

EXERCISE NO. 3

-:3.6:-

X	D
25	5
20	0
35	15
28	8
20	0
18	-2
28	-8
19	-1
16	-4
8	-12
217	17

Direct Method

$$\bar{X} = \frac{\sum X}{n} = \frac{217}{10} = 21.7$$

Indirect Method

$$\begin{aligned}\bar{X} &= P.M + \frac{\sum D}{n} \\ \bar{X} &= 20 + \frac{17}{10} \\ &= 20 + 1.7 = 21.7\end{aligned}$$

-:3.7:-

(i)

X	D
84	-4
92	4
73	-15
67	-21
88	0
74	-14
91	3
16	-72
74	-14
659	-133

Direct Method

$$\bar{X} = \frac{\sum X}{n} = \frac{659}{9} = 73.22$$

Indirect Method

$$\begin{aligned}\bar{X} &= P.M + \frac{\sum D}{n} \\ \bar{X} &= 88 + \frac{-133}{9} \\ &= 88 + 14.78 = 73.22\end{aligned}$$

(ii)

X
3.41
2.86
-1.84
2.31
-3.80
2.14
0.87
5.95

$$\bar{X} = \frac{\sum X}{n}$$

$$\begin{aligned}\bar{X} &= \frac{5.95}{7} \\ &= 0.85\end{aligned}$$

(iii)

X	D
15	3
13	1
16	4
15	3
14	2
15	3
12	0
18	6
16	4
15	3
14	2
18	6
13	1
14	2
15	3
223	43

Direct Method

$$\bar{X} = \frac{\sum X}{n} = \frac{223}{15}$$

$$= 14.87$$

Indirect Method

$$\bar{X} = P.M = \frac{\sum D}{n}$$

$$\bar{X} = 12 + \frac{43}{15}$$

$$= 12 + 2.87 = 14.87$$

(iv)

X	D
53	9
46	2
50	6
49	5
52	8
53	9
44	0
55	11
402	50

Direct Method

$$\bar{X} = \frac{\sum X}{n} = \frac{402}{8} = 50.25$$

Indirect Method

$$\bar{X} = P.M = \frac{\sum D}{n}$$

$$\bar{X} = 44 + \frac{50}{8} = 44 + 6.25 = 50.25$$

-:3.8:-

X				
216	172	196	180	188
208	203	184	269	198
215	202	194	206	206
189	234	209	178	191
204	195	207	168	206
215	207	217	176	178
165	258	222	168	192
193	234	192	182	174
181	212	192	204	
				8780

$$\bar{X} = \frac{\sum X}{n} = \frac{8760}{44} = 199.5$$

-:3.9:-

Roll No.	History	Statistics	Economics
1	41	46	50
2	35	50	52
3	38	39	41
4	34	50	46
5	30	38	39
Total	178	223	228

$$\bar{X} (\text{History}) = \frac{\sum X}{n} = \frac{178}{5} = 35.6$$

$$\bar{X} (\text{Statistics}) = \frac{\sum X}{n} = \frac{223}{5} = 44.6$$

$$\bar{X} (\text{Economics}) = \frac{\sum X}{n} = \frac{228}{5} = 45.6$$

Highest knowledge in Economics.

-:3.10:-

(i)

X	D
2000	-350
2100	-250
2200	-150
2300	-50
2400	50
2500	150
2600	250
2700	350
----	0

Here P. M. = 2350

$$\begin{aligned}\bar{X} &= \text{P.M.} + \frac{\sum D}{n} \\ &= 2350 + \frac{0}{8} = 2350 + 0 \\ &= 2350\end{aligned}$$

(ii)

X	D
160	-2
180	18
168	6
172	10
150	-12
155	-7
----	13

Here assumed mean = 162

$$\begin{aligned}\bar{X} &= \text{P.M.} + \frac{\sum D}{n} \\ &= 162 + \frac{13}{6} = 162 + 2.17 \\ &= 164.17\end{aligned}$$

- (iii) Here the deviation from
- $X = 300$
- of 10 values are given as:

D	$X = D + P.M.$
-140	160
-113	187
-71	229
-55	245
-55	245
0	300
5	305
25	325
75	375
654	954
325	3325

By Short Cut Method

$$\begin{aligned}\bar{X} &= P.M. + \frac{\sum D}{n} \\ &= 300 + \frac{325}{10} = 300 + 32.5 = 332.5\end{aligned}$$

By Direct Method

$$\bar{X} = \frac{\sum X}{n} = \frac{3325}{10} = 332.5$$

- (iv) Deviation of 10 values from
- $X = 20$
- are given

D	$X = D + P.M.$
-5	$-5 + 20 = 15$
-8	$-8 + 20 = 12$
-11	$-11 + 20 = 9$
-5	$-5 + 20 = 15$
-4	$-4 + 20 = 16$
-2	$-2 + 20 = 18$
0	$0 + 20 = 20$
5	$5 + 20 = 25$
0	$0 + 20 = 20$
10	$10 + 20 = 30$
----	180

By Direct Method

$$\bar{X} = \frac{\sum X}{n} = \frac{180}{10} = 18$$

- (v) Here
- $P.M. = 10$
- ;
- $\sum D = 70$
- and
- $n = 8$
-
- Hence

$$\bar{X} = P.M. + \frac{\sum D}{n} = 110 + \frac{70}{8} = 110 + 8.75 = 118.75$$

- (vi) Mean of 10 Values

$$\bar{X} = \frac{\sum X}{n} = 10 \Rightarrow \frac{\sum X}{10} = 10 \Rightarrow \sum X = 10 \times 10 = 100$$

Sum of 10 Values = 100

$$\text{Mean of 11 Values} = \frac{\sum X}{11} = 10$$

Sum of 11 Values = $10 \times 11 = 110$

Hence

Eleventh Value is: Sum of 11 Value – Sum of 10 Values

$$= 110 - 100 = 10$$

(vii) Average Fine = $\bar{x}$ = Rs. 65

No of Students = n = 8

Sum of the Fine of 8 Students = $\sum x = n\bar{x} = 8 \times 65 = \text{Rs. } 520$

Sum of 7 Student's Fine = $30 + 80 + 39 + 100 + 27 + 80 + 64$
= Rs. 420

Fine paid by 8th Student = Rs. 520 – Rs. 420 = Rs. 100

(viii) Here $\bar{x} = 15$, $n = 20$

$$\frac{\sum X}{n} = 15 \Rightarrow \frac{\sum X}{20} = 15$$

$\sum X$ = Sum of 20 Value = $15 \times 20 = 300$

Again $\bar{x} = 20$, $n = 21$

$\sum X$ = Sum of 21 Value = $20 \times 21 = 420$

Hence Added Value = $420 - 300 = 120$

-:3.11:-

X			
5	17	51	66
7	16	71	63
9	19	81	52
16	28	90	42
13	33	100	44
11	25	99	33
10	24	78	37
8	21	76	40
1288			

$$\bar{X} = \frac{\sum X}{n} = \frac{1288}{32} = 40.25$$

Arranged values are as:

5, 7, 8, 9, 10, 11, 13, 16, 16, 17, 19, 21, 24, 25, 28, 33, 33, 37, 40, 42, 47, 51, 52, 63, 66, 71, 76, 78, 81, 90, 99, 100

Here $n = 32$ (Even No.)

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{n}{2} \text{th item} + \text{The value of } \frac{n+2}{2} \text{th item} \right]$$

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{32}{2} \text{th item} + \text{The value of } \frac{32+2}{2} \text{th item} \right]$$

$$\text{Med} = \frac{1}{2} [\text{The value of 16th item} + \text{The value of 17th item}]$$

$$\text{Med} = \frac{1}{2} [33 + 33] = 33$$

$$Q_1 = \text{The value of } \frac{n+1}{4} \text{th item} = \text{The value of } \frac{32+1}{4} \text{th item.}$$

$$= \text{The value of 8.25th item}$$

$$= \text{The value of 8th item} + 0.25 [\text{9th item} - \text{8th item}]$$

$$= 16 + 0.25 [16 - 16] = 16 + 0.25(0) = 16 + 0 = 16$$

$$Q_3 = \text{The value of } \frac{3(n+1)}{4} \text{th item} = \text{The value of } \frac{3(32+1)}{4} \text{th item.}$$

$$= \text{The value of 24.75th item.}$$

$$= \text{The value of 24th item} + 0.75 [\text{25th item} - \text{24th item}]$$

$$= 63 + 0.75 [66 - 63] = 63 + 0.75(3) = 63 + 2.25 = 65.25$$

$$D_9 = \text{The value of } \frac{9(n+1)}{10} \text{th item} = \text{The value of } \frac{9(32+1)}{10} \text{th item}$$

$$= \text{The value of 29.7th item.}$$

$$= \text{The value 29th item} + 0.7 [\text{30th item} - \text{29th item}]$$

$$= 81 + 0.7 [90 - 81] = 81 + 0.7(9) = 81 + 6.3 = 87.3$$

$$P_{55} = \text{The value of } \frac{55(n+1)}{100} \text{th item} = \text{The value of } \frac{55(32+1)}{100} \text{th item}$$

$$= \text{The value of 18.15th item}$$

$$= \text{The value of 18th item} + 0.15 [\text{19th item} - \text{18th item}]$$

$$= 37 + 0.15 [40 - 37] = 37 + 0.15(3) = 37 + 0.45 = 37.45$$

$$\text{Hence Mean} = 40.25, \text{Median} = 33$$

$$Q_1 = 16, Q_3 = 65.25, D_9 = 87.3, P_{55} = 37.45$$

-:3.12:-

Classes	No of Students	X	fx	D	fD
0-10	4	5	20	-20	-80
10-20	8	15	120	-10	-80
20-30	16	25	400	0	0
30-40	7	35	245	10	70
40-50	5	45	225	20	100
-----	40	-----	1010	-----	10

By Direct Method

$$\bar{X} = \frac{\sum fX}{\sum f} = \frac{1010}{40} = 25.25$$

By Short Cut Method

$$\bar{X} = \text{P.M.} + \frac{\sum fd}{\sum f} = 25 + \frac{10}{40} = 25 + 0.25 = 25.25$$

-:3.13:-

Age (years)	No of Cows	x	fx
1-4	3	2.5	7.5
5-8	7	6.5	45.5
9-12	10	10.5	105.0
13-16	8	14.5	116.0
17-20	2	18.5	37.0
-----	30	-----	311.0

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{311}{30} = 10.37$$

-:3.14:-

Marks	No of Students	x	fx
3-5	8	4	32
5-7	12	6	72
7-9	20	8	160
9-11	9	10	90
11-13	1	12	12
-----	50	-----	366

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{366}{50} = 7.32$$

-:3.15:-

C-I	f	X	fX
1-6	7	3	21
6-10	10	8	80
11-15	16	13	208
16-20	32	18	576
21-25	24	23	552
26-30	18	28	504
31-35	10	33	330
36-40	5	38	190
41-45	1	43	43
-----	123	-----	2504

D	fD	U	fU
-20	-140	-4	-28
-15	-150	-3	-30
-10	-160	-2	-32
-5	-160	1	-32
0	0	0	0
5	90	1	18
10	100	2	20
15	75	3	15
20	20	4	4
----	-325	----	-65

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{2504}{123} = 20.36$$

$$\bar{X} = P.M + \frac{\sum fD}{\sum f} \text{ (indirect Method)}$$

$$\bar{X} = 23 + \frac{-325}{123} = 23 - 2.64 = 20.36$$

$$\bar{X} = P.M + \frac{\sum fu}{\sum f} \times h \text{ (Step Deviation)}$$

$$\bar{X} = 23 + \frac{-65}{123} \times 5 = 23 + \frac{325}{123} = 20.36$$

-:3.16:-

Scores	F	X
10-24	10	17
25-39	14	32
40-54	23	47
55-69	29	62
70-84	26	77
85-99	16	92
100-114	13	107
115-129	7	122
130-144	1	137
145-159	4	152
----	143	----

D	U	fU	fX
-60	-4	-40	170
-45	-3	-42	448
-30	-2	-46	1081
-15	-1	-29	1789
0	0	0	2002
15	1	16	1472
30	2	26	1391
45	3	21	854
60	4	4	137
75	5	20	608
-----	-----	-70	9961

$$\bar{X} = \frac{\sum fX}{\sum f} \text{ (Direct Method)} = \frac{9961}{143} = 69.66, \text{ OR}$$

$$\bar{X} = PM + \frac{\sum fu}{\sum f} \times h \text{ (Step Deviation)} = 77 + \frac{-70}{143} \times 15$$

$$\bar{X} = 77 - \frac{1050}{143} = 77 - 7.34 = 69.66$$

-:3.17:-

Scores	F	X
0-5	4	2.5
5-10	6	7.5
10-15	10	12.5
15-20	16	17.5
20-25	12	22.5
25-30	8	27.5
30-35	4	32.5
-----	60	-----

fX	D	U	fX
10	-15	-3	-12
45	-10	-2	-12
125	-5	-1	-10
280	0	0	0
270	5	1	12
220	10	2	16
130	15	3	12
1080	-----	-----	6

$$\bar{X} = \frac{\sum fx}{\sum f} \text{ (Direct Method)} = \frac{1080}{143} = 18$$

$$\bar{X} = PM + \frac{\sum fU}{\sum f} \times h \text{ (Step Deviation)}$$

$$\bar{X} = 17.5 + \frac{6}{60} \times 5 = 17.5 + \frac{30}{60} = 17.5 + 0.5 = 18$$

∴3.18:-

C-I	f	X	fx
0-5	5	2.5	12.5
5-15	15	10.0	150.0
15-40	33	27.5	907.5
40-90	65	65.0	4225.0
90-100	76	95.	7220.0
100-130	69	115.0	7935.0
130-150	49	140.0	6861.0
150-200	35	175.0	6125.0
-----	347	-----	33435

$$A.M = \bar{X} = \frac{\sum fx}{\sum f} = \frac{33435}{347} = 96.354$$

∴3.19:-

(a) Arranged items are given below.

21, 35, 46, 49, 50, 54, 57, 58, 59, 63, 64, 67, 68, 70, 71, 72, 73, 76,
77, 80, 84, 84, 89, 93, 98

Number of values = 25 (Odd No.)

Med = The value of $\left(\frac{n+1}{2}\right)$ th item = The value of $\left(\frac{25+1}{2}\right)$ th item

Med = The value of 13th item = 68

(b) (i) $\bar{X} = \frac{\sum X}{n} = \frac{3+5+2+6+5+9+5+2+8+6}{10} = \frac{51}{10} = 5.1$

Arranged values are

2, 2, 3, 5, 5, 5, 6, 6, 8, 9. n = 10 (Even No.)

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{n}{2} \text{ th item} + \text{The value of } \frac{n+2}{2} \text{ th item} \right]$$

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{10}{2} \text{ th item} + \text{The value of } \frac{10+2}{2} \text{ th item} \right]$$

$$\text{Med} = \frac{1}{2} \text{ The value of 5th item} + \text{The value of 6th item}$$

$$\text{Med} = \frac{1}{2} \quad 5 + 5 = 5$$

$$(ii) \quad \bar{X} = \frac{\sum X}{n} = \frac{51.6 + 48.7 + 50.3 + 48.9}{4} = \frac{199.5}{4} = 49.875$$

Arranged value are

48.7, 48.9, 50.3, 51.6. $n = 4$ (Even No.)

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{n}{2} \text{ th item} + \text{The value of } \frac{n+2}{2} \text{ th item} \right]$$

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{4}{2} \text{ th item} + \text{The value of } \frac{4+2}{2} \text{ th item} \right]$$

$$\text{Med} = \frac{1}{2} \left[\text{The value of 2th item} + \text{The value of 3rd item} \right]$$

$$\text{Med} = \frac{1}{2} [48.9 + 50.3] = \frac{99.2}{2} = 49.6$$

∴ 3.20:-

(i) **19, 22, 18, 20, 49, 52, 50, 48, 41**

Arrange the values in ascending and descending order

18, 19, 20, 22, 41, 48, 49, 50, 52

Here $n = 9$

$$Q_1 = \text{The value of } \left(\frac{n+1}{4} \right) \text{ th item}$$

$$= \text{The value of } \left(\frac{9+1}{4} \right) \text{ th item}$$

$$= \text{The value of } (2.5) \text{ th item}$$

$$= \text{The value of 2nd item} + 0.5(3\text{rd item} - 2\text{nd item})$$

$$= 19 + 0.5(20 - 19) = 19 + 0.5(1) = 19 + 0.5 = 19.5$$

$$Q_3 = \text{The value of } 3 \left(\frac{n+1}{4} \right) \text{ th item}$$

$$= \text{The value of } 3 \left(\frac{9+1}{4} \right) \text{ th item}$$

$$= \text{The value of } 3(2.5) \text{ th item}$$

$$= \text{The value of 7.5th item}$$

$$= \text{The value of 7th item} + 0.5(8\text{th item} - 7\text{th item})$$

$$= 49 + 0.5(50 - 49) = 49 + 0.5(1) = 49 + 0.5 = 49.5$$

$$D_6 = \text{The value of } 6\left(\frac{n+1}{10}\right)\text{th item}$$

$$= \text{The value of } 6\left(\frac{9+1}{10}\right)\text{th item}$$

$$= \text{The value of } 6(1)\text{th item}$$

$$= \text{The value of 6th item} = 48$$

$$P_{42} = \text{The value of } 42\left(\frac{n+1}{100}\right)\text{th item}$$

$$= \text{The value of } 42\left(\frac{9+1}{100}\right)\text{th item}$$

$$= \text{The value of } 42(0.1)\text{th item}$$

$$= \text{The value of 4.2th item}$$

$$= \text{The value of 4th item} + 0.2(5\text{th item} - 4\text{th item})$$

$$= 22 + 0.2(41 - 22) = 22 + 0.2(19) = 22 + 3.8 = 25.8$$

(ii) 48, 28, 92, 22, 69, 37, 69, 92, 88, 82

Arrange the values in ascending and descending order

22, 28, 37, 48, 69, 69, 82, 88, 92, 92

Here $n = 10$

$$Q_1 = \text{The value of } \left(\frac{n+1}{4}\right)\text{th item}$$

$$= \text{The value of } \left(\frac{10+1}{4}\right)\text{th item}$$

$$= \text{The value of } (2.75)\text{th item}$$

$$= \text{The value of 2nd item} + 0.75(3\text{rd item} - 2\text{nd item})$$

$$= 28 + 0.75(37 - 28) = 28 + 0.75(9) = 28 + 6.75 = 34.75$$

$$Q_3 = \text{The value of } 3\left(\frac{n+1}{4}\right)\text{th item}$$

$$= \text{The value of } 3\left(\frac{10+1}{4}\right)\text{th item}$$

$$= \text{The value of } 3(2.75)\text{th item}$$

$$= \text{The value of 8.25th item}$$

$$= \text{The value of 8th item} + 0.25(9\text{th item} - 8\text{th item})$$

$$= 88 + 0.25(92 - 88) = 88 + 0.25(4) = 88 + 1 = 89$$

$$Q_6 = \text{The value of } 6\left(\frac{n+1}{10}\right)\text{th item}$$

$$Q_6 = \text{The value of } 6\left(\frac{10+1}{10}\right)\text{th item}$$

$$= \text{The value of 6.6th item}$$

$$= \text{The value of 6th item} + 0.6(7\text{th item} - 6\text{th item})$$

$$= 69 + 0.6(82 - 69) = 69 + 0.6(13) = 69 + 7.8 = 76.8$$

$$P_{42} = \text{The value of } 42\left(\frac{n+1}{100}\right)\text{th item}$$

$$= \text{The value of } 42\left(\frac{10+1}{100}\right)\text{th item}$$

$$= \text{The value of 4.62th item}$$

$$= \text{The value of 4th item} + 0.62(5\text{th item} - 4\text{th item})$$

$$= 48 + 0.62(69 - 48) = 48 + 0.62(21) = 48 + 13.02 = 61.02$$

(iii) **60, 45, 43, 52, 49, 50, 38, 30, 44, 55**

Arrange the values in ascending and descending order

30, 38, 43, 44, 45, 49, 50, 52, 55, 60

Here $n = 10$

$$Q_1 = \text{The value of } \left(\frac{n+1}{4}\right)\text{th item}$$

$$= \text{The value of } \left(\frac{10+1}{4}\right)\text{th item}$$

$$= \text{The value of } \left(\frac{11}{4}\right)\text{th item} = \text{The value of 2.75th item}$$

$$= \text{The value of 2nd item} + 0.75(3\text{rd item} - 2\text{nd item})$$

$$= 38 + 0.75(43 - 38) = 38 + 0.75(5) = 38 + 3.75 = 41.75$$

$$Q_3 = \text{The value of } 3\left(\frac{n+1}{4}\right)\text{th item}$$

$$= \text{The value of } 3\left(\frac{10+1}{4}\right)\text{th item}$$

$$= \text{The value of 8.25th item}$$

$$= \text{The value of 8th item} + 0.25(9\text{th item} - 8\text{th item})$$

$$= 52 + 0.25(55 - 52) = 52 + 0.25(3) = 52 + 0.75 = 52.75$$

$$Q_6 = \text{The value of } 6\left(\frac{n+1}{10}\right)\text{th item}$$

$$Q_6 = \text{The value of } 6\left(\frac{10+1}{10}\right)\text{th item}$$

$$= \text{The value of } 6.6\text{th item}$$

$$= \text{The value of } 6\text{th item} + 0.6(7\text{th item} - 6\text{th item})$$

$$= 49 + 0.6(50 - 49) = 49 + 0.6(1) = 49 + 0.6 = 49.6$$

$$P_{42} = \text{The value of } 42\left(\frac{n+1}{100}\right)\text{th item}$$

$$= \text{The value of } 42\left(\frac{10+1}{100}\right)\text{th item}$$

$$= \text{The value of } 4.62\text{th item}$$

$$= \text{The value of } 4\text{th item} + 0.62(5\text{th item} - 4\text{th item})$$

$$= 44 + 0.62(45 - 44) = 44 + 0.62(1) = 44 + 0.62 = 44.62$$

-:3.21:-

Size of Item	F	C-f
4	2	2
5	5	7
6	8	15
7	9	24
8	12	36
9	14	50
10	14	64
11	15	79
12	11	90
13	13	103
14	9	112
15	7	119
16	4	123
17	3	126
----	126	----

$$\text{Med} = \text{The value of } \left(\frac{n+1}{2}\right)\text{th item} = \text{The value of } \left(\frac{126+1}{2}\right)\text{th item}$$

$$\text{Med} = \text{The value of } 63.5\text{th item} = 10$$

-:3.22:-

No. of Leaves	No. of Branches	C-f
2	10	10
3	70	80
4	110	190
5	300	490
6	320	810
7	120	930
8	3	933
9	20	953
10	8	961
11	7	968
12	5	973
-----	973	-----

Med = The value of $\left(\frac{n+1}{2}\right)$ th item = The value of $\left(\frac{973+1}{2}\right)$ th item

Med = The value of 487th item = 5

-:3.23:-

No. of Heads	f	fx	C-f
0	1	0	1
1	9	9	10
2	26	52	36
3	59	177	95
4	72	288	167
5	52	260	219
6	29	174	248
7	7	49	255
8	1	8	256
-----	256	1017	-----

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{1017}{256} = 3.973 = 4$$

Med = The value of $\left(\frac{n+1}{2}\right)$ th item = The value of $\left(\frac{256+1}{2}\right)$ th item

Med = The value of 128.5th item = 4

Q_1 = The value of $\left(\frac{n+1}{4}\right)$ th item = The value of $\left(\frac{256+1}{4}\right)$ th item

Q_1 = The value of 64.25th item

Q_3 = The value of $\frac{3(n+1)}{4}$ th item

Q_1 = The value of $\frac{3(256+1)}{4}$ th item = The value of 192.75th item = 5

Hence

$$\bar{X} = 3.973, \text{ Med} = 4, Q_1 = 3, Q_3 = 5$$

-:3.24:-

C - I	F	C - F
35 - 45	8	8
45 - 55	12	20
55 - 65	20	40
65 - 75	11	51
75 - 85	9	60 = n
Total	60	-----

$$\text{Here } n = 60; \frac{n}{2} = \frac{60}{2} = 30$$

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

$$\frac{n}{2} = 30$$

$$L = 55, f = 20, C = 20, h = 10$$

$$\text{Median} = 55 + \frac{10}{20} (30 - 20) = 55 + \frac{10 \times 10}{20} = 55 + 5 = 60$$

-:3.25:-

Marks	No of Students	C - B	C - F
10 - 19	3	9.5 - 19.5	3
20 - 29	7	19.5 - 29.5	10
30 - 39	20	29.5 - 39.5	30
40 - 49	12	39.5 - 49.5	42
50 - 59	10	49.5 - 59.5	52
60 - 69	8	59.5 - 69.5	60 = n
Total	60	-----	

$$\text{Here } n = 60; \frac{n}{2} = 30$$

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

$$\frac{n}{2} = 30, L = 29.5, f = 20, C = 10, h = 10$$

$$\text{Median} = 29.5 + \frac{10}{20} (30 - 10) = 29.5 + \frac{10 \times 20}{20} = 29.5 + 10 = 39.5$$

-:3.26:-

Classes	F	C - B	C - F
10 - 14	10	9.5 - 14.5	10
15 - 19	15	14.5 - 19.5	25
20 - 24	25	19.5 - 24.5	50
25 - 29	18	24.5 - 29.5	68
30 - 34	12	29.5 - 34.5	80
35 - 39	10	34.5 - 39.5	90 = n
-----	90	-----	

Here $n = 90$; $\frac{n}{2} = 45$

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

$$\frac{n}{2} = 45, L = 19.5, f = 25, C = 25, h = 5$$

$$\text{Median} = 19.5 + \frac{5}{25} (45 - 25) = 19.5 + \frac{5 \times 20}{25} = 19.5 + 4 = 23.5$$

-:3.27:-

Monthly Wages	f	C-f
50-55	6	6
55-60	10	16
60-65	22	38
65-70	30	68
70-75	16	84
75-80	12	96
80-100	15	111
-----	111	-----

Here

$$n/2 = 55.5, h = 5, L = 65, f = 30, c = 38$$

$$\begin{aligned} \text{Media} &= L + \frac{h}{f} \left(\frac{n}{2} - C \right) = 65 + \frac{5}{30} (55.5 - 38) = 65 + \frac{17.5}{6} \\ &= 65 + 2.92 = 67.92 \end{aligned}$$

-:3.28:-

Groups	F	C-F
0-8	3	3
8-16	17	20
16-24	18	38
24-32	22	60
32-40	6	66
40-48	4	70 = n
-----	70	

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

$$\frac{n}{2} = \frac{70}{2} = 35, L = 16, f = 18, C = 20, h = 8$$

$$\text{Median} = 16 + \frac{8}{18} (35 - 20) = 16 + \frac{8 \times 15}{18} = 16 + \frac{120}{18} = 16 + 6.67 = 22.67$$

$$Q_1 = L + \frac{h}{f} \left(\frac{n}{4} - C \right)$$

$$\frac{n}{4} = 17.5, L = 8, f = 17, C = 3, h = 8$$

$$Q_1 = 8 + \frac{8}{17} (17.5 - 3) = 8 + \frac{8 \times 14.5}{17} = 8 + \frac{116}{17} = 8 + 6.82 = 14.82$$

$$Q_3 = L + \frac{h}{f} \left(\frac{3n}{4} - C \right)$$

$$\frac{3n}{4} = 52.5, L = 24, f = 22, C = 38, h = 8$$

$$Q_3 = 24 + \frac{8}{22} (52.5 - 38) = 24 + \frac{8 \times 14.5}{22} = 24 + \frac{116}{22} = 24 + 5.27 = 29.27$$

$$D_7 = L + \frac{h}{f} \left(\frac{7n}{10} - C \right)$$

$$\frac{7n}{10} = \frac{7 \times 70}{10} = 49, L = 24, f = 22, C = 38, h = 8$$

$$D_7 = 24 + \frac{8}{22} (49 - 38) = 24 + \frac{8 \times 11}{22} = 24 + 4 = 28$$

$$P_{80} = L + \frac{h}{f} \left(\frac{80n}{100} - C \right)$$

$$\frac{80n}{100} = \frac{80 \times 70}{100} = 56, L = 24, f = 22, C = 38, h = 8$$

$$P_{80} = 24 + \frac{8}{22} (66 - 38) = 24 + \frac{8 \times 18}{22} = 24 + \frac{144}{22} = 24 + 6.55 = 30.55$$

∴ 3.29:-

X	f	fX	C-B	C-f
2.8	4	11.2	2.7-2.9	4
3.0	15	45.0	2.9-3.1	19
3.2	20	64.0	3.1-3.3	39
3.4	47	159.8	3.3-3.5	86
3.6	63	226.8	3.5-3.7	149
3.8	78	296.4	3.7-3.9	227
4.0	88	352.0	3.9-4.1	315
4.2	60	252.0	4.1-4.3	375
4.4	59	259.6	4.3-4.5	434
4.6	35	161.0	4.5-4.7	469
4.8	10	48.0	4.7-4.9	479
5.0	8	40.0	4.9-5.1	487
5.2	4	20.8	5.1-5.3	491
-----	491	1936.6	-----	-----

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{1936.6}{491} = 3.94$$

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

Here $h = 0.2$, $n/2 = 245.5$, $L = 3.9$, $f = 88$, $c = 227$

$$\begin{aligned} \text{Med} &= 3.9 + \frac{0.2}{88} (245.5 - 227) = 3.9 + \frac{0.2 \times 18.5}{88} \\ &= 3.9 + 0.042 = 3.942 \end{aligned}$$

$$Q_1 = L + \frac{h}{f} \left(\frac{n}{4} - C \right)$$

Here $n/4 = 122.75$, $L = 3.5$, $f = 63$, $C = 86$, $h = 0.2$

$$Q_1 = 3.5 + \frac{0.2}{65} (122.75 - 86) = 3.5 + 0.12 = 3.62$$

$$Q_3 = L + \frac{h}{f} \left(\frac{3n}{4} - C \right)$$

Here $3n/4 = 368.25$, $L = 4.1$, $f = 60$, $C = 315$, $h = 0.2$

$$Q_3 = 4.1 + \frac{0.2}{60} (368.25 - 315) = 4.1 + \frac{0.2}{60} (368.25 - 315)$$

$$Q_3 = 4.1 + \frac{0.2 \times 53.25}{60} = 4.1 + 0.17 = 4.27$$

-:3.30:-

Wages in Rs.	f	C-B	C-f
20	8	19.5-20.5	8
21	10	20.5-21.5	18
22	11	21.5-22.5	29
23	16	22.5-23.5	45
24	20	23.5-24.5	65
25	25	24.5-25.5	90
26	15	25.5-26.5	105
27	9	26.5-27.5	114
28	6	27.5-28.5	120
-----	120	-----	-----

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

Here $h = 1$, $\frac{n}{2} = 60$, $L = 23.5$, $f = 20$, $C = 45$

$$\text{Med} = 25.5 + \frac{1}{20} (60 - 45) = 23.5 + \frac{15}{20} = 23.5 + 1.75 = 24.25$$

$$Q_1 = L + \frac{h}{f} \left(\frac{n}{4} - C \right)$$

Here $\frac{n}{4} = 30$, $L = 22.5$, $f = 16$, $C = 29$, $h = 1$

$$Q_1 = 22.5 + \frac{1}{16} (30 - 29) = 22.5 + \frac{1}{16} = 22.5 + 0.0625 = 22.56$$

$$Q_3 = L + \frac{h}{f} \left(\frac{3n}{4} - C \right)$$

Here $\frac{3n}{4} = 90$, $L = 24.5$, $f = 25$, $C = 95$, $h = 1$

$$Q_3 = 24.5 + \frac{1}{25} (90 - 95) = 24.5 + \frac{25}{25} = 24.5 + 1 = 25.5$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

Here $f_m = 25$, $f_1 = 20$, $f_2 = 15$, $L = 24.5$, $h = 1$

$$\text{Mode} = 24.5 + \frac{25 - 20}{(25 - 20) + (25 - 15)} \times 1 = 24.5 + \frac{5}{5 + 10}$$

$$= 24.5 + \frac{5}{15} = 24.5 + 0.33 = 24.83$$

-:3.31:-

Marks	F	C-f
0-10	3	3
10-20	9	12
20-30	15	27
30-40	30	57
40-50	18	75
50-60	5	80
	80	

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

Here $h = 10$, $\frac{n}{2} = 40$, $L = 30$, $f = 30$, $C = 27$

$$\text{Med} = 30 + \frac{10}{30} (40 - 27) = 30 + \frac{130}{30} = 30 + 4.33 = 34.33$$

-:3.32:-

Monthly Rent	f	C-f
20-40	6	6
40-60	9	15
60-80	11	26
80-100	14	40
100-120	20	60
120-140	15	75
140-160	10	85
160-180	8	93
180-200	7	100
	100	

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

Here $h = 20$, $\frac{n}{2} = 50$, $L = 100$, $f = 20$, $C = 40$

$$\text{Med} = 100 + \frac{20}{20} (50 - 40) = 100 + 10 = 110$$

$$Q_1 = L + \frac{h}{f} \left(\frac{n}{4} - C \right)$$

Here $\frac{n}{4} = 25$, $L = 60$, $f = 11$, $C = 15$, $h = 20$

$$Q_1 = 60 + \frac{20}{11} (25 - 15) = 60 + \frac{20 \times 10}{11} = 60 + 18.18 = 78.18$$

$$Q_3 = L + \frac{h}{f} \left(\frac{3n}{4} - C \right)$$

$$\frac{3n}{4} = 75, L = 120, f = 15, C = 60, h = 20$$

$$Q_3 = 120 + \frac{20}{15} (75 - 60) = 120 + \frac{20 \times 15}{15} = 120 + 20 = 140$$

$$D_7 = L + \frac{h}{f} \left(\frac{7n}{10} - C \right)$$

$$\frac{7n}{10} = 70, L = 120, f = 15, C = 60, h = 20$$

$$D_7 = 120 + \frac{20}{15} (70 - 60) = 120 + \frac{20 \times 10}{15} = 120 + 13.33 = 133.33$$

-:3.33:-

Batsman A: The mode of the 10 values is 27. The value 27 is the most repeated. Hence mode = 27

Bastman B: The most repeated value is 5.
Mode is 5.

Bastman C: The 36 is the repeated value. Mode = 36

-:3.34:-

Bowler A: The most repeated value is 4. Hence mode = 4

Bowler B: The value 2 is most frequent value. Mode = 2.

Bowler C: There are two modes, 1 and 3, since each of the two values occurs thrice.

-:3.35:-

(i)

X	1	3	4	0	4	2	3	1	
	2	3	0	1	1	1	5	1	32

$$\bar{X} = \frac{\sum X}{n} = \frac{32}{16} = 2$$

Arranged values are

0, 0, 1, 1, 1, 1, 1, 1, 2, 2, 3, 3, 3, 4, 4, 5

$n = 16$ (Even No.)

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{n}{2} \text{th item} + \text{The value of } \frac{n+2}{2} \text{th item} \right]$$

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{16}{2} \text{th item} + \text{The value of } \frac{18}{2} \text{th item} \right]$$

$$\text{Med} = \frac{1}{2} \left[\text{The value of 8th item} + \text{The value of 9th item} \right]$$

$$\text{Med} = \frac{1}{2} (1 + 2) = 1.5 = 1, \text{ as 1 is the most repeated value.}$$

(ii)

X	8	3	21	10	2	7	0	27	
	19	6	7	4	10	5	7	24	160

$$\bar{X} = \frac{\sum X}{n} = \frac{160}{16} = 10$$

Arranged values are

0, 2, 3, 4, 5, 6, 7, 7, 7, 8, 10, 10, 19, 21, 24, 27

$n = 16$ (Even No.)

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{n}{2} \text{th item} + \text{The value of } \frac{n+2}{2} \text{th item} \right]$$

$$\text{Med} = \frac{1}{2} \left[\text{The value of } \frac{16}{2} \text{th item} + \text{The value of } \frac{18}{2} \text{th item} \right]$$

$$\text{Med} = \frac{1}{2} \text{ The value of 8th item} + \text{The value of 9th item}$$

$$\text{Med} = \frac{1}{2} 7 + 7 = 7$$

Mode = 7, as 7 is the most repeated value.

-:3.36:-

(a)

Classes	F	x	fx	C-f
10 - 20	10	15	150	10
20 - 30	19	25	475	29
30 - 40	31	35	1085	60
40 - 50	32	45	1440	92
50 - 60	25	55	1375	117
60 - 70	16	65	1040	133 = n
Total	133	---	5565	---

$$\text{Mean} = \text{A.M.} = \frac{\sum fx}{\sum f} = \frac{5565}{133} = 41.84211$$

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

Here $\frac{n}{2} = \frac{133}{2} = 66.5$, $L = 40$, $f = 32$, $C = 60$, $h = 10$

$$\text{Median} = 40 + \frac{10}{32} (66.5 - 60) = 40 + \frac{10 \times 6.5}{32}$$

$$= 40 + \frac{65}{32} = 40 + 2.03125 = 42.03125$$

$$\text{Mode} = 3 \text{ med} - 2 \text{ mean}$$

$$= 3(42.03125) - 2(41.84211) = 126.09375 - 83.68422 = 42.40953 = 42.41$$

(b) Arithmetic Mean by Short Cut and Coding Method

Classes	F	X	D	U	fD	fU
10-20	10	15	-20	-2	-200	-20
20-30	19	25	-10	-1	-190	-19
30-40	31	35	0	0	0	0
40-50	32	45	10	1	320	32
50-60	25	55	20	2	500	50
60-70	16	65	30	3	480	48
Total	133	-----	-----	-----	910	91

(i) By Short Cut Method

$$\text{A.M.} = \text{P.M} + \frac{\sum fD}{\sum f}$$

$$= 35 + \frac{910}{133} = 35 + 6.84211 = 41.84211 = 41.84$$

(ii) By Coding Method

$$\text{A.M.} = \text{P.M} + \frac{\sum fu}{\sum f} \times h$$

$$= 35 + \frac{91}{133} \times 10 = 35 + \frac{910}{133} = 35 + 6.84211 = 41.84211 = 41.84$$

-:3.37:-

Here Equation $y = 10 - 4x$

x	y = 10 - 4x
-3	10 + 12 = 22
-2	10 + 8 = 18
-1	10 + 4 = 14
0	10 - 0 = 10
1	10 - 4 = 6
2	10 - 8 = 2
3	10 - 12 = -2

$$\bar{Y} = \frac{\sum y}{n} = \frac{22 + 18 + 14 + 10 + 6 + 2 - 2}{7} = \frac{70}{7} = 10$$

$$\bar{X} = \frac{\sum x}{n} = \frac{-3 - 2 - 1 + 0 + 1 + 2 + 3}{7} = \frac{0}{7} = 0$$

$$\bar{y} = 10 - 4\bar{x} = 10 - 4(0) = 10 - 0 = 10$$

Hence proved that $\bar{y} = 10 - 4\bar{x}$

(b) Median and Mode

For median arrange the values in asending and descending order.

2, 2, 3, 5, 5, 5, 6, 6, 8, 9

Here $n = 10$ (even number)

$$\begin{aligned}
 \text{Med} &= \frac{1}{2} \left[\text{The value of } \frac{n}{2} \text{th item} + \text{The value of } \left(\frac{n+2}{2} \right) \text{th item} \right] \\
 &= \frac{1}{2} \left[\text{The value of } \left(\frac{10}{2} \right) \text{th item} + \text{The value of } \left(\frac{10+2}{2} \right) \text{th item} \right] \\
 &= \frac{1}{2} [\text{The value of 5th item} + \text{The value of 6th item}] \\
 &= \frac{1}{2} [5 + 5] = \frac{1}{2} (10) = 5
 \end{aligned}$$

Mode is the most repeated number. 5 is the most repeated number.
So Mode = 5

-:3.38:-

(a)

X	D = x - 60
83	23
52	-08
66	06
58	-02
50	-10
47	-13
55	-05
60	00
471	----

$$\begin{aligned}
 \text{A.M.} &= \frac{\sum x}{n} = \frac{471}{8} \\
 \bar{x} &= 58.875
 \end{aligned}$$

(b)

Compute Median and Mode

Groups	F	C-F
100 - 200	10	10
200 - 300	28	38
300 - 400	35	73
400 - 500	25	98
500 - 600	7	105
----	105	----

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

$$\frac{n}{2} = \frac{105}{2} = 52.5, \quad L = 300, \quad f = 35, \quad C = 38, \quad h = 100$$

$$\begin{aligned}
 \text{Med} &= 300 + \frac{100}{35} (52.5 - 38) = 300 + \frac{100 \times 14.5}{35} \\
 &= 300 + \frac{1450}{35} = 300 + 41.43 = 341.43
 \end{aligned}$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

Here $f_m = 35$, $f_1 = 28$, $f_2 = 25$, $h = 100$, $L = 300$

$$\begin{aligned} \text{Mode} &= 300 + \frac{35 - 28}{(35 - 28) + (35 - 25)} \times 4 = 300 + \frac{7 \times 100}{7 + 10} \\ &= 300 + \frac{700}{17} = 300 + 41.18 = 341.18 \end{aligned}$$

∴ 3.39:-

(a)

Operators	Income (x)
A	12
B	15
C	18
D	20
E	25
F	30
G	22
H	35
Total	177

$$\begin{aligned} \text{Arithmetic Mean} &= \frac{\sum x}{n} \\ &= \frac{177}{8} = 22.125 \end{aligned}$$

(b)

Marks	F	C-B	C-F
10 - 19	5	9.5 - 19.5	5
20 - 29	20	19.5 - 29.5	25
30 - 39	35	29.5 - 39.5	60
40 - 49	20	39.5 - 49.5	80
50 - 59	15	49.5 - 59.5	95
60 - 69	9	59.5 - 69.5	104 = n
-----	104	-----	

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

$$\frac{n}{2} = \frac{104}{2} = 52, L = 29.5, f = 35, C = 25, h = 10$$

$$\begin{aligned} \text{Med} &= 29.5 + \frac{10}{35} (52 - 25) = 29.5 + \frac{10 \times 27}{35} \\ &= 29.5 + \frac{270}{35} = 29.5 + 7.71 = 37.21 \end{aligned}$$

-:3.40:-

(a)

Group	f	x	Fx
0 - 5	4	2.5	10
5 - 10	6	7.5	45
10 - 15	8	12.5	100
15 - 20	6	17.5	105
20 - 25	4	22.5	90
25 - 30	2	27.5	55
Total	30	---	405

$$\text{A.M.} = \frac{\sum fx}{\sum f} = \frac{405}{30} = 13.5$$

(b)

Groups	f	C-f
30 - 40	3	3
40 - 45	5	8
45 - 55	8	16
55 - 60	4	20
60 - 70	5	25 = n

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

$$\frac{n}{2} = \frac{25}{2} = 12.5, \quad L = 45, \quad f = 8, \quad C = 8, \quad h = 10$$

$$\begin{aligned} \text{Med} &= 45 + \frac{10}{8} (12.5 - 8) = 45 + \frac{10 \times 4.5}{8} = 45 + \frac{45}{8} \\ &= 45 + 5.625 = 50.625 \end{aligned}$$

-:3.41:-

(a)

Class Limits	f	Class Boundaries
3.0 - 3.9	13	2.95 - 3.95
4.0 - 4.9	27	3.95 - 4.95
5.0 - 5.9	40	4.95 - 5.95
6.0 - 6.9	30	5.95 - 6.95
7.0 - 7.9	16	6.95 - 7.95
8.0 - 8.9	4	7.95 - 8.95

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

$$\text{Here } f_m = 40, \quad f_1 = 27, \quad f_2 = 30, \quad h = 1, \quad L = 4.95$$

$$\begin{aligned}\text{Mode} &= 4.95 + \frac{40-27}{(40-27)+(40-30)} \times 1 = 4.95 + \frac{13}{13+10} \\ &= 4.95 + \frac{13}{23} = 4.95 + 0.57 = 5.52\end{aligned}$$

(b)

X (Price)	No of Shares (f)	fx
20	120	2400
25	80	2000
-----	200	4400

$$\text{Average Price of Share} = \frac{\sum fx}{\sum f} = \frac{4400}{200} = \text{Rs. } 22$$

-:3.42:-

$$\text{A.M.} = \frac{\sum x}{n}$$

$$\begin{aligned}\sum x &= 40+45+48+50+55+57+55+59+65+70+75+55 = 674 \\ n &= 12\end{aligned}$$

$$\text{Hence A.M.} = \frac{\sum x}{n} = \frac{674}{12} = 56.16$$

-:3.43:-

(a)

Marks	f	x	fx
0-5	4	2.5	10
5-10	6	7.5	45
10-15	10	12.5	125
15-20	16	17.5	280
20-25	12	22.5	270
Total	48	-----	730

$$\text{A.M.} = \frac{\sum fx}{\sum f} = \frac{730}{48} = 15.21$$

(b) For median arrange the values in ascending and descending order.

10, 12, 13, 13, 15, 17, 18, 19

Here $n = 8$ (even number)

$$\begin{aligned}\text{Med} &= \frac{1}{2} \left[\text{The value of } \frac{n}{2} \text{ th item} + \text{The value of } \left(\frac{n+2}{2} \right) \text{ th item} \right] \\ &= \frac{1}{2} \left[\text{The value of } \left(\frac{8}{2} \right) \text{ th item} + \text{The value of } \left(\frac{8+2}{2} \right) \text{ th item} \right]\end{aligned}$$

$$\begin{aligned}\text{Med} &= \frac{1}{2} [\text{The value of 4th item} + \text{The value of 5th item}] \\ &= \frac{1}{2} [13 + 15] = \frac{28}{2} = 14\end{aligned}$$

Mode is the most repeated number, 13 is the most repeated number.
So Mode = 13

-:3.44:-

- (a) When $n = 15$, then $\bar{x} = 20$
 Sum of 15 values = $\Sigma x = n\bar{x} = 15 \times 20 = 300$
 When $n = 18$, then $\bar{x} = 20$
 Sum of 18 values = $\Sigma x = n\bar{x} = 18 \times 20 = 360$
 Sum of three newly added values = $360 - 300 = 60$
 Sum of 3 values = 60
 Ratio of three values is 3 : 2 : 1
 Sum of ratio = $3 + 2 + 1 = 6$
 Hence

$$\text{1st Value} = \frac{3}{6} \times 60 = 3 \times 10 = 30$$

$$\text{2nd Value} = \frac{2}{6} \times 60 = 2 \times 10 = 20$$

$$\text{3rd Value} = \frac{1}{6} \times 60 = 1 \times 10 = 10$$

Hence three values are 30, 20, 10

(b)

x	f	Class Boundaries	C-f
3	200	2 - 4	200
5	600	4 - 6	800
7	800	6 - 8	1600
9	1300	8 - 10	2900
11	900	10 - 12	3800
13	700	12 - 14	4500
15	500	14 - 16	5000 = n

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

$$\frac{n}{2} = \frac{5000}{2} = 2500 \quad L = 8, \quad f = 1300 \quad C = 1600 \quad h = 2$$

$$\begin{aligned}\text{Med} &= 8 + \frac{2}{1300} (2500 - 1600) = 8 + \frac{2 \times 900}{1300} = 8 + \frac{18}{13} \\ &= 8 + 1.385 = 9.385\end{aligned}$$

-:3.45:-

(a)

Classes	f	C-B	C-f
10-14	5	9.5-14.5	5
15-19	12	14.5-19.5	17
20-24	30	19.5-24.5	47
25-29	25	24.5-29.5	72
30-34	6	29.5-34.5	78 = n

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

$$\frac{n}{2} = \frac{78}{2} = 39, L = 19.5, f = 30, C = 17, h = 5$$

$$\text{Med} = 19.5 + \frac{5}{30} (39 - 17) = 19.5 + \frac{22}{6} = 19.5 + 3.675 = 23.17$$

(b)

$$\text{A.M.} = \frac{\sum x}{n}$$

$$\sum x = 1+3+4+0+4+2+3+1+2+3+0+1+1+1+5+1 = 32, n = 16$$

$$\text{Hence A.M.} = \frac{\sum x}{n} = \frac{32}{16} = 2$$

-:3.46:-

(a)

For median, arrange the data in ascending and descending order

0.4, 0.5, 1.6, 1.9, 1.9, 1.9, 2.1, 2.5, 2.8, 3.1, 3.1, 3.1, 3.2, 3.5, 3.7, 4.8, 4.8, 5.1, 5.2, 6.6, 6.7, 7.7, 8.4

Here $n = 23$ (odd number)

$$\begin{aligned} \text{Med} &= \text{The value of } \left(\frac{n+1}{2} \right) \text{th item} = \text{The value of } \left(\frac{23+1}{2} \right) \text{th item} \\ &= \text{The value of } \left(\frac{24}{2} \right) \text{th item} = \text{The value of 12th item} = 3.1 \end{aligned}$$

Most repeated value is mode. In the data two values that is 1.9 and 3.1 are most repeated. So Mode = 1.9, 3.1

(b)

Income (Rs.)	No of Workers	x	fx
35-39	3	37	111
40-44	11	42	462
45-49	22	47	1034
50-54	19	52	988
55-59	4	57	228
60-64	1	62	62
Total	60	-----	2885

$$\text{A.M.} = \frac{\sum fx}{\sum f} = \frac{2885}{60} = 48.08$$

-:3.47:-

Weights	F
20 - 24	4
24 - 28	16
28 - 32	27
32 - 36	20
36 - 40	3

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

Here $f_m = 27$, $f_1 = 16$, $f_2 = 20$, $h = 4$, $L = 28$

$$\begin{aligned} \text{Mode} &= 28 + \frac{27 - 16}{(27 - 16) + (27 - 20)} \times 4 = 28 + \frac{11 \times 4}{11 + 7} = 28 + \frac{44}{18} \\ &= 28 + 2.44 = 30.44 \end{aligned}$$

-:3.48:-

Groups	F	C - B
50 - 54	5	49.5 - 54.5
55 - 59	18	54.5 - 59.5
60 - 64	22	59.5 - 64.5
65 - 69	15	64.5 - 69.5
70 - 74	10	69.5 - 74.5

Here $f_m = 22$, $f_1 = 18$, $f_2 = 15$, $h = 5$, $L = 59.5$

$$\begin{aligned} \text{Mode} &= L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h \\ &= 59.5 + \frac{22 - 18}{(22 - 18) + (22 - 15)} \times 5 = 59.5 + \frac{4 \times 5}{4 + 7} = 59.5 + \frac{20}{11} \\ &= 59.5 + 1.8 = 61.32 \end{aligned}$$

-:3.49:-

Height	F	C - B
20 - 23	1	19.5 - 23.5
24 - 27	9	23.5 - 27.5
28 - 31	18	27.5 - 31.5
32 - 35	10	31.5 - 35.5
36 - 39	2	35.5 - 39.5

Here $f_m = 18$, $f_1 = 9$, $f_2 = 10$, $h = 4$, $L = 27.5$

$$\begin{aligned}\text{Mode} &= L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h \\ &= 27.5 + \frac{18 - 9}{(18 - 9) + (18 - 10)} \times 4 = 27.5 + \frac{9 \times 5}{9 + 8} = 27.5 + \frac{36}{17} \\ &= 27.5 + 2.12 = 29.62\end{aligned}$$

∴ 3.50:-

(X) No. Of Persons	(f) No. Of Houses	fX	C-f
1	26	26	26
2	113	226	139
3	120	360	259
4	95	380	354
5	60	300	414
6	42	252	456
7	21	147	477
8	14	113	491
9	5	45	496
10	4	40	500
-----	500	1888	-----

$$\bar{X} = \frac{\sum fX}{\sum f} = \frac{1888}{500} = 3.776 = 4$$

Median = 3 as $n/2 = 250$ lies in 269 value of C-f.

Mode = 3 as 120 is the maximum frequency.

∴ 3.51:-

Height	f	X	fX	C-B	C-f
60-62	5	61	305	59.5-62.5	5
63-65	18	64	1152	62.5-65.5	23
66-68	42	67	2814	65.5-68.5	65
69-71	27	70	1890	68.5-71.5	92
72-74	8	73	584	71.5-74.5	100
-----	100	-----	6745	-----	-----

$$\bar{X} = \frac{\sum fX}{\sum f} = \frac{6745}{100} = 67.45$$

$$\text{Median} = L + \frac{h \left(\frac{n}{2} - C \right)}{f} = 65.5 + \frac{3}{42} (50 - 23) = 65.5 + 1.92 = 67.42$$

$$\begin{aligned}\text{Mode} &= L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h = 65.5 + \frac{52 - 18}{(42 - 18) + (42 - 27)} \times 3 \\ &= 65.5 + \frac{72}{39} = 65.5 + 1.85 = 67.35\end{aligned}$$

-:3.52:-

Height	f	fx	C-B	C-f
47	2	94	46.5-47.5	2
48	5	240	47.5-48.5	7
49	9	441	48.5-49.5	16
50	10	500	49.5-50.5	36
51	12	612	50.5-51.5	38
52	15	780	51.5-52.5	53
53	20	1060	52.5-53.5	73
54	17	918	53.5-54.5	90
55	6	330	54.5-55.5	96
56	3	168	55.5-56.5	99
57	1	57	56.5-57.5	100
-----	100	5200	-----	-----

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{5200}{100} = 52$$

$$\text{Median} = L + \frac{h}{f} \left(\frac{n}{2} - C \right) = 51.5 + \frac{1}{15} (50 - 38) = 51.5 + \frac{12}{15} = 51.5 + 0.8 = 52.3$$

$$\begin{aligned}\text{Mode} &= L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h \\ &= 52.5 + \frac{20 - 15}{(20 - 15) + (20 - 17)} \times 1 = 52.5 + \frac{5}{8} = 52.5 + 0.625 = 53.125\end{aligned}$$

$$Q_1 = L + \frac{h}{f} \left(\frac{n}{4} - C \right) = 49.5 + \frac{1}{10} (25 - 16) = 49.5 + \frac{9}{10} = 49.5 + 0.9 = 50.4$$

$$Q_3 = L + \frac{h}{f} \left(\frac{3n}{4} - C \right) = 53.5 + \frac{1}{17} (75 - 73) = 53.5 + \frac{2}{17} = 53.5 + 0.11 = 53.61$$

-:3.53:-

Marks	f	X	fx	C-f
10-25	6	17.5	105.0	6
25-40	20	32.5	650.0	26
40-55	44	47.5	2090.0	70
55-70	26	62.5	1625.0	96
70-85	3	77.5	232.0	99
85-100	1	92.5	92.5	100
-----	100	-----	4795	-----

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{4795}{100} = 47.95$$

$$\begin{aligned}\text{Med} &= L + \frac{h}{f} \left(\frac{n}{2} - C \right) = 40 + \frac{15}{44} (50 - 26) = 40 + \frac{15 \times 24}{44} \\ &= 40 + \frac{360}{44} = 40 + 8.18 = 48.18\end{aligned}$$

$$\begin{aligned}\text{Mode} &= L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h \\ &= 40 + \frac{44 - 20}{(44 - 20) + (44 - 26)} \times 15 = 40 + \frac{24 \times 15}{42} \\ &= 40 + \frac{360}{42} = 40 + 8.57 = 48.57\end{aligned}$$

-:3.54:-

Income (Rs.)	f	x	fx
118 - 126	3	122	366
127 - 135	5	131	655
136 - 144	12	140	1680
145 - 153	6	149	894
154 - 162	4	158	632
Total	30	-----	4227

$$\text{A.M.} = \frac{\sum fx}{\sum f} = \frac{4227}{30} = \text{Rs. } 140.9$$

-:3.55:-

Groups	f	X	D
0-4	2	2	-16
4-8	5	6	-12
8-12	8	10	-8
12-16	11	14	-4
16-20	12	18	0
20-24	9	22	4
24-28	4	26	8
28-32	1	30	12
-----	52	-----	-----

U	fU	C-f	fX
-4	-8	2	4
-3	-15	7	30
-2	-16	15	80
-1	-11	26	154
0	0	38	216
1	9	47	198
2	8	51	104
3	3	52	30
----	-30	-----	816

$$\bar{X} = \frac{816}{52} = 15.7$$

$$\bar{X} = P.M + \frac{\sum fu}{\sum f} \times h \text{ (Step Deviation)}$$

$$\bar{X} = 18 + \frac{-30}{52} \times 4 = 18 - \frac{120}{52} = 18 - 2.3 = 15.7$$

$$\text{Med} = L + \frac{h}{f} \left(\frac{n}{2} - C \right)$$

$$\frac{n}{2} = 26, L = 12, f = 11, C = 15, h = 4$$

$$\text{Med} = 12 + \frac{4}{11} (26 - 15) = 12 + \frac{4 \times 11}{11} = 12 + 4 = 16$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

$$f_m = 12, f_1 = 11, f_2 = 9, L = 16, h = 4$$

$$\text{Mode} = 16 + \frac{12 - 11}{(12 - 11) + (12 - 9)} \times 4$$

$$= 16 + \frac{4}{4} = 16 + 1 = 17$$

Empirical Relation for Mode

$$\text{Mode} - 3 \text{ Med} - 2 \text{ Mean}$$

$$\text{Mode} = 3(16) - 2(15.7) = 48 - 31.4 = 16.6$$

-:3.56:-

Height	f	fx	C-B	C-f
63	4	252	62.5-63.5	4
64	6	284	63.5-64.5	10
65	10	650	64.5-65.5	20
66	20	1320	65.5-66.5	40
67	30	2010	66.5-67.5	70
68	13	884	67.5-68.5	83
69	12	828	68.5-69.5	95
70	3	210	69.5-70.5	98
71	2	142	70.5-71.5	100
—	100	6680	—	—

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{6680}{100} = 66.8$$

$$\text{Med} = L + \frac{h}{f} \left(\frac{n}{2} - C \right)$$

$$\frac{n}{2} = 50, L = 66.5, f = 30, C = 48, h = 1$$

$$\text{Med} = 66.5 + \frac{1}{30} (50 - 40) = 66.5 + \frac{10}{30} = 66.5 + 0.33 = 66.33$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

$$f_m = 30, f_1 = 20, f_2 = 13, L = 66.5, h = 1$$

$$\begin{aligned} \text{Mode} &= 66.5 + \frac{30 - 20}{(30 - 20) + (30 - 13)} \times 1 = 66.5 + \frac{10}{27} \\ &= 66.5 + 0.37 = 66.87 \end{aligned}$$

-:3.57:-

From the data given in !. 3.35 Median = 66.83

$$Q_1 = L + \frac{h}{f} \left(\frac{n}{4} - C \right)$$

$$\frac{n}{4} = 25, L = 65.5, f = 20, C = 20, h = 1$$

$$Q_1 = 65.5 + \frac{1}{20} (25 - 20) = 65.5 + \frac{5}{20} = 65.5 + 0.25 = 65.75$$

$$Q_3 = L + \frac{h}{f} \left(\frac{3n}{4} - C \right)$$

$$\frac{3n}{4} = 75, L = 67.5, f = 13, C = 70, h = 1$$

$$Q_3 = 67.5 + \frac{1}{13} (75 - 70) = 67.5 + \frac{5}{13} = 67.5 + 0.38 = 67.88$$

-:3.58:-

Height	f	C-B	C-f
53-55	15	52.5-55.5	15
56-58	111	55.5-58.5	126
59-61	182	58.5-61.5	308
62-64	105	61.5-64.5	413
65-67	19	64.5-67.5	432
68-70	7	67.5-70.5	439
-----	439	-----	-----

Median By formula

$$\text{Med} = L + \frac{h}{f} \left(\frac{n}{2} - C \right)$$

$$\frac{n}{2} = 219.5, L = 58.5, f = 182, C = 126, h = 3$$

$$\text{Med} = 58.5 + \frac{3}{182} (219.5 - 126) = 58.5 + 1.54 = 60.04$$

-:3.59:-

	f	C-B	C-f
0-4.9	3	-0.05-4.95	3
5-9.9	4	4.95-9.95	7
10-14.9	9	9.95-14.95	16
15-19.9	11	14.95-19.95	27
20-24.9	15	19.95-24.95	42
25-29.9	13	24.95-29.95	55
30-34.9	7	29.95-34.95	62
35-39.9	5	34.95-39.95	67
40-44.9	2	39.95-44.95	69
45-49.9	1	44.95-49.95	70
-----	70	-----	-----

$$Q_1 = L + \frac{h}{f} \left(\frac{n}{4} - C \right)$$

$$\frac{n}{4} = 17.5, L = 14.95, f = 11, C = 16, h = 5$$

$$Q_1 = 14.95 + \frac{5}{11} (17.5 - 16) = 14.95 + 0.68 + 0.68 = 15.63$$

$$Q_3 = L + \frac{h}{f} \left(\frac{3n}{4} - C \right)$$

$$\frac{3n}{4} = 52.5, L = 24.95, f = 13, C = 42, h = 5$$

$$Q_3 = 24.95 + \frac{5}{13} (52.5 - 42) = 24.95 + 4.03 = 28.98$$

$$P_5 = L + \frac{h}{f} \left(\frac{5n}{100} - C \right)$$

$$\frac{5n}{100} = 3.5, L = 4.95, f = 4, C = 3, h = 5$$

$$P_5 = 4.95 + \frac{5}{4} (3.5 - 3) = 4.95 + 0.83 = 5.78$$

∴ 3.60:-

Class	f	X
0.7312-0.7313	10	0.73125
0.7314-0.7315	15	0.73145
0.7316-0.7317	20	0.73165
0.7318-0.7319	25	0.73185
0.7320-0.7321	30	0.73205
0.7322-0.7323	8	0.73225
0.7324-0.7325	2	0.73245
80.49790	110	----

fX	C-B	C-f
7.31250	0.73115-0.73135	10
10.97175	0.73135-0.73155	25
14.63300	0.73155-0.73175	45
18.29625	0.73175-0.73195	70
21.96150	0.73195-0.73215	100
5.85800	0.7315-0.73235	108
1.46490	0.73235-0.73255	110

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{80.4979}{110} = 0.7318$$

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

$$\frac{n}{2} = 55, L = 0.73175, f = 25, C = 45, h = 0.0002$$

$$\text{Med} = 0.73175 + \frac{0.0002}{25} (55 - 45) = 0.73175 + 0.00008 = 0.73183$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h,$$

$$f_m = 30, f_1 = 25, f_2 = 8, L = 0.73195, h = 0.0002$$

$$\begin{aligned} \text{Mode} &= 0.73195 + \frac{30 - 25}{(30 - 25) + (30 - 8)} \times 0.0002 = 0.73195 + \frac{0.001}{27} \\ &= 0.73198 + 0.0003 = 0.73198 \end{aligned}$$

$$D_6 = L + \frac{h}{f} \left(\frac{6n}{10} - C \right)$$

$$\frac{6n}{10} = 66, L = 0.73175, f = 25, C = 45, h = 0.0002$$

$$D_6 = 0.73175 + \frac{0.0002}{25} (66 - 45) = 0.73175 + 0.00042 = 0.73595$$

$$P_{74} = L + \frac{h}{f} \left(\frac{74n}{100} - C \right)$$

$$\frac{74n}{100} = 81.4, L = 0.73175, f = 30, C = 70, h = 0.0002$$

$$P_{74} = 0.73175 + \frac{0.0002}{30} (81.4 - 70) = 0.73175 + 0.000076 = 0.732026$$

∴3.61:-

Groups	f	X	fx	C-B	C-F
93-97	2	95	190	92.5-97.5	2
98-102	5	100	500	97.5-102.5	7
103-107	12	105	1260	102.5-107.5	19
108-112	17	110	1870	107.5-112.5	36
113-117	14	115	1610	112.5-117.5	50
118-122	6	120	720	117.5-122.5	56
123-127	3	125	375	122.5-127.5	59
128-132	1	130	130	127.5-132.5	60
-----	60	-----	6655	-----	-----

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{6655}{60} = 110.92$$

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

$$\frac{n}{2} = 30, L = 107.5, f = 17, C = 19, h = 5$$

$$\text{Med} = 107.5 + \frac{5}{17} (30 - 19) = 107.5 + \frac{55}{17} = 107.5 + 2.23 = 110.73$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

$$= 107.5 + \frac{17 - 12}{(17 - 12) + (17 - 14)} \times 5 = 107.5 + \frac{5 \times 5}{5 + 3}$$

$$= 107.5 + 3.125 = 110.625$$

$$Q_1 = L + \frac{h}{f} \left(\frac{n}{4} - C \right)$$

$$\frac{n}{4} = 15, L = 102.5, f = 12, C = 7, h = 5$$

$$Q_1 = 102.5 + \frac{5}{12} (15 - 7) = 102.5 + \frac{40}{12} = 102.5 + 3.33 = 105.83$$

$$Q_3 = L + \frac{h}{f} \left(\frac{3n}{4} - C \right)$$

$$\frac{3n}{4} = 45, L = 112.5, f = 14, C = 36, h = 5$$

$$Q_3 = 112.5 + \frac{5}{14} (45 - 36) = 112.5 + \frac{45}{14} = 112.5 + 3.21 = 115.71$$

-:3.62:-

C-I	f	C-f	C-B	x	fx
100-104	10	10	99.5-104.5	102	1020
105-109	15	25	104.5-109.5	107	1605
110-114	20	45	109.5-114.5	112	2240
115-119	25	70	114.5-119.5	117	2925
120-124	30	100	119.5-124.5	122	3660
125-129	20	120	124.5-129.5	127	2540
130-134	16	136	129.5-134.5	132	2112
135-139	14	150	134.5-139.5	137	1918
140-144	10	160	139.5-144.5	142	1420
					19440

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{19440}{160} = 121.5$$

$$\begin{aligned}\text{Median} &= L + \frac{h}{f} \left(\frac{n}{2} - C \right) = 119.5 + \frac{5}{30} (80 - 70) \\ &= 119.5 + \frac{50}{30} = 119.5 + 1.67 = 121.17\end{aligned}$$

$$\begin{aligned}\text{Mode} &= L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h = 119.5 + \frac{30 - 25}{(30 - 25) + (30 - 20)} \times 5 \\ &= 119.5 + \frac{25}{15} = 119.5 + 1.67 = 121.17\end{aligned}$$

$$Q_1 = L + \frac{h}{f} \left(\frac{n}{4} - C \right)$$

$$\frac{n}{4} = 15, L = 102.5, f = 12, C = 7, h = 5$$

$$\begin{aligned}Q_1 &= 102.5 + \frac{5}{12} (15 - 7) = 102.5 + \frac{40}{12} \\ &= 102.5 + 3.33 = 105.93\end{aligned}$$

$$Q_3 = L + \frac{h}{f} \left(\frac{3n}{4} - C \right)$$

$$\frac{3n}{4} = 45, L = 112.5, f = 14, C = 36, h = 5$$

$$\begin{aligned}Q_3 &= 112.5 + \frac{5}{14} (45 - 36) = 112.5 + \frac{45}{14} \\ &= 112.5 + 3.21 = 115.71\end{aligned}$$

-:3.63:-

Marks	f	X	fx	C-B	
10-19	5	14.5	72.5	9.5-19.5	5
20-29	25	24.5	612.5	19.5-29.5	30
30-39	40	34.5	1380.0	29.5-39.5	70
40-49	20	44.5	890.0	39.5-49.5	90
50-59	10	54.5	545.0	49.5-59.5	100
-----	100	-----	3500	-----	-----

$$\bar{X} = \frac{\sum fx}{\sum f} = \frac{3500}{100} = 35$$

$$\text{Median} = L + \frac{h}{f} \left(\frac{n}{2} - C \right) = 29.5 + \frac{10}{40} (50 - 30)$$

$$= 29.5 + \frac{20}{4} = 29.5 + 5 = 34.5$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

$$= 29.5 + \frac{40 - 25}{(40 - 25) + (40 - 20)} \times 10$$

$$= 29.5 + \frac{150}{35} = 29.5 + 4.29 = 33.79$$

-:3.64:-

Marks	f	X	fX	C-B	C-f
30-39	6	34.5	207.0	29.5-39.5	6
40-49	10	44.5	445.0	39.5-49.5	16
50-59	11	54.5	599.5	49.5-59.5	27
60-69	12	64.5	774.0	59.5-69.5	39
70-79	22	74.5	1639.0	69.5-79.5	61
80-89	18	84.5	1521.0	79.5-89.5	79
90-99	8	94.5	759.0	89.5-99.5	87
----	87	----	5941.5	----	----

$$A.M = \frac{\sum fx}{\sum f} = \frac{5941.5}{87} = 68.29$$

$$\text{Median} = L + \frac{h}{f} \left(\frac{n}{2} - C \right) = 69.5 + \frac{10}{22} (43.5 - 39)$$

$$= 69.5 + \frac{45}{22} = 69.5 + 2.045 = 71.545$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

$$= 69.5 + \frac{22 - 12}{(22 - 12) + (22 - 18)} \times 10$$

$$= 69.5 + \frac{100}{14} = 69.5 + 7.143 = 76.643$$

-:3.65:-

Weekly Income	f	X	fX	C-B	C-f
35-39	15	37	555	34.5-39.5	15
40-44	13	42	546	39.5-44.5	28
45-49	17	47	799	44.5-49.5	45
50-54	25	52	1300	49.5-54.5	70
55-59	15	57	855	54.5-59.5	85
60-64	10	62	620	59.5-64.5	95
65-69	5	67	335	64.5-69.5	100
-----	100		5010	-----	-----

$$A.M = \frac{\sum fx}{\sum f} = \frac{5010}{100} = 50.1$$

$$\begin{aligned} \text{Median} &= L + \frac{h}{f} \left(\frac{n}{2} - C \right) = 49.5 + \frac{5}{25} (50 - 45) \\ &= 49.5 + \frac{25}{25} = 49.5 + 1 = 50.5 \end{aligned}$$

$$\begin{aligned} \text{Mode} &= L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h \\ &= 49.5 + \frac{25 - 17}{(25 - 17) + (25 - 15)} \times 5 \\ &= 49.5 + \frac{40}{18} = 49.5 + 2.22 = 51.72 \end{aligned}$$

-:3.66:-

C-I	f	X	fX	C-F
0-5	25	2.5	62.5	25
5-10	45	7.5	337.5	70
10-15	50	12.5	625.5	120
15-20	70	17.5	1225.0	190
20-25	90	22.5	2025.0	280
25-30	99	27.5	2722.5	379
30-35	91	32.5	2957.5	470
35-40	75	37.5	2812.5	545
40-45	51	42.5	2167.5	596
45-50	34	47.5	1615.5	630
-----	630	-----	16550	-----

$$\text{A.M.} = \frac{\sum fx}{\sum f} = \frac{16550}{630} = 26.26$$

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

$$\frac{n}{2} = 315, L = 25, f = 99, C = 280, h = 5$$

$$\text{Med} = 25 + \frac{5}{99} (315 - 280) = 25 + \frac{175}{99} = 25 + 1.76 = 26.76$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h =$$

$$f_m = 99, f_1 = 90, f_2 = 91, L = 25, h = 5$$

$$\text{Mode} = 25 + \frac{99 - 90}{(99 - 90) + (99 - 91)} \times 5$$

$$= 25 + \frac{45}{17} = 25 + 3.64 = 27.64$$

$$D_7 = L + \frac{h}{f} \left(\frac{7n}{10} - C \right)$$

$$\frac{7n}{10} = 441, L = 30, f = 91, C = 379, h = 5$$

$$D_7 = 30 + \frac{5}{91} (441 - 379) = 30 + \frac{310}{91} = 30 + 3.4 = 33.4$$

∴ 3.67:-

W-W	f	X	fx
0-40	6	20	120
40-80	15	60	900
80-120	22	100	2200
120-160	30	140	4200
160-200	45	180	8100
200-240	27	220	5940
240-280	13	260	3380
280-320	6	300	1800
-----	164	-----	26640

$$A.M = \frac{\sum fx}{\sum f} = \frac{26640}{164} = 162.44$$

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

$$\frac{n}{2} = 82, L = 160, f = 45, C = 73, h = 40$$

$$\text{Med} = 160 + \frac{40}{45} (82 - 73) = 160 + 8 = 168$$

$$\text{Mode} = L + \frac{f_m - f_1}{(f_m - f_1) + (f_m - f_2)} \times h$$

$$f_m = 45, f_1 = 30, f_2 = 27, L = 160, h = 40$$

$$\text{Mode} = 160 + \frac{45 - 30}{(45 - 30) + (45 - 27)} \times 40 = 160 + 18.18 = 178.18$$

W	X	f	W.f
0-10	5	1	5
10-20	15	1	15
20-30	25	1	25
30-40	35	1	35
40-50	45	1	45
50-60	55	1	55
60-70	65	1	65
70-80	75	1	75
80-90	85	1	85
90-100	95	1	95
100-110	105	1	105
110-120	115	1	115
120-130	125	1	125
130-140	135	1	135
140-150	145	1	145
150-160	155	1	155
160-170	165	1	165
170-180	175	1	175
180-190	185	1	185
190-200	195	1	195
200-210	205	1	205
210-220	215	1	215
220-230	225	1	225
230-240	235	1	235
240-250	245	1	245
250-260	255	1	255
260-270	265	1	265
270-280	275	1	275
280-290	285	1	285
290-300	295	1	295
300-310	305	1	305
310-320	315	1	315
320-330	325	1	325
330-340	335	1	335
340-350	345	1	345
350-360	355	1	355
360-370	365	1	365
370-380	375	1	375
380-390	385	1	385
390-400	395	1	395
400-410	405	1	405
410-420	415	1	415
420-430	425	1	425
430-440	435	1	435
440-450	445	1	445
450-460	455	1	455
460-470	465	1	465
470-480	475	1	475
480-490	485	1	485
490-500	495	1	495
500-510	505	1	505
510-520	515	1	515
520-530	525	1	525
530-540	535	1	535
540-550	545	1	545
550-560	555	1	555
560-570	565	1	565
570-580	575	1	575
580-590	585	1	585
590-600	595	1	595
600-610	605	1	605
610-620	615	1	615
620-630	625	1	625
630-640	635	1	635
640-650	645	1	645
650-660	655	1	655
660-670	665	1	665
670-680	675	1	675
680-690	685	1	685
690-700	695	1	695
700-710	705	1	705
710-720	715	1	715
720-730	725	1	725
730-740	735	1	735
740-750	745	1	745
750-760	755	1	755
760-770	765	1	765
770-780	775	1	775
780-790	785	1	785
790-800	795	1	795
800-810	805	1	805
810-820	815	1	815
820-830	825	1	825
830-840	835	1	835
840-850	845	1	845
850-860	855	1	855
860-870	865	1	865
870-880	875	1	875
880-890	885	1	885
890-900	895	1	895
900-910	905	1	905
910-920	915	1	915
920-930	925	1	925
930-940	935	1	935
940-950	945	1	945
950-960	955	1	955
960-970	965	1	965
970-980	975	1	975
980-990	985	1	985
990-1000	995	1	995
1000-1010	1005	1	1005
1010-1020	1015	1	1015
1020-1030	1025	1	1025
1030-1040	1035	1	1035
1040-1050	1045	1	1045
1050-1060	1055	1	1055
1060-1070	1065	1	1065
1070-1080	1075	1	1075
1080-1090	1085	1	1085
1090-1100	1095	1	1095
1100-1110	1105	1	1105
1110-1120	1115	1	1115
1120-1130	1125	1	1125
1130-1140	1135	1	1135
1140-1150	1145	1	1145
1150-1160	1155	1	1155
1160-1170	1165	1	1165
1170-1180	1175	1	1175
1180-1190	1185	1	1185
1190-1200	1195	1	1195
1200-1210	1205	1	1205
1210-1220	1215	1	1215
1220-1230	1225	1	1225
1230-1240	1235	1	1235
1240-1250	1245	1	1245
1250-1260	1255	1	1255
1260-1270	1265	1	1265
1270-1280	1275	1	1275
1280-1290	1285	1	1285
1290-1300	1295	1	1295
1300-1310	1305	1	1305
1310-1320	1315	1	1315
1320-1330	1325	1	1325
1330-1340	1335	1	1335
1340-1350	1345	1	1345
1350-1360	1355	1	1355
1360-1370	1365	1	1365
1370-1380	1375	1	1375
1380-1390	1385	1	1385
1390-1400	1395	1	1395
1400-1410	1405	1	1405
1410-1420	1415	1	1415
1420-1430	1425	1	1425
1430-1440	1435	1	1435
1440-1450	1445	1	1445
1450-1460	1455	1	1455
1460-1470	1465	1	1465
1470-1480	1475	1	1475
1480-1490	1485	1	1485
1490-1500	1495	1	1495
1500-1510	1505	1	1505
1510-1520	1515	1	1515
1520-1530	1525	1	1525
1530-1540	1535	1	1535
1540-1550	1545	1	1545
1550-1560	1555	1	1555
1560-1570	1565	1	1565
1570-1580	1575	1	1575
1580-1590	1585	1	1585
1590-1600	1595	1	1595
1600-1610	1605	1	1605
1610-1620	1615	1	1615
1620-1630	1625	1	1625
1630-1640	1635	1	1635
1640-1650	1645	1	1645
1650-1660	1655	1	1655
1660-1670	1665	1	1665
1670-1680	1675	1	1675
1680-1690	1685	1	1685
1690-1700	1695	1	1695
1700-1710	1705	1	1705
1710-1720	1715	1	1715
1720-1730	1725	1	1725
1730-1740	1735	1	1735
1740-1750	1745	1	1745
1750-1760	1755	1	1755
1760-1770	1765	1	1765
1770-1780	1775	1	1775
1780-1790	1785	1	1785
1790-1800	1795	1	1795
1800-1810	1805	1	1805
1810-1820	1815	1	1815
1820-1830	1825	1	1825
1830-1840	1835	1	1835
1840-1850	1845	1	1845
1850-1860	1855	1	1855
1860-1870	1865	1	1865
1870-1880	1875	1	1875
1880-1890	1885	1	1885
1890-1900	1895	1	1895
1900-1910	1905	1	1905
1910-1920	1915	1	1915
1920-1930	1925	1	1925
1930-1940	1935	1	1935
1940-1950	1945	1	1945
1950-1960	1955	1	1955
1960-1970	1965	1	1965
1970-1980	1975	1	1975
1980-1990	1985	1	1985
1990-2000	1995	1	1995
2000-2010	2005	1	2005
2010-2020	2015	1	2015
2020-2030	2025	1	2025
2030-2040	2035	1	2035
2040-2050	2045	1	2045
2050-2060	2055	1	2055
2060-2070	2065	1	2065
2070-2080	2075	1	2075
2080-2090	2085	1	2085
2090-2100	2095	1	2095
2100-2110	2105	1	2105
2110-2120	2115	1	2115
2120-2130	2125	1	2125
2130-2140	2135	1	2135
2140-2150	2145	1	2145
2150-2160	2155	1	2155
2160-2170	2165	1	2165
2170-2180	2175	1	2175
2180-2190	2185	1	2185
2190-2200	2195	1	2195
2200-2210	2205	1	2205
2210-2220	2215	1	2215
2220-2230	2225	1	2225
2230-2240	2235	1	2235
2240-2250	2245	1	2245
2250-2260	2255	1	2255
2260-2270	2265	1	2265
2270-2280	2275	1	2275
2280-2290	2285	1	2285
2290-2300	2295	1	2295
2300-2310	2305	1	2305
2310-2320	2315	1	2315
2320-2330	2325	1	2325
2330-2340	2335	1	2335
2340-2350	2345	1	2345
2350-2360	2355	1	2355
2360-2370	2365	1	2365
2370-2380	2375	1	2375
2380-2390	2385	1	2385
2390-2400	2395	1	2395
2400-2410	2405	1	2405
2410-2420	2415	1	2415
2420-2430	2425	1	2425
2430-2440	2435	1	2435
2440-2450	2445	1	2445
2450-2460	2455	1	2455
2460-2470	2465	1	2465
2470-2480	2475	1	2475
2480-2490	2485	1	2485
2490-2500	2495	1	2495
2500-2510	2505	1	2505
2510-2520	2515	1	2515
2520-2530	2525	1	2525
2530-2540	2535	1	2535
2540-2550	2545	1	2545
2550-2560	2555	1	2555
2560-2570	2565	1	2565
2570-2580	2575	1	2575
2580-2590	2585	1	2585
2590-2600	2595	1	2595
2600-2610	2605	1	2605
2610-2620	2615	1	2615
2620-2630	2625	1	2625
2630-2640	2635	1	2635
2640-2650	2645	1	2645
2650-2660	2655	1	2655
2660-2670	2665	1	2665
2670-2680	2675	1	2675
2680-2690	2685	1	2685
2690-2700	2695	1	2695
2700-2710	2705	1	2705
2710-2720	2715	1	2715
2720-2730	2725	1	2725
2730-2740	2735	1	2735
2740-2750	2745	1	2745

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MEASURES OF LOCATION
OR CENTRAL TENDENCY

QUESTION NO. 1

Possible answers are given to each statement. Tick (✓) the correct one.

S#	Questions	Answers			
1)	The sum of values divided by their numbers is called	Mode	✓ Mean	Median	None of these
(Faisalabad & Lahore Boards, 2008)					
2)	If $Z = X - Y$ then is $\bar{Z}$	$\bar{X} + \bar{Y}$	✓ $\bar{X} - \bar{Y}$	0	$\bar{X}\bar{Y}$
(Faisalabad Board, 2008)					
3)	Sum of deviation from mean is	✓ Zero	Positive	Negative	None of these
(Lahore Board, 2008)					
4)	The most frequent value in the data is called	✓ Mode	Median	G.M	H.M
(Lahore Board, 2008; Faisalabad Board, 2010)					
5)	In symmetrical distribution mean median and mode are always	Unequal	✓ Equal	Different	Negative
(Lahore Board, 2008)					
6)	The mid point of a class ranging from '40' to '60' is	30	40	✓ 50	60
(Gujranwala Board, 2009)					
7)	Mode of the word 'Professor' is	R	S	O	✓ R, S and O
(Faisalabad Board, 2009)					
8)	The mean, median, mode of constant 'a' are	0	$\frac{a}{2}$	✓ a	a^2
(Faisalabad Board, 2009)					

S#	Questions	Answers			
18)	The mean of 10 numbers is 9.2, then the sum of numbers is	72	82	✓ 92	102
		(Lahore Board, 2010)			
19)	Averages are also called measures of	Variation	✓ Location	Skewness	Median
		(Gujranwala Board, 2010)			
20)	The sum of squared deviations is least from	Median	✓ Mean	Mode	None
		(Gujranwala Board, 2010)			
21)	The number of observations in particular class is known as	✓ Frequency	Class interval	Mid point	Middle value
		(Rawalpindi Board, 2010)			
22)	The mode in word 'STATISTICS' is /are	I	T	S	✓ T and S
		(Rawalpindi Board, 2010)			
23)	A data having single mode is	✓ Uni-model	Bi-model	Tri-model	Multi-model
		(Rawalpindi Board, 2010)			
24)	A value obtained by dividing sum of all the values by their number is called	✓ A.M.	Median	Mode	G.M.
		(Sargodha Board, 2010)			
25)	To find out mid-point of class the formula is	✓ $\frac{\text{Upper Limit} + \text{Lower Limit}}{2}$	$\frac{\text{Upper Limit} - \text{Lower Limit}}{2}$	$\frac{\text{Upper Limit} + \text{Lower Limit}}{2}$	$\frac{\text{Upper Limit} - \text{Lower Limit}}{2}$
		(Sargodha Board, 2010)			
26)	Quartiles divide the values in equal parts	2	3	✓ 4	5
		(Sargodha Board, 2010)			

S#	Questions	Answers			
27)	Mid point of class 10 – 20 is				✓
		10	20	30	15

(Sargodha Board, 2010)

QUESTION NO. 2

Possible answers are given to each statement. Tick (✓) the correct one.

S#	Questions	Answers			
1)	The central value which represents a set of data is called measure of:	✓ Central tendency	Skewness	Dispersion	Symmetry
2)	The value obtained by dividing the sum of all the values by their numbers is called:	Median	Mode	✓ Arithmetic mean	Skewness
3)	The sum of deviations taken from mean is:	✓ Always equal to zero	Some times equal to zero	Never equal to zero	Less than zero
4)	The sum of deviations of observations is zero if deviations are taken from:	Mode	Median	✓ Arithmetic Mean	Provisional Mean
5)	For a data if $\Sigma(x-20) = 14$, $\Sigma(x-25) = 0$, $\Sigma(x-40) = 29$, then the value of A.M. is:	20	✓ 25	40	29
6)	Sum of deviations from arithmetic mean is always:	Less than zero	More than zero	✓ Equal to zero	None of these
7)	The smallest and the largest values of any given class of a frequency distribution are called:	✓ Class limits	Class marks	Class interval	Class frequency

S#	Questions	Answers			
		Class limits	Class interval	Class marks	Class frequency
8)	The difference between the upper and lower class boundaries of a class are known as:		✓		
9)	The number of observations or objects falling into a particular class is called	✓ Class frequency	Relative frequency	Cumulative frequency	None of these
10)	The average value of the lower and upper limits is called:	✓ Class mark	Class width	Class frequency	Class boundaries
11)	Class mark or class mid point is equal to:	Upper limit lower limit	Upper limit + lower limit	✓ $\frac{\text{Upper Limit} + \text{Lower Limit}}{2}$	$\frac{\text{Upper Limit} - \text{Lower Limit}}{2}$
12)	The mid point of a class ranging from 40 to 60 is:	30	40	✓ 50	60
13)	Given 8 quantities, x_1 to x_8 , the correct notation for adding quantities 3 to 6 is:	$\sum_{i=1}^4 x_i$	$\sum_{i=2}^5 x_i$	✓ $\sum_{i=3}^6 x_i$	$\sum_{i=4}^8 x_i$
14)	Given $x_1 = 10$, $x_2 = 20$, $x_3 = 25$, $x_4 = 11$ $\sum_{i=1}^4 x_i$ equal:	45	✓ 55	65	75
15)	We calculate arithmetic mean by:	Direct method	Short cut method	Step deviation	✓ All the above methods
16)	The most common value in a set of data is called:	A.M.	Median	Mode	None of these
17)	The algebraic sum of the observations of a set of data from their mean is always equal to:	Three	Two	One	✓ Zero

S#	Questions	Answers			
18)	The sum of squares of the observations from their mean is always:	✓ Minimum	Maximum	Central	Zero
19)	If the mean of 15 observations is 20, then the sum of these numbers is:	100	200	✓ 300	400
20)	The average which is used to find the middle value of data is called:	Arithmetic mean	✓ Median	Mode	None of these
21)	We must arrange the data before calculating:	Mean	✓ Median	Mode	All of these
22)	The combined mean is calculated by the formula:	$\frac{\bar{x}_1 + \bar{x}_2}{n_1 + n_2}$	$\frac{n_1 \bar{x}_1 + n_2 \bar{x}_2}{n_1 + n_2}$	✓ $\frac{n_1 \bar{x}_1 + n_2 \bar{x}_2}{n_1 + n_2}$	$\frac{n_1 + n_2}{\bar{x}_1 + \bar{x}_2}$
23)	Which of the following is not based upon all the values	A.M.	✓ Mode	Both A.M. & mode	None of these
24)	In a symmetrical distribution $Q_1 = 20$, $Med = 30$, then the value of Q_3 will be:	80	60	✓ 40	10
25)	Upper quartile = Q_3 = _____	✓ P_{75}	D_4	Median	D_7
26)	The formula of median used for discrete grouped frequency distribution is:	$L + \frac{f}{2} \left(\frac{n}{f} - c \right)$	$\left(\frac{n+1}{4} \right)^{th} \text{ value}$	$\left(\frac{n+2}{2} \right)^{th} \text{ value}$	✓ None of these
27)	The most frequent value of data is called:	Mean	Median	✓ Mode	None of these
28)	The mode of the letters in the word 'MATHEMATICS' is:	M	A	T	✓ All M, A, T

S#	Questions	Answers			
		S	T	Both S & T	A
29)	The mode of the letters in the word 'STATISTICS' is:			✓	
30)	Median is a value which divides an arranged distribution into:	Four parts	Three parts	Two parts	None of these
31)	Cumulative frequency is called:	✓			
		Increasing	Decreasing	Both increasing & Decreasing	Constant
32)	Mode will lie in a class which is said to be:	✓			
		Modal class	Middle class	Class boundaries	Class frequency
33)	If the data are arranged, median is central value:	✓			
		Always	Never	Some time	None of these
34)	Corresponds to maximum frequency:			✓	
		Median	AM	Mode	Skewness
35)	The relation between mean, median, mode i.e. Mode = 3 Median - 2 mean is called:	✓			
		Empirical	Symmetrical	Asymmetrical	All of these
36)	For positively skewed distribution Mean Median Mode:			✓	
		=	<	>	≠
37)	For negatively skewed distribution Mean Median Mode		✓		
		=	<	>	≠
38)	For a symmetrical distribution Mean Median Mode:	✓			
		=	<	>	≠

S#	Questions	Answers			
39)	In a symmetrical distribution, the relation between mean, median and mode is:	✓ Mean Median = Mode	Mean < Median < Mode	Mean > Median > Mode	Mean > Median < Mode
40)	Mean, Median and Mode are equal in	Skewed distribution	✓ Symmetrical distribution	Both skewed & symmetrical distribution	None of these
41)	For positively skewed distribution:	Mean = Median = Mode	✓ Mean > Median > Mode	Mean < Median < Mode	Mean < Med > Mode
42)	For negatively skewed distribution:	Mean = Median = Mode	Mean > Median > Mode	✓ Mean < Median < Mode	Mean < Median > Mode
43)	The arithmetic mean, median, mode are called:	✓ First order averages	Second order averages	Third order averages	Fourth order average

QUESTION NO. 3

Write the short answer to the following questions in the space provided

Q. 1: What is a statistical average?

(Lahore Board, 2009)

(Rawalpindi Board, 2010)

Ans: An average is a single value that is typical or representative for a group of numbers.

Q. 2: What are other names of average?

Ans: As an average indicates the location or general position of the distribution or an average is some where in the middle of the group, so it is also called measures of central tendency or measures of location or measures of position.

Q. 3: Why are the averages called measures of central tendency?

Ans: As the averages tend to lie in the center of the distribution they are called measures of central tendency.

Q. 4: What is "Measures of central tendency"?

(Lahore Board, 2010)

Ans: Since the averages which mostly fall in the centre of data and used to represent the whole data. So these averages are called measures of central tendency.

Q. 5: What are the objects of measures of central tendency or an average.

Ans: Objects of measures of central tendency are as follows:

- (i) To find out a value that can be represent the whole data.
- (ii) To help the comparative study.
- (iii) To provide a condensed picture of a large group.

Q. 6: What are the important types of averages?

Ans: The most commonly used averages are:

- (i) Arithmetic mean
- (ii) Geometric mean
- (iii) Harmonic mean
- (iv) Median
- (v) Mode

Q. 7: What are characteristics of a good average?

(Lahore Board, 2009 & 2010)

(Sargodha Board, 2010)

Ans: It should be:

- (i) Easy to calculate
- (ii) Easy to understand
- (iii) Rigidly defined
- (iv) Based on the values of data
- (v) Least affected by extreme values

Q. 8: What type of averages are mathematical in character?

Ans: The arithmetic mean, geometric mean and harmonic mean are mathematical in character.

Q. 9: What type of average are averages of location?

Ans: The median and mode are averages of location.

Q. 10: What does Σ denote for?

Ans: Σ is used to denote the sum of all the values of a series.

Q. 11: Define arithmetic mean.

(Lahore Board, 2009)

(Gujranwala & Sargodha Boards, 2010)

Ans: The arithmetic mean is defined as a value obtained by dividing sum of all the values by their numbers.

Q. 12: Give any three algebraic properties of A.M.

(Lahore Board, 2008; Faisalabad Board, 2009; Rawalpindi Board, 2010)

Ans:

- (i) $\Sigma(X - \bar{X}) = 0$
- (ii) $\Sigma(X - \bar{X})^2$ is minimum
- (iii) If $y_i = ax_i + b$ then $\bar{Y} = a\bar{X} + b$

Q. 13: The sum of observations from their mean ----?

Ans: The sum of observations from their mean is zero.

Q. 14: What will be the mean of 36, 36, 36, ... 36?

Ans: As we know that arithmetic mean of a constant is constant itself, so mean is 36.

Q. 15: Discuss the use of weighted mean in statistics.

Ans: When all the observations are not of equal importance, then we use weighted arithmetic mean.

Q. 16: Where arithmetic mean is preferred to measure center of the data.

Ans: Arithmetic mean is preferred when:

- (i) The distribution is approximately symmetrical.
- (ii) A measure is needed that reflects the total.
- (iii) The measure of central tendency having the greatest stability is required.

Q. 17: Write three merits (advantages) of arithmetic mean.

(Faisalabad Board, 2009)

- Ans:**
- (i) Simple to understand and easy to calculate.
 - (ii) Rigidly defined.
 - (iii) Capable of further mathematical treatments.

Q. 18: Define median.

(Lahore Board, 2008, 2009 & 2010)

(Faisalabad & Sargodha Boards, 2010)

Ans: The median is defined as the middle most value of the arranged data.

Q. 19: Give the merits of the median.

(Lahore Board, 2008 & 2009)

(Sargodha Board, 2010)

Ans: Median is:

- (i) Simple to understand and easy to calculate
- (ii) Not affected by extreme observations
- (iii) Possible to locate graphically

Q. 20: What are the demerits of the median?

(Lahore Board, 2008)

(Faisalabad Board, 2009)

(Gujranwala Board, 2010)

Ans: Median is:

- (i) Not rigidly defined
- (ii) Not based on all values
- (iii) Not capable of further mathematical treatment

Q. 21: Is sum of absolute deviations of the observations from mean is minimum.

Ans: No, the sum of absolute deviations taken from median is minimum.

Q. 22: What do you mean by quartiles?

Ans: Quartiles are the values, which divide the arranged data into four equal parts.

Q. 23: Define deciles and percentiles?

Ans: Deciles and percentiles are the values, which divide the arranged data into ten and hundred equal parts.

Q. 24: Define mode with example.

(Lahore Board, 2008 & 2010)

(Faisalabad Board 2008, 2009 & 2010)

(Rawalpindi Board, 2010)

Ans: The most repeated or most common or most frequent value in the set of data is called mode. For example: 20, 10, 18, 10, 18, 7, 10, 30, 15
Here most repeated value is 10, so mode = 10

Q. 25: Which measure of location can measure more than one value for a data.

Ans: The only measure of location that can assume more than one value for a data is mode.

Q. 26: What is the mode of the following data?

10, 20, 30, 40, 50, 60, 70, 80, 90

Ans: No mode, as there is no repeated value.

Q. 27: Define bi-modal distribution.

(Lahore Board, 2009)

Ans: A distribution having two modes is defined bi-modal distribution.

Q. 28: Discuss the relationship between mean, median and mode.

Ans: For a skewed distribution:

$$\text{Mode} = 3 \text{ Med} - 2 \text{ Mean}$$

Which is called empirical relation.

For a symmetrical distribution, the mean, median and mode are equal
i.e.

$$\text{Mean} = \text{Median} = \text{Mode}$$

Q. 29: Give the two merits of the mode.

- Ans: (i) Mode is simple to understand and easy to calculate
(ii) It is not affected by extreme values.

Q. 30: Give three merits of the mode.

- Ans: (i) Mode is not rigidly defined.
(ii) It is not based on all the values.
(iii) It is not capable of further mathematical treatment.

Q. 31: What is mode of this data?

10, 20, 30, 10, 40, 50, 10, 60

(Faisalabad Board, 2009)

Ans: Here most common or most repeated number is 10, so mode = 10

Q. 32: Write down the formula to compute mode for grouped data.

(Faisalabad Board, 2010)

Ans: The formula to compute mode for group data is

$$\text{Mode} = L + \frac{f_m - f_{m-1}}{(f_m - f_{m-1}) + (f_m - f_{m+1})} \times h$$

Where f_m = Maximum frequency

f_1 = Preceding value of frequency to f_m

f_2 = Next value of frequency to f_m

L = Lower limit of mode – group

h = Interval size

Q. 33: What is meant by uni-modal distribution?

(Faisalabad & Sargodha Boards, 2010)

Ans: A distribution, having single value of mode is called uni-modal distribution.

For example, 55, 58, 57, 58, 60, 50, 53, 58
is a uni-modal distribution have mode = 58 only.

Q. 34: What do you understand by “Change of Origin”?

(Lahore Board, 2008)

Ans: The addition or subtraction of any constant value from each value of a variable is called change of origin.

Q. 35: What is modal class?

(Lahore Board, 2010)

Ans: The class in which maximum frequency lies, is called modal class.

Q. 36: State the formula of arithmetic mean (grouped data / ungrouped data).

(Lahore Board, 2010)

Ans: Ungrouped Data

$$i) \quad A.M = \frac{\sum X}{n} \quad \text{Direct Method}$$

$$ii) \quad A.M = P.M + \frac{\sum D}{n} \quad \text{Indirect or Short cut Method}$$

Grouped Data

$$i) \quad A.M = \frac{\sum fX}{\sum f} \quad \text{Direct Method}$$

$$ii) \quad A.M = P.M + \frac{\sum fD}{\sum f} \quad \text{Indirect or Short cut Method}$$

$$iii) \quad A.M = P.M + \frac{\sum fu}{\sum f} \times h \quad \text{Coding Method}$$

Q. 37: In a symmetrical distribution arithmetic mean is 10. Find the value of median and mode.

(Gujranwala Board, 2010)

Ans: In a symmetrical distribution mean, med and mode are equal.
So, if mean = 10, then med = 10 and mode = 10

Q. 38: Find median 5, 10, 12, 13, 15, 7, 9

(Lahore Board, 2010)

Ans: For median, arrange the values in ascending and descending order,
5, 7, 9, 10, 12, 13, 15

Here $n = 7$ (odd number), so

$$\begin{aligned}\text{Med} &= \text{The value of } \left(\frac{n+1}{2}\right)\text{th item} \Rightarrow \text{The value of } \left(\frac{7+1}{2}\right)\text{th item} \\ &= \text{The value of } \left(\frac{8}{2}\right)\text{th item} = \text{The value of 4th item} = 10\end{aligned}$$

Hence med = 10

Q. 39: Find out arithmetic mean given $\Sigma X = 308$, $n = 7$
(Lahore Board, 2008)

Ans: Here $\Sigma X = 308$, $n = 7$

$$A.M = \frac{\Sigma X}{n} = \frac{308}{7} = 44$$

Q. 40: For a certain frequency, the value of mean is 15, median is 20.
What will be the value of mode?

(Lahore Board, 2008)

Ans: Here Mean = 15, Median = 20

We know that

$$\text{Mode} = 3\text{med} - 2\text{mean} \Rightarrow 3(20) - 2(15) = 60 - 30 = 30$$

Q. 41: What position exit when mean = med = mode?

(Faisalabad Board, 2008)

Ans: A distribution is said to be symmetrical if mean, mode are equal.

Q. 42: Find A.M given that $X = 10 + 5u$, $\Sigma fu = 46$, and $n = 125$

(Lahore Board, 2008)

Ans: Here $X = 10 + 5u$, $\Sigma fu = 46$, $n = \Sigma f = 125$

We know that

$$\bar{X} = P.M + \frac{\Sigma fu}{\Sigma f} \times h \Rightarrow u = \frac{X - P.M.}{h}$$

We have $X = 10 + 5u$

$$5u = X - 10$$

$$u = \frac{x - 10}{5} = \frac{X - P.M.}{h}$$

Hence P.M. = 10, $h = 5$

Now

$$\bar{X} = 10 + \frac{46}{125} \times 5 = 10 + \frac{46}{h25} = 10 + 1.84 = 11.84$$