BUSINESS STATISTICS & ANALYTICS

PART - A

IAT - 1

QP answers

1.(a)

ROLL. NO.	MARKS (x)	A = 65 D = x − A	C = 10 d = (x − A)/C
1	65	0	0
2	80	15	1.5
3	100	35	3.5
4	102	37	3.7
5	108	43	4.3
6	110	45	4.5
7	112	47	4.7
8	113	48	4.8
9	115	50	5.0
10	124	59	5.9
11	128	63	6.3
12	143	78	7.8
13	180	115	11.5
14	160	95	9.5
15	151	86	8.6
N = 15	Σx = 1791	Σd = 816	Σd = 81.6

I. Direct Method

$$\bar{X} = \frac{\Sigma X}{N} = \frac{1791}{15} = 119.4//$$

II Short-cut Method

$$\bar{X} = A + \frac{\Sigma d}{N}$$

$$= 65 + \frac{816}{15}$$

$$= 65 + 54.4$$

$$= 119.4//$$

III Step-deviation Method

$$\bar{X} = A + \frac{\Sigma d}{N} \times C$$

$$= 65 + \frac{81.6}{15} \times 10$$

$$= 65 + 54.4$$

$$= 119.4//$$

1(b)

N_1 = Professors → 25 $\quad X_1 = 12000$

N_2 = Readers → 75 $\quad X_2 = 6000$

N_3 = Lecturers → 200 $\quad X_3 = 3000$

combined avg / mean

$$\bar{X}_{123} = \frac{N_1X_1 + N_2X_2 + N_3X_3}{N_1 + N_2 + N_3}$$

$$= \frac{25 \times 12000 + 75 \times 6000 + 200 \times 3000}{25 + 75 + 200}$$

$$= \frac{300000 + 450000 + 600000}{300}$$

$$= \frac{1350,000}{300}$$

$$= ₹4500.$$

after 5 years

N_3 = Lecturers = Readers = 0

N_2 = Readers = Professors = 200.

N_1 = Professors = 100 (25 + 75)

$\therefore N_1 = 100$

$N_2 = 200.$

$\therefore$ combined mean (future) = $\bar{X}_{12} = \frac{N_1X_1 + N_2X_2}{N_1 + N_2.}$

$$= \frac{100 \times 12000 + 200 \times 6000}{100 + 200}$$

$$= \frac{1200{,}000 + 1200{,}000}{300}$$

$= ₹\ 8000$ //.

∴ Excess salary = 8000 − 4500

$= ₹\ 3500$ //

1.(c)

C.I	Frequency (f)	Exclusive C.I	C.F.
11-12	5	10.5 − 12.5	5
13-14	426	12.5 − 14.5	431
15-16	Q_1 720	14.5 − 16.5	1151
17-18	Q_2 741	16.5 − 18.5	1892
19-20	Q_3 665	18.5 − 20.5	2557
21-22	395	20.5 − 22.5	2952
23-24	38	22.5 − 24.5	2990
25-26	8	24.5 − 26.5	2998
27-28	5	26.5 − 28.5	3003
29-30	7	28.5 − 30.5	3010
	$\Sigma f = 3010$		

$M = N/2 = \frac{3010}{2} = 1505$ ∴ Median class = 16.5 − 18.5 //

$$M = Lt\left(\frac{N/2 - cf}{f}\right) \times c$$

$= 16.5 + \left(\frac{1505 - 1151}{741}\right) \times 2$

$= 16.5 + \frac{354}{741} \times 2$

$= 16.5 + 0.955$

$= 17.455$ //.

$Q = \frac{n}{4}$ $\quad c = 2$

$= \frac{3010}{4} = 752.5^{th}$ value.

∴ Quartile class = 14.5 - 16.5.

$\therefore Q_1 = L + \frac{c}{f}\left(\frac{n}{4} - cf\right)$

$= 14.5 + \frac{2}{720}\left(752.5 - 431\right)$

$= 14.5 + \frac{2}{720} \times 321.5$

$= 14 + \frac{643}{720}$

$= 14 + 0.893$

$= 14.893$ //

$Q_2 = 2 \times 752.5$

$= 1505$ = Q. class = 16.5 - 18.5.

$Q_2 = L + \frac{c}{f}\left(n/4 - cf\right)$

$= 16.5 + \frac{2}{741}\left(1505 - 1151\right)$

$= 16.5 + \frac{2}{741} \times 341$

$= 16.5 + 0.955$

$= 17.455$ //.

$Q_3 = 752.5 \times 3$

$= 2257.5$

Q. class = 18.5 – 20.5

$\therefore Q_3 = L + \frac{c}{f}\left(\frac{n}{4} - cf\right)$

$= 18.5 + \frac{2}{665}(2257.5 - 1892)$

$= 18.5 + \frac{2}{665} \times 365.5$

$= 18.5 + \frac{731}{665}$

$= 18.5 + 1.099$

$= 19.099$ //.

$\therefore Q_1 = 14.893$

$Q_2 = 17.455$

$Q_3 = 19.099$ //.

2. (a) From the following data, find the frequencies of the various values of the variable.

Roll no	1	2	3	4	5	6	7	8	9	10
Marks	15	25	30	15	40	30	15	10	45	30
Roll no	11	12	13	14	15	16	17	18	19	20
Marks	40	20	15	25	35	20	25	40	35	45
Roll no	21	22	23	24	25	26	27	28	29	30
Marks	25	35	20	15	30	10	40	45	15	10

Sol.

Marks (x)	Tally bar	Frequency (f)
10-20	𝍸 𝍸 ||||	9
20-30	𝍸 ||	7
30-40	𝍸 ||	7
40-50	𝍸 ||	7

(b) Calculate the Standard Deviation, and its Co-efficient from the following set of data all the Possible method.

X:	12	10	19	8	11	5	15	23	9	8

Sol

X	X^2	D (X-A)	D^2
12	144	7	49
10	100	5	25
19	361	14	196
8	64	3	9
11	121	6	36
5	25	0	0
15	225	10	100
23	529	18	324
9	81	4	16
8	64	3	9
$\Sigma x = 120$	Σx^2 1714	Σd 70	Σd^2 764

here $N = 10$, $A = 5$.
$C = 1$

ⓐ. Direct method

$$\sigma = \sqrt{\frac{\Sigma x^2}{N} - \left(\frac{\Sigma x}{N}\right)^2}$$

$$\sigma = \sqrt{\frac{1714}{10} - \left(\frac{120}{10}\right)^2}$$

$$= \sqrt{171.4 - 144}$$

$$\sqrt{27.4}$$

$$= 5.23.$$

ⓑ. Short Cut method

$$\sigma = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2}$$

$$\sqrt{\frac{764}{10} - \left(\frac{70}{10}\right)^2}$$

$$\sqrt{76.4 - 49}$$

$$\sqrt{27.4}$$

$$= 5.23.$$

Step deviation Method

here $C = 1$

$$\therefore \delta = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2} \times C$$

$$= \sqrt{\frac{764}{10} - \left(\frac{70}{10}\right)^2} \times 1$$

$$= \sqrt{76.4 - 49} \times 1$$

$$= \sqrt{27.4} \times 1$$

$$= 5.23 .$$

(Mean) $\bar{X} = \frac{\Sigma X}{N} = \frac{120}{10} = 12$.

Co.efficient of $\sigma' = \frac{\delta}{\bar{X}} = \frac{5.234}{12} = 0.44$.

(c) Find the missing frequencies of the following Series, if the arithmetic average is 39.5 & the total number of items is 100.

Sol

Marks	(f)	M	fM
0-10	5	5	25
10-20	10	15	150
20-30	?(a)	25	25a
30-40	4	35	140
40-50	20	45	900
50-60	3	55	165
60-70	?(b)	65	65b

here $\Sigma f = 100$, $\Sigma fm = 1380 + 25a + 65b$.

$42 + a + b = 100$.

$a + b = 100 - 42$

$a + b = 58$ ——— ①.

$\bar{x} = \frac{\Sigma fM}{\Sigma f} = 39.5 = \frac{1380 + 25a + 65b}{100}$.

$39.5 \times 100 = 1380 + 25a + 65b$

$3950 - 1380 = 25a + 65b$

$25a + 65b = 2570$ — ②.

Multiply Equation ① × 25

Equation ② × 1

$25a + 25b = 1450$

$(-)\ 25b \pm 65b = 2570$

$+40b = +1120$.

$b = \frac{1120}{40}$ $\boxed{b = 28}$.

Putting $b = 28$ in Equation ①.

$a + b = 58$.

$a + 28 = 58$.

$\boxed{a = 30}$

3)

(a)

Total distance covered = 200 miles.

60 miles	–	40mph
40 miles	–	30mph
50 miles	-	60mph
45 miles	–	50mph
10 mins	-	30mph

$S = d/t$

$$= \frac{60 + 40 + 50 + 45 + 5}{60 \times \frac{1}{40} + 40 \times \frac{1}{30} + 50 \times \frac{1}{60} + 45 \times \frac{1}{50} + 5 \times \frac{1}{30}}$$

$$= \frac{200}{1.5 + 1.33 + 0.83 + 0.9 + 0.16}$$

$$= \frac{200}{4.72}$$

$$= 42.37$$

The Average speed in miles per hour of a scooter is 42.37.

(b)

$n_1 = 70$

$n_2 = 100$

$\bar{x}_1 = 75$ $\quad \bar{x}_2 = ?$

$\bar{x} = 72$

$n_1 + n_2 = 100$

$n_2 = 100 - 70 = 30$

$$\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

$$= \frac{(70 \times 75) + (30\bar{x}_2)}{100}$$

$$= 72 \times 100 = 5250 + 30\bar{x}_2$$

$$\bar{x} = \frac{7200 - 5250}{30}$$

$$= \frac{1950}{30}$$

$$= 65.$$

The mean marks of girls in the class is 65.

(c)

Marks	No of students	
5-10	5	
10-15	6	f_0
15-20	15	f_1
20-25	10	f_2
25-30	5	
30-35	4	
35-40	2	
40-45	2	

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

$$= 15 + \frac{15 - 6}{15 - 6 + 15 - 10} \times 5$$

$$= 15 + \frac{9}{9 + 5} \times 5$$

$$= 15 + \frac{9}{14} \times 5$$

$$= \underline{\underline{18.21}}$$

A(a)

Midvalue ↗ $A = 5$ $C = 10$

C.I	cf	f	x	Fx	x^2	Fx^2	$d = x - A$	d^2	Fd	Fd^2	$d = \frac{x-A}{C}$	d^2	fd	fd^2
0 - 10	100	30	5	150	25	750	0	0	0	0	0	0	0	0
10 - 20	80	35	15	525	225	7875	10	100	350	3500	1	1	35	35
20 - 30	45	5	25	125	625	3125	20	400	100	2000	2	4	20	20
30 - 40	40	10	35	350	1225	12250	30	900	300	9000	3	9	30	90
40 - 50	30	5	45	225	2025	10125	40	1600	200	8000	4	16	20	80
50 - 60	25	25	55	55	3025	75625	50	2500	1250	62500	5	25	125	625
		$\Sigma N = 110$	$\Sigma x = 180$	$\Sigma Fx = 2750$		$\Sigma Fx^2 = 109750$			$\Sigma Fd = 2200$	$\Sigma Fd^2 = 85000$			$\Sigma fd = 220$	$\Sigma fd^2 = 850$

Direct Method

$$\sigma = \sqrt{\frac{\Sigma fx^2}{N} - \left(\frac{\Sigma fx}{N}\right)^2}$$

$$= \sqrt{\frac{109750}{110} - \left(\frac{2750}{110}\right)^2}$$

$$= \sqrt{998 - 625}$$

$$= \sqrt{373}$$

$$= 19.3 //$$

$$\bar{X} = \frac{\Sigma X}{N}$$

$$= \frac{180}{110}$$

$$= 1.63.$$

Step - deviation Method

$$\sigma = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2}$$

$$= \sqrt{\frac{85000}{110} - \left(\frac{2200}{110}\right)^2}$$

$$= \sqrt{772.72 - 400}$$

$$= \sqrt{372.72}$$

$$= 19.3 //.$$

Step - deviation Method

$$\sigma = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2} \times C$$

$$= \sqrt{\frac{850}{110} - \left(\frac{220}{110}\right)^2} \times 10$$

$$= \sqrt{7.727 - 4} \times 10$$

$$= \sqrt{3.72} \times 10$$

$$= 1.93 \times 10$$

$$= 19.3 //$$

$$\text{Co. eff } \sigma = \frac{\sigma}{\bar{X}}$$

$$= \frac{19.3}{1.63}$$

$$= 11.84 //.$$