

(d) 18

Explanation:

18

5.

(d) 3

Explanation:

Marks Obtained	Number of students	f
0-10	(63-58)=5	5
10-20	(58-55)=3	3
20-30	(55-51)=4	4
30-40	(51-48)=3	3
40-50	(48-42)=6	6
50...	42=42	42

Hence, frequency in the class interval 30 - 40 is 3.

6.

(d) 4

Explanation:

Mean of x, x + 3, x + 6, x + 9, x + 12 = 10

$\Rightarrow \frac{x+x+3+x+6+x+9+x+12}{5} = 10$

$\Rightarrow \frac{5x+30}{5} = 10$

$\Rightarrow$ x + 6 = 10

$\Rightarrow$ x = 10 - 6 = 4

7. **(a)** 7.5

Explanation:

All factors of 24 are 1, 2, 3, 4, 6, 8, 12, 24

$\therefore$ Mean = $\frac{\text{Sum of all factors of 24}}{\text{Number of factors of 24}}$

$= \frac{1+2+3+4+6+8+12+24}{8}$

$= \frac{60}{8}$

= 7.5

8.

(d) 26

Explanation:

mode = 3 median - 2 mean

= 3(30) - 2(32)

= 90 - 64

= 26

9.

(c) $\frac{m}{x}$ + y

Explanation:

Let x_1, x_2, x_3, ..,x_n be 'n' observations.

$\Rightarrow$ m = $\frac{x_1+x_2+x_3+...+x_n}{n}$

Now , according to question, the observations become

$\frac{x_1}{x}$ + y, y + $\frac{x_2}{x}$ + y, ..., $\frac{x_n}{x}$ + y

Therefore, new mean is

$\Rightarrow m' = \frac{\frac{1}{x}(x_1+x_2+...+x_n)+ny}{n}$

$\Rightarrow m' = \frac{(x_1+x_2+...+x_n)}{nx} + \frac{ny}{n}$

$\Rightarrow m' = \frac{1}{x}\frac{(x_1+x_2+...+x_n)}{n}$ + y

$\Rightarrow m' = \frac{m}{x}$ + y

10.

(b) 33

Explanation:

The first 10 multiples of 6 are 6, 12, 18, 24, 30, 36, 42, 48, 54, 60

$\therefore$ Mean = $\frac{\text{Sum of first 10 multiples of 6}}{10}$

= $\frac{6+12+18+24+30+36+42+48+54+60}{10}$

= $\frac{330}{10}$

= 33

11.

(b) 24

Explanation:

Mean = 28

Mode = 16

Mode = 3 Median - 2 Mean

Hence, Median $= \frac{\text{Mode} + 2\text{Mean}}{3}$

$= \frac{16+2(28)}{3}$

$= \frac{16+56}{3}$

$= \frac{72}{3}$

= 24

12.

(d) 0

Explanation:

We know that

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

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

$n\bar{x} = \sum f_i x_i$ ...(1)

Now we have to find

$\sum_{i=1}^{n} f_i (x_i - \bar{x})$

put n = 1, 2, 3 ... n

$= f_i (x_1 - \bar{x}) + f_2 (x_2 - \bar{x}) + f_3 (x_3 - \bar{x}) \ldots + f_n (x_n - \bar{x})$

$= f_1 x_1 + f_2 x_2 + f_3 x_3 + \ldots + f_n x_n$

$- (f_1 \bar{x} + f_2 \bar{x} + f_3 \bar{x} \cdots f_n \bar{x})$

$= \sum f_i x_i - \bar{x} (f_1 + f_2 + \cdots f_n)$

$= \sum f_i x_i - \bar{x} n$ (from 1)

$= \sum f_i x_i - \sum f_i x_i$

= 0

13.

(d) 29

Explanation:

Mean of first n natural number = 15

$\frac{n(n+1)}{2n}$ = 15

$\frac{n+1}{2}$ = 15

$\Rightarrow$ n + 1 = 30

$\Rightarrow$n = 30 - 1 = 29

14. **(a)** 13

Explanation:

We know that

3 Median= Mode + 2 Mean

3×11 = Mode + 2×10

33 - 20 = Mode

Mode = 13

15.

(d) 15

Explanation:

x_i	f_i	f_ix_i
13	6	78
5	8	40
7	P	7P
19	11	209
11	8	88
13	4	52
	$\sum f_i = 37 + P$	$\sum f_ix_i = 467 + 7P$

Mean = $\frac{\Sigma f_i x_i}{\Sigma f_j} \Rightarrow 11 = \frac{467+7P}{37+P} \Rightarrow$ 407 + 11P = 467 + 7P

$\Rightarrow$ 4P = 60 $\Rightarrow$ P = 15

16.

(d) 62.4, 65

Explanation:

62.4, 65

17. **(a)** 15

Explanation:

Data is in ascending order:

4, 7, x - 1, x - 3, 16, 25

N = 6 (even)

$\therefore$ Median $= \frac{\left(\frac{6}{2}\right)^{\text{th}} \text{ value} + \left(\frac{6}{2}+1\right)^{\text{th}} \text{ value}}{2}$

$\therefore 13 = \frac{3^{rd} \text{ value} + 4^{th} \text{ value}}{2}$

$\therefore 13 = \frac{(x-1)+(x-3)}{2}$

$\therefore$ 26 = 2x - 4

$\therefore$ 2x = 30

$\therefore$ x = 15

18.

(d) 30 – 40

Explanation:

According to the question,

Class	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Freq	3	9	15	30	18	5

Here Maximum frequency is 30.
Therefore, the modal class is 30 – 40.

19.

(d) 6
Explanation:
Mean = 8.1
$\Sigma f_i x_i = 132 + 5k$
$\sum f_i = 20$
$\therefore$ Mean = $\frac{\Sigma f_i x_i}{\Sigma f_i} \Rightarrow 8.1 = \frac{132+5k}{20}$
$\Rightarrow 132 + 5k = 8.1 \times 20 = 162$
$\Rightarrow 5k = 162 - 132 = 30$
$\Rightarrow k = \frac{30}{5} = 6$

20.

(b) 12
Explanation:
Given,
mode - median = 24
median - mean = ?
we know that,
mode = 3 median - 2 mean
mode = median + 2 median - 2 mean
mode - median = 2 median - 2 mean
24 = 2 (median - mean)
median - mean = $\frac{24}{2}$ = 12

21.

(d) A is false but R is true.
Explanation:
A is false but R is true.

22.

(c) A is true but R is false.
Explanation:
Median = $\frac{1}{3}(mode + 2\text{mean})$
= $\frac{1}{3}(60 + 2 \times 66)$ = 64

23.

(d) A is false but R is true.
Explanation:
A is false but R is true.

24. **(a)** Both A and R are true and R is the correct explanation of A.
Explanation:
Both A and R are true and R is the correct explanation of A.

Section B

25. 52
Explanation:
Here, maximum frequency is 18 and the class corresponding to this frequency is 40 - 60. So, the modal class is 40 - 60.

Marks	0 - 20	20 - 40	40 - 60	60 - 80
Frequency	15	6	18	10

$\therefore$ l = 40 and f_1 = 18, f_0 = 6, f_2 = 10, h = 20

Now, Mode = $l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$

= $40 + \frac{18-6}{2(18)-6-10} \times 20$

= 52

26. 14.46

Explanation:

Here, the maximum frequency is 17 and the corresponding class is 12-16. So, 12-16 is the modal class such that l= 12, h = 4, f = 17, f_1 = 9 and f_2 = 12..

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

$\Rightarrow$ Mode $= 12 + \frac{17-9}{34-9-12} \times 4 = 12 + \frac{8}{13} \times 4 = 12 + \frac{32}{13}$ = 12 + 2.46 = 14.46.

27. 16

Explanation:

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

let unknown frequency is p,

given mean = 25

$\therefore$ mean = $\frac{\Sigma(f_i \times x_i)}{\Sigma f_i}$

$\Rightarrow \frac{(940+35p)}{(44+p)}$ = 25

$\Rightarrow$ (940 + 35p) = 25(44 + p)

$\Rightarrow$ (35p - 25p) = (1100 - 940)

$\Rightarrow$ 10p = 160

$\Rightarrow$ p = 16

28. 20

Explanation:

Here, mode = 48

Modal Class = 40 - 50

l = 40, f_0 = 12, f_1 = p, f_2 =18, h = 10

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

$\Rightarrow \quad 48 = 40 + \frac{p-12}{2p-12-18} \times 10$

$8 = \frac{10p-120}{2p-30}$

$\Rightarrow$ 16p - 240 = 10p - 120

$\Rightarrow$ 6p = 120

$\Rightarrow$ p = 20

29. 28

Explanation:

Marks	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
Number of students	20	24	40	36	20
		f_0	f_1	f_2	

Modal class = 20 - 30

l = 20, f_1 = 40, f_0 = 24, f_2 = 36, h = 10

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

$= 20 + \frac{(40-24)}{2(40)-24-36} \times 10$

$= 20 + \frac{(40-24)}{80-24-36} \times 10$

$= 20 + \frac{16 \times 10}{20}$

$= 20 + \frac{160}{20}$

= 20 + 8

= 28

30. 55

Explanation:

x_i	f_i	$f_i x_i$
10	7	70
30	8	240
50	10	500
70	15	1050
89	10	890
	$N = \Sigma f_i = 50$	$\Sigma f_i x_i = 2750$

$\therefore$ Mean $= \frac{\sum f_i x_i}{N} = \frac{2750}{50} = 55$

31. 9

Explanation:

X	f	fx
3	6	18
5	8	40
7	15	105
9	p	9p
11	8	88
13	4	52
	N = P + 41	**Sum= 9p + 303**

Given

Mean = 7.68

$\frac{9p+303}{p+41} = 7.68$

9p + 303 = p(7.68) + 314.88

9p – p(7.68) = 314.88 – 303

1.32p = 11.88

P = $\frac{(11.88)}{1.32}$

P = 9

32. 21.1

Explanation:

We know that Mean = Mode + $\frac{3}{2}$(Median - Mode)

= 21.4 + $\frac{3}{2}$ (21.2 - 21.4)

= 21.4 + $\frac{3}{2}$ (-2)

= 21.4 - 0.3

= 21.1

33. 25

Explanation:

X	f	fx
19	13	247
21	15	315
23	16	368
25	18	450
27	16	432
29	15	435
31	13	403
	N = 106	**Sum = 2650**

Sum of observation = 2650 and number of observation = 106

Therefore, Mean (x) = $\frac{2650}{106}$ = 25

34. 19.5

Explanation:

Classes	0 - 6	6 - 12	12 - 18	18 - 24	24 - 30
Frequency	7	5	10	12	6

Here, Modal class = 18 - 24

Now l = 18 ,f_1 = 12, f_0 = 10, f_2 = 6, h = 6

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

= 18 + $\frac{12-10}{24-10-6} \times 6$

= 18 + $\frac{2}{8} \times 6$

= 18 + $\frac{12}{8}$

= 18 + 1.5

Mode = 19.5

35.

C.I.	**Frequency**	**C.f.**
0 - 5	2	2
5 - 10	9	11
10 - 15	6	17
15 - 20	7	24
20 - 25	1	25

Here, $\frac{N}{2} = \frac{25}{2}$ = 12.5

17 is just greater than 12.5

∴ Median class is (10 - 15)

Upper limit of median class = 15

Now, modal class = class with maximum frequency

∴ Modal class is (5 - 10)

Lower limit of modal class = 5

∴ Sum of lower limit of modal class and upper limit of median class

= 5 + 15

= 20

36. According to the question,

Average age of parents 20 years ago = 23 years

Their total ages 20 years ago = 23 $\times$ 2 = 46 years

Let parents age = x years

Sum of present age of parents = 46 + 20 $\times$ 2 = 86 years

Average = $\frac{86+x}{3}$

$\Rightarrow \quad 34 = \frac{86+x}{3}$

$\Rightarrow 102 = 86 + x$

$\Rightarrow x = 16$

Therefore my present age is 16 years.

37. Table:

Marks	**Frequency**	**c.f.**
30	10	10
40	4	14
50	12	26
60	6	32
70	1	33
80	8	41
90	4	45

$N = 45$

Median = $\left(\frac{45+1}{2}\right)$th

i.e, 23rd Observation

Median = 50

38.

x	**f**	**fx**
15	3	45
16	8	128
17	10	170
18	10	180
19	5	95
20	4	80
	N = 40	**Sum = 698**

Mean age = $\frac{Sum}{N}$

$\frac{698}{40}$

= 17.45 years

39. Maximum frequency is 25 which belongs to (400 - 600)

$\therefore$ modal class = 400 - 600

l = 400

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

= 400 + $\left(\frac{25-21}{2\times25-21-19}\right)$

= 400 + $\frac{7}{10} \times 100$

= 470

hence, mode of distribution is 470

40.

C. I	0 - 10	10 - 20	**20 - 30**	30 - 40	40 - 50
Frequency	5	8	**13**	7	6

From the above table, it can be observed that the maximum class frequency is 13.

This belonging to class interval 20 - 30.

Hence modal class = 20 - 30

Lower limit (l) of modal class = 20

41.

Runs Scored	0-40	40-80	80-120	120-160	160-200	Total
Number of Batsmen (f_i)	12	20	35	30	23	120
x_i	20	60	100	140	180	
f_ix_i	240	1200	3500	4200	4140	13280

mean ($\bar{x}$) = $\frac{\sum f_i x_i}{\sum f_i} = \frac{13280}{120}$ = 110.67 runs

42.

Class	**Frequency (f_i)**	**Cumulative frequency (cf)**
0-20	11	11
20-40	22	33
40-60	19	52
60-80	13	65
80-100	7	72
	$\sum f_i$ = 72	

Here, highest frequency is 22

Hence, modal class is 20-40

Also, N = sum f_i = 72

Now, $\frac{N}{2} = \frac{72}{2}$ = 36

36 lies in cumulative frequency 52

So, median class is 40-60.

43. Since, class 40-50 have highest frequency.

So, modal class is 40 - 50

Lower limit (l) of modal class = 40

Class size (h) = 10

Frequency of modal class (f_1) = 45

Frequency of class proceeding to modal class (f_0) = 30

Frequency of class succeeding to modal class (f_2) = 42

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

$= 40 + \left(\frac{45-30}{90-30-42}\right) \times 10$

$= 40 + \frac{150}{18}$

$= \frac{720+150}{18}$

$= \frac{870}{18}$

= 48.33

44.

Class Interval	**Frequency**
0 - 10	9
10 - 20	11
20 - 30	10
30 - 40	8
40 - 50	8
50 - 60	3

Here, modal class = 10 - 20

Upper limit of modal class = 20

Section C

45. Since the maximum number of students (i.e., 7) have got marks in the interval 40 - 55, the modal class is 40 - 55

Therefore, the lower limit (l) of the modal class = 40

the class size (h) = 15

the frequency (f_1) of modal class = 7

the frequency (f_0) of the class preceding the modal class = 3

the frequency (f_2) of the class succeeding in the modal class = 6

Now, using the formula:

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

we get Mode = $40 + \left(\frac{7-3}{14-6-3}\right) \times 15 = 52$

So, the mode mark is 52

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

$\bar{x} = \frac{1860.0}{30} = 62$

So, the maximum number of students obtained 52 marks, while on average a student obtained 62 marks.

46.

variable	frequency	c.f
15-25	8	8
25-35	10	18
35-45	X	18+x
45-55	25	43+x
55-65	40	83+x
65-75	Y	83+x+y
75-85	15	98+x+y
85-95	7	105+x+y

median = 58

$\therefore$ median class = 55 - 65

$\therefore$ l = 55

$\sum f_i$ = 140

105 + x + y = 140

x + y = 35 ...(i)

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

58 = 55 + $\left(\frac{70-(43+x)}{40}\right)$ 10

58 = 55 + $\left(\frac{70-43-x}{40}\right) \times 10$

58 = 55 + $\left(\frac{27-x}{40}\right) \times 10$

58 = 55 + $\left(\frac{27-x}{4}\right)$

3 = $\frac{27-x}{4}$

12 = 27 - x

x = 27 - 12

x = 15

from (i)

x + y = 35

15 + y = 35

y = 35 - 15

y = 20

47.

Class	Frequency (f_i)	C.F.
0 - 10	3	3
10 - 20	5	8
20 - 30	11	19
30 - 40	10	29
40 - 50	x	x + 29
50 - 60	3	x + 32
60 - 70	2	x + 34

Median = $30 + \frac{\left(\frac{34+x}{2} - 19\right)}{10} \times 10$

$34.5 = 30 + \frac{34+x-38}{2}$

$\Rightarrow$ 34 + x - 38 = (34.5 - 30)2 = 9

$\Rightarrow$ x = 9 + 4 = 13

48.

C.I	frequency (f_i)	x_i	$d_i = X_i - A$	$u_i = \frac{d_i}{n}$	$f_i u_i$
135-140	4	137.5	-20	-4	-16
140-145	9	142.5	-15	-3	-27
145-150	18	147.5	-10	-2	-36
150-155	28	152.5	-5	-1	-28
155-160	24	**A** = 157.5	0	0	0
160-165	10	162.5	5	1	10
165-170	05	167.5	10	2	10
170-175	02	172.5	15	3	6

mean = A + h $\left(\frac{\sum f_i x_i}{\sum f_i}\right)$

= 157.5 + 5$(\frac{-81}{100})$

= 157.5 - $\frac{405}{100}$

= 157.5 - 4.05

= 153.45

49. Given:

Median value = 33

To find: M

Since the media is 33, it falls in the median class of 30-45

The formula for median= l + $(\frac{n}{2} - cf) \div$ f $\times$ h

here, l = lower limit

n = total frequency.

cf = cumulative frequency of media class

h = class width

we know from the data,l= 30,

h = 15,

f = 40,

cf = 52, and

$\frac{n}{2} = \frac{(112+m)}{2}$

Putting the values in the equation, we get:

30 + [(112 + $\frac{m}{2}$) - 52] $\div$ 40 $\times$ 15 = 33

(8 + m) = $\frac{(3\times80)}{15}$

8 + m= 16

m = 8

50. Calculation of mean by using direct method.

Class Interval	Frequency(f_i)	Class mark x_i	$(f_i \times x_i)$
0 - 100	6	50	300
100 - 200	9	150	1350
200 - 300	15	250	3750
300 - 400	12	350	4200
400 - 500	8	450	3600
	$\Sigma f_i = 50$		$\Sigma (f_i \times x_i) = 13200$

we know that, mean= $\frac{\Sigma(f_i \times x_i)}{\Sigma f_i} = \frac{13200}{40} = 264$

51. The given series is converted from inclusive to exclusive form and on preparing the frequency table, we get

Class	Frequency
0.5 - 5.5	3
5.5 - 10.5	8
10.5 - 15.5	13
15.5 - 20.5	18
20.5 - 25.5	28
25.5 - 30.5	20
30.5 - 35.5	13
35. 5- 40.5	8
40.5 - 45.5	6
45.5 - 50.5	4

Clearly, the modal class is 20.5 - 25.5, as it has the maximum frequency.

Now, x_k (lower limit of modal class) = 20.5, h (length of interval of modal class) = 5, f_k (frequency of modal class) = 28, f_{k-1} (frequency of the class just preceding the modal class) = 18, f_{k+1} (frequency of the class just exceeding the modal class) = 20

Mode (M_o) is given by the formula ,

$M_o = x_k + \left\{ h \times \frac{(f_k - f_{k-1})}{(2f_k - f_{k-1} - f_{k+1})} \right\}$

$= 20.5 + \left[5 \times \frac{(28-18)}{(56-18-20)} \right]$

$= 20.5 + \left[\frac{5 \times 10}{18} \right]$

= 20.5 + 2.78

= 23.28

Hence, mode = 23.28

52.

Class interval	Frequency	Cumulative frequency
0-6	4	4
6-12	x	4 + x
12-18	5	9 + x
18-24	y	9 + x + y
24-30	1	10 + x + y

		Total =20

10 + x + y = 20

$\Rightarrow$ x + y =10 ...(i)

Median = 14.4

Hence, median class is 12 - 18.

$\therefore$ l = 12, h = 6, f = 5, F = cumulative frequency of preceding class = 4 + x, N = 20

Median= $1 + \frac{\frac{N}{2} - F}{f} \times$ h

$\Rightarrow 14.4 = 12 + \frac{10-(4+x)}{5} \times 6$

$\Rightarrow 2.4 = \frac{6-x}{5} \times 6$

$\Rightarrow 0.4 = \frac{6-x}{5}$

$\Rightarrow$ x = 4

substitute x value in (i), we get

$\Rightarrow$ y = 10 - 4 = 6

53. The given series is an inclusive series.

Making it an exclusive series, we get

Class interval	**Frequency f_i**	**Mid-value x_i**	$u_i = \frac{x_i - A}{h} = \frac{x_i - 500.5}{200}$	**f_iu_i**
0.5-200.5	14	100.5	-2	-28
200.5-400.5	15	300.5	-1	-15
400.5-600.5	14	500.5 =A	0	0
600.5-800.5	7	700.5	1	7
	$\sum f_i = 50$			$\sum f_iu_i = -36$

Thus, A = 500.5, h = 200, $\sum f_i = 50$ and $\sum f_iu_i = -36$

Mean= $A + \left\{ h \times \frac{\sum f_i u_i}{\sum f_i} \right\}$

= $500.5 + \left\{ 200 \times \frac{-36}{50} \right\}$

= 500.5 - 144

= 356.5

Thus, the mean daily income of employees is ₹ 356.50

54.

Weight (in kg)	**Number 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

Now, n = 30

So, $\frac{n}{2} = \frac{30}{2} = 15$

This observation lies in the class 55-60,

So, 55-60 is the median class.

Therefore,

l = 55

h = 5

f = 6

cf = 13

$\therefore$ Median $= l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h = 55 + \left(\frac{15-13}{6}\right) \times 5$

$= 55 + \frac{10}{6} = 55 + \frac{5}{3}$

= 55 + 1.67 = 56.67

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

Section D

55. i. Upper limit of modal class = 15

ii. Median class = 10 - 15

iii. a. $I = 10, \mathrm{f_0} = 16, \mathrm{f_1} = 22, \mathrm{f_2} = 18,\ \mathrm{h} = 5$

Mode $= I + \frac{\mathrm{f_1} - \mathrm{f_0}}{2\mathrm{f_1} - \mathrm{f_0} - \mathrm{f_2}} \times \mathrm{h} = 10 + \left(\frac{22-16}{44-16-18}\right) \times 5$

$= 13$

OR

1.

NAV (in ₹)	f	cf
0 - 5	13	13
5 - 10	16	29
10 - 15	22	51
15 - 20	18	69
20 - 25	11	80

Median $= I + \left(\frac{\frac{N}{2} - cf}{f}\right) \times \mathrm{h} = 10 + \left(\frac{40-29}{22}\right) \times 5$

= 12.5

56. i. Modal Class is 600 - 800

ii. $\frac{N}{2}$ = 12, median class is 600 - 800

Rainfall	x_i	f_i	ef.
200 - 400	300	2	2
400 - 600	500	4	6
600 - 800	700	7	13
800 - 1000	900	4	17
1000 - 1200	1100	2	19
1200 - 1400	1300	3	22
1400 - 1600	1500	1	23
1600 - 1800	1700	1	24
		24	

Median = 600 + $\frac{200}{7}$(12 - 6)

= $\frac{5400}{7}$ or 771.4

iii. Sub-divisions having good rainfall = 2 + 3 + 1 + 1 = 7.

OR

Rainfall	x_i	f_i	$f_i x_i$
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
		24	20400

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

57. i. The maximum class frequency is 15 belonging to class interval 150-155

∴ 150 - 155 is the modal class

lower limit (l) of modal class =150

ii.

Height (in cm)	frequency	C.F
135-140	2	2
140-145	8	10
145-150	10	20
150-155	15	35
155-160	6	41
160-165	5	46
165-170	4	50
	$\sum fi$ = 50	

$\sum fi$ = 2 + 8 + 10 + 15 + 6 + 5 + 4 =50 =N

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

c.f just greater that $\frac{N}{2}$ i.e, 25 is 35

∴ Median class 150-155

iii.

Height (in cm)	frequency (f_i)	x_i
135-140	2	137.5
140-145	8	142.5
145-150	10	147.5
150-155	15	**152.5**
155-160	6	157.5
160-165	5	162.5
165-170	4	167.5

$x_i = \frac{\text{lower limit+upper limit}}{2}$

middle term of x_i,is the assumean mean

Hence, Assumed Mean = 152.5

OR

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

= 150 + $(\frac{25-20}{15}) \times 5$

= 150 + $\frac{5}{15} \times 5$

= 150 + $\frac{5}{3}$

= 150 + 1.67

= 151.67

58. i. Median class : 100 - 110

ii. No. of leaves equal to or more than 10cm(100 mm) = 23

a.

C.I	f	cf
70-80	3	3
80-90	5	8
90-100	9	17
100-110	12	29
110-120	5	34
120-130	4	38
130-140	2	40 = N

Median $= 100 + \frac{10}{12}(20 - 17) = 102 \cdot 5$

OR

b. Modal class is 100 - 110

Mode $= 100 + 10 \times \frac{12-9}{24-9-5} = 103$

59. i. Women having heart beat in range 68 - 77

= 4 + 3 + 8 = 15

ii. Median class = 74 - 77

iii. a. Mode = $l + \left(\frac{\mathrm{f}_1 - \mathrm{f}_0}{2\mathrm{f}_1 - \mathrm{f}_0 - \mathrm{f}_2}\right) \times \mathrm{h}$

$l = 74, \mathrm{f}_1 = 8, \mathrm{f}_0 = 3, \mathrm{f}_2 = 7,\ \mathrm{h} = 3$

$\therefore$ Modal value = $74 + \left(\frac{8-3}{16-3-7}\right) \times 3$

= 76.5

OR

b.

No. of heart beats	f	cf
65 - 68	2	2
68 - 71	4	6
71 - 74	3	9
74 - 77	8	17
77 - 80	7	24
80 - 83	4	28
83 - 86	2	30

Median = $I + \frac{\frac{N}{2} - Cf}{f} \times h$

$= 74 + \frac{(15-9)}{8} \times 3$

= 76.25

60. i. Maximum class frequency is 23 belonging to class interval 35-45

Mode = $l + \left(\frac{\mathrm{f}_1 - \mathrm{f}_0}{2\mathrm{f}_1 - \mathrm{f}_0 - \mathrm{f}_2}\right) \times \mathrm{h}$

= $35 + \left(\frac{23-21}{46-21-14}\right) \times 10$

= 35 + $\frac{2}{11} \times 10$

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

= 35 + 1.81

= 36.81

ii. Since, the modal class is (35-45)

$\therefore$ Upper limit of modal class = 45

iii.

C.I (Age)	No of cases (f)	C.F

5-15	8	8
15-25	16	24
25-35	10	34
35-45	42	76
45-55	24	100
55-65	12	112

$\sum f$ = 112

$\frac{N}{2} = \frac{\sum f}{2}$

$= \frac{112}{2}$ = 56

c.f just greater than 56 is 76

∴ median class 35-45

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

35 + $\left(\frac{56-34}{42}\right) \times 10$

35 + $\frac{22}{42} \times 10$

35 + 5.23 = 40.23

OR

C.I (Age)	No of cases (f)	C.F
5-15	6	6
15-25	11	17
25-35	21	38
35-45	23	61
45-55	14	75
55-65	5	80

$\sum f$ = 80

$\frac{N}{2} = \frac{\sum f}{2}$

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

c.f just greater than 40 is 61

∴ median class = 35 - 45

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

= 35 + $(\frac{40-38}{23}) \times 10$

= 35 + $\frac{2}{23} \times 10$

= 35 + $\frac{20}{23}$

= 35 + 0.86

= 35.86

61.

Time (in sec)	Number of students (f)	x_i	cf	$f_i x_i$
0 - 20	8	10	8	80
20 - 40	10	30	18	300
40 - 60	13	50	31	650
60 - 80	6	70	37	420
80 - 100	3	90	40	270

Total	**40**			**1720**

i. Correct Cummulative Frequency

Median class = 40 - 60

ii. a. Correct table for x_i and f_ix_i

Mean = $\frac{1720}{40}$ = 43

OR

b. Modal class = 40 - 60

Mode = $40 + \frac{(13-10)}{(26-10-6)} \times 20$

= 46

iii. 31 students took time less than 60 seconds.

62.

Number announced	0 - 15	15 - 30	30 - 45	45 - 60	60 - 75
Number of times (f)	8	9	10	12	9
cf	8	17	27	39	48 = N

i. $\frac{N}{2}$ = 24

$\therefore$ median class is 30 - 45

ii. P(picking up an even number) = $\frac{37}{75}$

iii. a. Median = $30 + \frac{\left(\frac{48}{2}-17\right)}{10} \times 15$

= 40.5

OR

b. Modal class is 45 - 60

Mode = $45 + \frac{12-10}{2\times12-10-9} \times 15$

= 51

Section E

63. Calculation of median:

Class interval	**Frequency(f_i)**	**Cumulative frequency**
0 - 15	5	5
15 - 30	20	25
30 - 45	40	65
45 - 60	50	115
60 - 75	25	140

N = 140$\Rightarrow \frac{N}{2}$= 70.

The median class is 45 -60.

$\therefore l = 45, h = 15, f = 50, c.f. = 65$

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

$= 45 + \left\{15 \times \frac{(70-65)}{50}\right\}$

$= 45 + \left\{15 \times \frac{5}{50}\right\}$

$= 45 + 1.5 = 46.5$

Hence, the median age of diabetic patients is 46.5 years.

64.

C.I	**x**	**f**	$u = \frac{x-50}{20}$	**fu**	**cf**
0 - 20	10	5	-2	-10	5
20 - 40	30	8	-1	-8	13
40 - 60	50	10	0	0	23

60 - 80	70	12	1	12	35
80 - 100	90	7	2	14	42
100 - 120	110	8	3	24	50
				32	

Mean = $50 + 20 \times \frac{32}{50} = 62.8$

Median = $60 + \frac{20}{12}(25 - 23) = 63.3$ (approx)

65. class 10000 - 15000 has the maximum frequency,

so it is the modal class.

$\therefore$ l = 10000, h = 5000, f = 41, f_1 = 26 and f_2 = 16

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

$= 10000 + \frac{41-26}{2(41)-26-16} \times 5000$

$= 10000 + \frac{15}{40} \times 5000$

$= 10000 + 1875$

$= 11875$

66.

Class	x_i	f_i	$u_i = \frac{x-97.5}{5}$	f_iu_i	**c.f.**
85 - 90	87.5	10	-2	-20	10
90 - 95	92.5	12	-1	-12	22
95 - 100	97.5	15	0	0	37
100 - 105	102.5	14	1	14	51
105 - 110	107.5	12	2	24	63
110 - 115	112.5	7	3	21	70
				27	

Mean = $97{\cdot}5 + \left(5 \times \frac{27}{70}\right) = 99.4$

f = 15, c.f. = 22, l = 95

Median class : 95 - 100

Median = $95 + \frac{5}{15}(35 - 22) = 99.3$

67. Modal Class: 45 - 60

Mode = 55

$55 = 45 + \frac{15-a}{30-(a+10)} \times 15$

$\Rightarrow$ a = 5

6 + 7 + a + 15 + 10 + b = 51

$\Rightarrow$ a + b = 13

$\Rightarrow$ b = 13 - 5 = 8

68.

No. of wickets:	20 - 60	60 - 100	100 - 140	140 - 180	180 - 220	220 - 260	Sum
(f_i) No. of bowlers:	7	5	16	12	2	3	45
x_i	40	80	120	160	200	240	
u_i	-2	-1	0	1	2	3	
f_ix_i	-14	-5	0	12	4	9	6
cf	7	12	28	40	42	45	

Mean = $a + \frac{\sum f_iu_i}{\sum f_i} \times h = 120 + \frac{6 \times 40}{45} = 125.33$

Median = $l + \frac{\frac{N}{2} - c}{f} \times h = 100 + \frac{22.5-12}{16} \times 40 = 126.25$

69.

Family size	X_i	F_i	f_ix_i

1 - 3	2	7	14
3 - 5	4	8	32
5 - 7	6	2	12
7 - 9	8	2	16
9 - 11	10	1	10
		20	84

Mean = $\frac{\sum f_i x_i}{\sum f_i} = \frac{84}{20} = 4.2$

Mode : Modal Class = 3-5

I = 3, f1 = 8, f0 = 7, f2 = 2, h = 2

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

$= 3 + \left(\frac{8-7}{16-7-2}\right) \times 2$

$= \frac{23}{7}$ or 3.287

70.

Marks	x	f	$u = \frac{x-35}{10}$	fu	cf
0-10	5	3	-3	-9	3
10-20	15	5	-2	-10	8
20-30	25	16	-1	-16	24
30-40	35	12	0	0	36
40-50	45	13	1	13	49
50-60	55	20	2	40	69
60-70	65	6	3	18	75
70-80	75	5	4	20	80
		80		56	

Mean = $35 + \left(10 \times \frac{56}{80}\right) = 42$

Median class: 40 - 50

Median = $40 + \frac{10}{13}(40 - 36) = 43$

71.

Daily expense (CI)	Households (f_i)	Mid-point (x_i)	$f_i x_i$
100-150	4	125	500
150-200	5	175	875
200-250	12	225	2700
250-300	2	275	550
300-350	2	325	650
	$\sum f_i = 25$		$\sum f_i x_i = 5275$

Mean = $\frac{\sum f_i x_i}{\sum f_i} = \frac{5275}{25} = 211$

For modal expenditure

$\because$ 12 is the maximum frequency

$\therefore$ Modal class = 200 - 250

$\Rightarrow$ l = 200, h = 50, $f_0 = 5$

$f_1 = 12$, $f_2 = 2$

Now,

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

= 200 + $\left(\frac{12-5}{2\times12-5-2}\right) \times 50$

= 200 + $\left(\frac{7}{24-7}\right) \times 50$

= 200 + $\left(\frac{7}{17}\right) \times 50$ = 200 + $\frac{350}{17}$

= 200 + 20.58

Mode = 220.58

Hence, mean daily expenditure = 211

& Modal expenditure - 220.58

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

True Class Interval	**No. of boxes(f_i)**	**Class mark(x_i)**	$u_i = \frac{x_i-a}{h}$	**f_iu_i**
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_iu_i = 25

Let assumed mean (a) = 57,

h = 3 ,

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

Using formula, Mean $(\bar{x})$ = a + h$\bar{u}$

= 57 + 3 (0.0625

= 57 + 0.1875

= 57.1875

= 57.19 (approx)

Therefore, the mean number of mangoes is 57.19

73.

Monthly consumption	**Number of consumers**	**cf**
65 - 85	7	7
85 - 105	8	15
105 - 125	7	22
125 - 145	20	42
145 - 165	14	56
165 - 185	9	65
185 - 205	5	70

$\frac{N}{2} = \frac{70}{2} = 35$

$l = 125,$ c.f $= 22,$ f $= 20,$ h $= 20$

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

$= 125 + \frac{(35-22)}{20} \times 20$

$= 125 + 13 = 138$

Note: No marks to be deducted in case student substitutes the values correctly in the formula without writing values of l, cf, etc.

74. From the given data we have

Class internal	Frequency f_i	Mid-value x_i	$u_i = \frac{x_i-A}{h} = \frac{x_1-162.5}{5}$	$f_i \times u_i$
150-155	15	152.5	-2	-30
155-160	8	157.5	-1	-8

160-165	20	162.5 = A	0	0
165-170	12	167.5	1	12
170-175	5	172.5	2	10
	$\sum f_i = 60$			$\sum f_i u_i = -16$

As the class 160-165 has the maximum frequency.

so it is the modal class.

$\therefore$ x_k = 160, h = 5, f_k = 20, f_{k-1} = 8, f_{k+1} = 12

Now, Mode $= x_k + h\left\{\frac{(f_k - f_{k-1})}{(2f_k - f_{k-1} - f_{k+1})}\right\}$

$= 160 + 5\left\{\frac{20-8}{2(20)-8-12}\right\}$

$= 160 + 5 \times \frac{12}{20}$

= 160 + 3

= 163

Thus, the modal height is 163 cm, which means the maximum number of students has height 163 cm.

Thus, A = 162.5, h = 5, $\sum f_i$ = 60 and $\sum f_i u_i$ = -16

Mean $= A + \left\{h \times \frac{\sum f_i u_i}{\sum f_i}\right\}$

$= 162.5 + \left\{5 \times \frac{-16}{60}\right\}$

= 162.5 - 1.33

= 161.17

Thus, the mean height is 161.17 cm, which means on an average, the height of a student in a class is 161.17 cm.

75. We prepare the cumulative frequency table as given below:

Consumption	Frequency f_1	C.F.
65-85	4	4
85-105	5	9
105-125	13	22
125-145	20	42
145-165	14	56
165-185	7	63
185-205	4	67
	$N = \Sigma f_i = 67$	

Now, $N = 67 \Rightarrow \left(\frac{N}{2}\right) = \frac{67}{2} = 33.5$

The cumulative frequency just greater than 33.5 is 42 and the corresponding class 125 - 145.

Thus, the median class is 125 - 145

l = 125, h = 20, f = 20 and F = CF preceding the median class = 22, N/2 = 33.5.

Median $= m_e = 1 + \left[h \times \frac{\left(\frac{N}{2} - F\right)}{f}\right] = 125 + \left[20 \times \frac{(33.5-22)}{20}\right]$

= (125 + 11.5) = 136.5

Hence median of electricity consumed is 136.5