

X1-BM-Public Question Paper-2022-Key

X1-Business Mathematics and Statistics

May-2022- Answer Keys - (Reduced syllabus)

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PART-I.

①. (d) (0,1)

②. (d) 18

③. (a) 5

④. (d) n^r

⑤. (a) $\frac{1}{3}$

⑥. (b) 3

⑦. (d) $22^\circ 30'$

⑧. (b) $\frac{5\pi}{24}$

⑨. (b) 2

⑩. (b) $f(x) = x^3 + 5$

⑪. (a) $-x^2$

⑫. (b) $|\eta_d| > 1$

⑬. (b) $\eta_d = \frac{AR}{AR - MR}$

⑭. (a) ₹. 91

⑮. (b) 11.25

⑯. (b) $\frac{1}{36}$

⑰. (c) Independent

⑱. (b) Negative

⑲. (b) Income and expenditure

⑳. (b) $E_j - E_i = L_j - L_i = t_{ij}$

PART- II

$$\textcircled{21} \quad |A| = \begin{vmatrix} 2 & -4 \\ -3 & 2 \end{vmatrix} = 16 \neq 0 \quad \therefore A^{-1} \text{ exist.}$$

$$\text{adj } A = \begin{pmatrix} 2 & -4 \\ 3 & 2 \end{pmatrix}$$

$$\therefore A^{-1} = \frac{1}{|A|} (\text{adj } A) = \frac{1}{16} \begin{pmatrix} 2 & -4 \\ 3 & 2 \end{pmatrix}$$

$\textcircled{22}$ "LAGARITHMS" having 10 letters.

$$\therefore n = 10$$

We have to find 4 letter words $\therefore r = 4$

$$\begin{aligned} \therefore \text{Required no. of 4 letter words} &= n P_r \\ &= {}^{10}P_4 \\ &= 10 \times 9 \times 8 \times 7 \\ &= 5040 \end{aligned}$$

$\textcircled{23}$ Let $p(x_1, y_1)$ be any point on the locus.

A be the foot of $\perp^r$ from $p(x_1, y_1)$ to y-axis

$$\text{Given: } OP = 3 AP$$

$$\Rightarrow OP^2 = 9 AP^2$$

$$\Rightarrow (x_1 - 0)^2 + (y_1 - 0)^2 = 9x_1^2$$

$$x_1^2 + y_1^2 = 9x_1^2$$

$$8x_1^2 - y_1^2 = 0$$

$\therefore$ The locus of p is $8x^2 - y^2 = 0$

(24)

$$\cot(A+B) = \frac{1 - \tan A \tan B}{\tan A + \tan B}$$

$$\cot 75^\circ = \cot(45^\circ + 30^\circ) = \frac{1 - \tan 45^\circ \tan 30^\circ}{\tan 45^\circ + \tan 30^\circ}$$

$$= \frac{1 - 1 \cdot \frac{1}{\sqrt{3}}}{1 + \frac{1}{\sqrt{3}}} = \frac{1 - \frac{1}{\sqrt{3}}}{1 + \frac{1}{\sqrt{3}}}$$

$$= \frac{(\sqrt{3}-1)/\sqrt{3}}{(\sqrt{3}+1)/\sqrt{3}} = \frac{\sqrt{3}-1}{\sqrt{3}+1}$$

$$\therefore \cot 75^\circ = \frac{\sqrt{3}-1}{\sqrt{3}+1}$$

$$(25) \quad y = x^3 + 19 \quad \therefore \frac{dy}{dx} = 3x^2 \rightarrow (1)$$

$$\text{Given that, } \frac{dy}{dx} = 27 \rightarrow (2)$$

$$\text{From (1) and (2), } 3x^2 = 27$$

$$x^2 = 9$$

$$x = \pm 3$$

$$(26) \quad \text{M.V of 1 Share} = \text{Rs. } 132$$

$$\therefore \text{M.V of 62 Shares} = 62 \times 132$$

$$= \text{Rs. } 8184.$$

(27) Given: $P(A) = \frac{3}{5}$ and $P(B) = \frac{1}{5}$

$$\therefore P(A \cap B) = \frac{3}{5} \times \frac{1}{5} = \frac{3}{25}$$

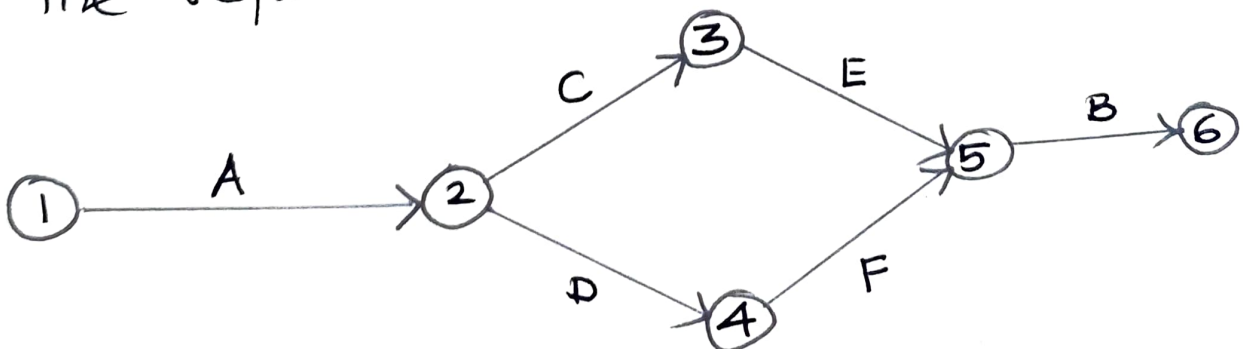
(28) Given: $\sum x = 50$, $\sum y = -30$, $\sum x^2 = 290$
 $\sum y^2 = 300$, $\sum xy = -115$, $N = 10$

Co-efficient of correlation is

$$\begin{aligned} r(x,y) &= \frac{N \sum xy - (\sum x)(\sum y)}{\sqrt{N \sum x^2 - (\sum x)^2} \sqrt{N \sum y^2 - (\sum y)^2}} \\ &= \frac{10(-115) - (50)(-30)}{\sqrt{10(290) - (50)^2} \sqrt{10(300) - (-30)^2}} \\ &= \frac{-1150 + 1500}{20 \times \sqrt{2100}} \\ &= \frac{350}{20 \times 45.83} = \frac{350}{916.6} \end{aligned}$$

$$r = 0.382$$

(29) The required network is



$$(30) \quad x = \frac{1}{t} \quad \text{and} \quad y = \cos t$$

$$\therefore \frac{dx}{dt} = -\frac{1}{t^2}$$

$$\therefore \frac{dy}{dt} = -\sin t$$

$$\therefore \frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{-\sin t}{-1/t^2} = t^2 \cdot \sin t.$$

PART-III

(31)

$$AB = \begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix} \begin{pmatrix} -\frac{4}{35} & \frac{11}{35} & -\frac{5}{35} \\ -\frac{1}{35} & -\frac{6}{35} & \frac{25}{35} \\ \frac{6}{35} & \frac{1}{35} & -\frac{10}{35} \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix} \frac{1}{35} \begin{pmatrix} -4 & 11 & -5 \\ -1 & -6 & 25 \\ 6 & 1 & -10 \end{pmatrix}$$

$$= \frac{1}{35} \begin{pmatrix} 35 & 0 & 0 \\ 0 & 35 & 0 \\ 0 & 0 & 35 \end{pmatrix}$$

$$AB = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} = I$$

$$\therefore BA = \begin{pmatrix} -\frac{4}{35} & \frac{11}{35} & -\frac{5}{35} \\ -\frac{1}{35} & -\frac{6}{35} & \frac{25}{35} \\ \frac{6}{35} & \frac{1}{35} & -\frac{10}{35} \end{pmatrix} \begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix}$$

$$= \frac{1}{35} \begin{pmatrix} -4 & 11 & -5 \\ -1 & -6 & 25 \\ 6 & 1 & -10 \end{pmatrix} \begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix}$$

$$BA = \frac{1}{35} \begin{pmatrix} 35 & 0 & 0 \\ 0 & 35 & 0 \\ 0 & 0 & 35 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} = I$$

Then, $AB = BA = I$

$\therefore A$ and B are inverse of each other.

(33) Since, A, B, C are in A.P, $B = \frac{A+C}{2} \rightarrow \textcircled{1}$

$$\begin{aligned} \text{RHS: } \frac{\sin A - \sin C}{\cos C - \cos A} &= \frac{\cancel{2\sin\left(\frac{A-C}{2}\right)} \cos\left(\frac{A+C}{2}\right)}{\cancel{2\sin\left(\frac{A+C}{2}\right)} \sin\left(\frac{A-C}{2}\right)} \\ &= \frac{\cos\left(\frac{A+C}{2}\right)}{\sin\left(\frac{A+C}{2}\right)} = \cot\left(\frac{A+C}{2}\right) \\ &\quad , \text{ using } \textcircled{1} \\ &= \cot B \\ &= \text{R.H.S.} \end{aligned}$$

(32) Required no. of words = ${}^7C_3 \times {}^4C_2 \times 5!$

$$= \frac{7 \times 6 \times 5}{3 \times 2 \times 1} \times \frac{4 \times 3}{2 \times 1} \times 5!$$

$$= 35 \times 6 \times 120$$

$$= 25200$$

$$(34) \text{ Let } y = \frac{1-3x}{1+3x}$$

$$\frac{dy}{dx} = \frac{(1+3x)(-3) - (1-3x)(3)}{(1+3x)^2}$$

$$\frac{dy}{dx} = \frac{-6}{(1+3x)^2}$$

$$(35) \quad y = x^3 + 10x^2 - 48x + 8 \quad \text{and} \quad \frac{dy}{dx} = 2x \rightarrow (1)$$

$$\therefore \frac{dy}{dx} = 3x^2 + 20x - 48 \rightarrow (2)$$

$$\text{From (1) \& (2), } 3x^2 + 20x - 48 = 2x$$

$$3x^2 + 18x - 48 = 0$$

$$x^2 + 6x - 16 = 0$$

$$(x+8)(x-2) = 0$$

$$x = -8, \text{ and } x = 2$$

$$\begin{array}{r} -16 \\ \sqrt{6} \\ 8 \quad -2 \end{array}$$

$$(36) \quad F.V = ₹.100$$

$$\therefore M.V = 100 - 17 + 1 = ₹.84$$

$$\therefore \text{Percentage of his Income} = \frac{12 \times 100}{84}$$

$$= \frac{100}{7}$$

$$= 14 \frac{2}{7} \%$$

(37) Mean = $\frac{\sum x}{n}$
 $= \frac{22000}{5}$
 $= 4400$

Inc (x)	$ D = x - 4400 $
4000	400
4200	200
4400	0
4600	200
4800	400
$\sum x$ 22000	$\sum D = 1200$

Median Deviation about Mean M.D = $\frac{\sum |D|}{n}$
 $= \frac{1200}{5}$
 $= 240$

Co-eff of MD = $\frac{240}{4400} = 0.055$

(38)

R_A	R_B	$d = R_A - R_B$	d^2
1	6	-5	25
2	7	-5	25
3	5	-2	4
4	10	-6	36
5	3	2	4
6	9	-3	9
7	4	3	9
8	1	7	49
9	8	1	1
10	2	8	64
			$\sum d^2 = 226$

Rank correlation

$$r = 1 - \frac{6 \sum d^2}{N(N^2 - 1)}$$

$$= 1 - \frac{6(226)}{10(10^2 - 1)}$$

$$= 1 - \frac{1356}{990}$$

$$r = -0.37$$

$$(39) B = \begin{bmatrix} 0.6 & 0.9 \\ 0.2 & 0.8 \end{bmatrix}$$

$$\therefore I - B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 0.6 & 0.9 \\ 0.2 & 0.8 \end{bmatrix} = \begin{bmatrix} 0.4 & -0.9 \\ -0.2 & 0.2 \end{bmatrix}$$

$$|I - B| = \begin{vmatrix} 0.4 & -0.9 \\ -0.2 & 0.2 \end{vmatrix} = 0.08 - 0.18 = -0.1 < 0$$

Since, $|I - B|$ is negative. Hawkins - Simon condition are not satisfied.

$\therefore$ The given system is not viable.

$$(40) 6x^2 + 6y^2 + 4x - 8y - 16 = 0$$

$$6 \div, x^2 + y^2 + \frac{4}{6}x - \frac{8}{6}y - \frac{16}{6} = 0$$

$$x^2 + y^2 + \frac{2}{3}x - \frac{4}{3}y - \frac{8}{3} = 0$$

$$\Rightarrow x^2 + y^2 + 2gx + 2fy + c = 0$$

$$\begin{array}{l} 2g = \frac{2}{3} \quad \left| \quad 2f = -\frac{4}{3} \quad \right| \quad c = -\frac{8}{3} \\ g = \frac{1}{3} \quad \left| \quad f = -\frac{2}{3} \quad \right| \end{array}$$

$$\text{Centre} = (-g, -f) = \left(-\frac{1}{3}, \frac{2}{3}\right)$$

$$\text{Radius} = \sqrt{g^2 + f^2 - c} = \sqrt{\frac{1}{9} + \frac{4}{9} + \frac{8}{3}}$$

$$= \sqrt{\frac{1+4+24}{9}} = \frac{\sqrt{29}}{3}$$

$$r = \frac{\sqrt{29}}{3} \text{ units}$$

PART- IV (41) (b).

(41) (a)

$$|A| = \begin{vmatrix} 1 & 2 \\ 1 & 1 \end{vmatrix} = 1 - 2 = -1 \neq 0$$

$$\text{adj } A = \begin{pmatrix} 1 & -2 \\ -1 & 1 \end{pmatrix}$$

$$A^{-1} = \frac{1}{-1} \begin{pmatrix} 1 & -2 \\ -1 & 1 \end{pmatrix} = \begin{pmatrix} -1 & 2 \\ 1 & -1 \end{pmatrix}$$

$$|B| = \begin{vmatrix} 0 & -1 \\ 1 & 2 \end{vmatrix} = 0 + 1 = 1 \neq 0$$

$$\text{adj } B = \begin{pmatrix} 2 & 1 \\ -1 & 0 \end{pmatrix}$$

$$B^{-1} = \frac{1}{1} \begin{pmatrix} 2 & 1 \\ -1 & 0 \end{pmatrix} = \begin{pmatrix} 2 & 1 \\ -1 & 0 \end{pmatrix}$$

$$\therefore B^{-1} A^{-1} = \begin{pmatrix} 2 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} -1 & 2 \\ 1 & -1 \end{pmatrix}$$

$$B^{-1} A^{-1} = \begin{pmatrix} -1 & 3 \\ 1 & -2 \end{pmatrix} \rightarrow \textcircled{1}$$

$$AB = \begin{pmatrix} 1 & 2 \\ 1 & 1 \end{pmatrix} \begin{pmatrix} 0 & -1 \\ 1 & 2 \end{pmatrix}$$

$$AB = \begin{pmatrix} 2 & 3 \\ 1 & 1 \end{pmatrix}$$

$$|AB| = \begin{vmatrix} 2 & 3 \\ 1 & 1 \end{vmatrix} = -1 \neq 0$$

$$\text{adj } (AB) = \begin{pmatrix} 1 & -3 \\ -1 & 2 \end{pmatrix}$$

$$(AB)^{-1} = \frac{1}{-1} \begin{pmatrix} 1 & -3 \\ -1 & 2 \end{pmatrix}$$

$$(AB)^{-1} = \begin{pmatrix} -1 & 3 \\ 1 & -2 \end{pmatrix} \rightarrow \textcircled{2}$$

from ① & ②, $(AB)^{-1} = B^{-1} A^{-1}$.

LHS:

$$\frac{\sin(180+A) \cos(90-A) \tan(270-A)}{\sec(540-A) \cos(360+A) \csc(270+A)}$$

$$= \frac{(-\sin A) (\sin A) (\cot A)}{(-\sec A) (\cos A) (-\sec A)}$$

$$= - \frac{\sin A \cos A}{\sec A}$$

$$= -\sin A \cdot \cos A \cdot \cos A$$

$$= -\sin A \cos^2 A$$

$$= \text{RHS.}$$

$$\therefore \text{LHS} = \text{RHS.}$$

(42) (a)

	(4) Bowlers	(2) Wicket Keeper	(10) Other Players	Number of ways
(i)	3	1	7	$4C_3 \times 2C_1 \times 10C_7$ $= 4C_1 \times 2C_1 \times 10C_3$ $= 960 \text{ ways}$
(ii)	3	2	6	$4C_3 \times 2C_2 \times 10C_6$ $= 840 \text{ ways}$
(iii)	4	1	6	$4C_4 \times 2C_1 \times 10C_6$ $= 420 \text{ ways}$
(iv)	4	2	5	$4C_4 \times 2C_2 \times 10C_5$ $= 252 \text{ ways}$

By addition principle of counting,

$$\text{Total No. of ways} = 960 + 840 + 420 + 252 = 2472$$

(42) (b) E_1 : X speaks truth E_2 : X tells a lie E : X reports a six.

$$\therefore P(E_1) = \frac{4}{5}; P(E_2) = \frac{1}{5}; P\left(\frac{E}{E_1}\right) = \frac{1}{6}; P\left(\frac{E}{E_2}\right) = \frac{5}{6}$$

By Bayes theorem,

$$\begin{aligned}
 P\left(\frac{E_1}{E}\right) &= \frac{P(E_1) \cdot P\left(\frac{E}{E_1}\right)}{P(E_1) \cdot P\left(\frac{E}{E_1}\right) + P(E_2) \cdot P\left(\frac{E}{E_2}\right)} \\
 &= \frac{\frac{4}{5} \times \frac{1}{6}}{\left(\frac{4}{5} \times \frac{1}{6}\right) + \left(\frac{1}{5} \times \frac{5}{6}\right)} = \frac{4}{9}
 \end{aligned}$$

(43) (a)

Let $P(x_1, y_1)$ be any point on the locus and
 $A(2, 1)$, $B(1, 2)$ are the fixed points.

Given: $PA : PB = 2 : 1$

$$PA = 2PB$$

$$PA^2 = 4PB^2$$

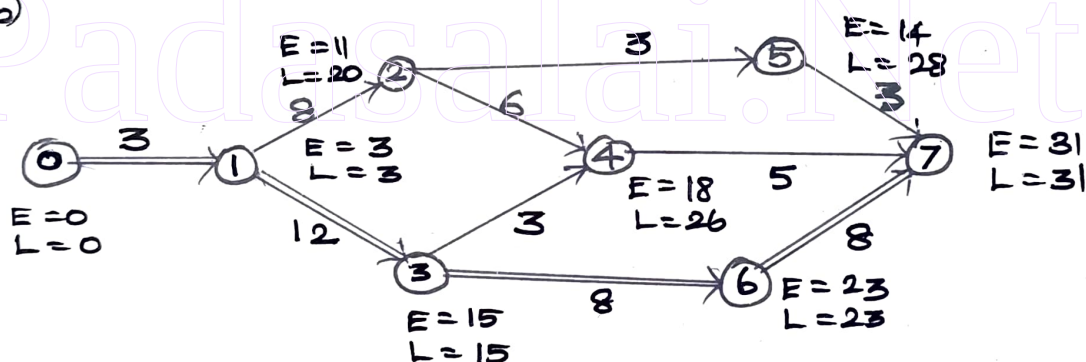
$$(x_1 - 2)^2 + (y_1 - 1)^2 = 4[(x_1 - 1)^2 + (y_1 - 2)^2]$$

$$x_1^2 + 4 - 4x_1 + y_1^2 - 2y_1 + 1 = 4x_1^2 + 4y_1^2 - 8x_1 - 16y_1 + 20$$

$$\Rightarrow 3x_1^2 + 3y_1^2 - 4x_1 - 14y_1 + 15 = 0$$

$\therefore$ Locus of (x_1, y_1) is $3x^2 + 3y^2 - 4x - 14y + 15 = 0$

(43) (b)



Activity	Duration	EST	EFT	LST	LFT
0-1	3	0	3	3	3
1-2	8	3	11	12	20
1-3	12	3	15	3	15
2-4	6	11	17	3	26
2-5	3	11	14	20	26
3-4	3	15	18	25	28
3-6	8	15	23	23	26
4-7	5	18	23	15	23
5-7	3	14	17	28	31
6-7	8	23	31	23	31

The Critical path is 0-1-3-6-7

The Project Completion time is 31 weeks.

④④ (a)

$$y = a \cos mx + b \sin mx$$

$$y_1 = a(-\sin mx)m + b(\cos mx)m$$

$$y_2 = am(-\cos mx)m + bm(-\sin mx)m$$

$$= -am^2 \cos mx - bm^2 \sin mx$$

$$= -m^2 [a \cos mx + b \sin mx]$$

$$y_2 = -m^2 y$$

$$y_2 + m^2 y = 0$$

④④ (b)

Let $p(n): n^2 + n$ is an even number"

Put $n=1$,

$$\therefore 1^2 + 1 = 2, \text{ (even)}$$

Let us assume that $p(k)$ is true

$p(k): k^2 + k$ is even number is true.

$$\therefore \text{Take } k^2 + k = 2m \rightarrow \textcircled{1}$$

TO prove $p(k+1)$ is true

$$\therefore (k+1)^2 + (k+1)$$

$$= k^2 + 2k + 1 + k + 1$$

$$= k^2 + k + 2k + 2$$

$$= 2m + 2(k+1)$$

$$= 2(m+k+1)$$

= multiple of 2.

$\therefore (k+1)^2 + (k+1)$ is an even number.

$\therefore p(k+1)$ is true whenever $p(k)$ is true

$\therefore p(n)$ is true for $n \in \mathbb{N}$.

(45) (a)

$$f(x) = 2x^3 + 9x^2 + 12x + 1$$

$$f'(x) = 6x^2 + 18x + 12$$

$$= 6(x^2 + 3x + 2)$$

$$f'(x) = 6(x+2)(x+1)$$

$$f'(x) = 0 \Rightarrow 6(x+2)(x+1) = 0$$

$$\begin{array}{l|l} x+2=0 & x+1=0 \\ x=-2 & x=-1 \end{array}$$

$f(x)$ has stationary points at $x = -2$ & $x = -1$

$$\text{when } x = -2, f(-2) = -3$$

$$\text{when } x = -1, f(-1) = -4$$

$\therefore$ The stationary points are $(-2, -3)$ and $(-1, -4)$.

(45) (b)

Let x be the no. of units.

and y be the production cost.

x y

$$x_1: 500 \quad y_1: ₹. 6000$$

$$x_2: 1000 \quad y_2: ₹. 9000$$

The required eqn is

$$\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$$

$$\frac{y - 6000}{9000 - 6000} = \frac{x - 500}{1000 - 500}$$

$$\frac{y - 6000}{3000} = \frac{x - 500}{500}$$

$$y - 6000 = 3000 \left(\frac{x - 500}{500} \right)$$

$$y - 6000 = 6(x - 500)$$

$$y - 6000 = 6x - 3000$$

$$6x - y + 6000 - 3000 = 0$$

$$6x - y + 3000 = 0$$

(46) (a)

$$C = 2x \left(\frac{x+5}{x+2} \right) + 7$$

$$C = \frac{2x^2 + 10x}{x+2} + 7$$

$$MC = \frac{dC}{dx} = \frac{2(x^2 + 4x + 10)}{(x+2)^2}$$

$$MC = 2 \left[\frac{(x+2)^2 + 6}{(x+2)^2} \right]$$

$$MC = 2 \left[1 + \frac{6}{(x+2)^2} \right]$$

$\Rightarrow$ as x increases, MC decreases
- Hence proved.

(46) (b)

(i) Investment = ₹ 96000

F.V = ₹ 100

M.V = ₹ 80

$$\text{No. of Shares} = \frac{\text{Investment}}{\text{M.V}} \\ = \frac{96000}{80} = 1200 \text{ Shares.}$$

(ii) Total dividend = $1200 \times \frac{18}{100} \times 100 = ₹ 21,600$ (iii) Percentage of return = $\frac{21600}{96000} \times 100 = 22.5\%$

(47) (a)

CI	f	Cf
10-20	12	12
20-30	19	31
30-40	5	36
40-50	10	46
50-60	9	55
60-70	6	61
70-80	6	67
	N = 67	

$$Q_1 = \text{Size of } \left(\frac{N}{4}\right)^{\text{th}} \text{ value} = \frac{67}{4} \\ = 16.75^{\text{th}} \text{ value.}$$

Thus, Q_1 lies in 20-30.

$$\therefore L = 20, \frac{N}{4} = 16.75, \text{pcf} = 12, \\ f = 19, C = 10.$$

$$\therefore Q_1 = L + \left(\frac{\frac{N}{4} - \text{pcf}}{f} \right) \times C \\ = 20 + \frac{16.75 - 12}{19} \times 10$$

$$Q_1 = 20 + 2.5 = 22.5$$

$$Q_3 = \text{Size of } \left(\frac{3N}{4}\right)^{\text{th}} \text{ value} = 50.25^{\text{th}} \text{ value}$$

 Q_3 lies in 50-60

$$\therefore L = 50, \frac{3N}{4} = 50.25, \text{pcf} = 46 \\ f = 9, C = 10$$

$$Q_3 = 50 + \frac{50.25 - 46}{9} \times 10 = 54.72$$

$$Q.D = \frac{1}{2} (Q_3 - Q_1) = (54.72 - 22.5) / 2 = 16.11$$

(47) (b) Let x : Height of father
 y : Height of son.

x	$dx = (x - 67)$	dx^2	y	$dy = (y - 68)$	dy^2	$dx dy$
65	-2	4	67	-1	1	2
66	-1	1	68	0	0	0
67	0	0	64	-4	16	0
67	0	0	68	0	0	0
68	1	1	72	4	16	4
69	2	4	70	2	4	4
71	4	16	69	1	1	4
73	6	36	70	2	4	12
$\Sigma x =$ 546	$\Sigma dx =$ 10	$\Sigma dx^2 =$ 62	$\Sigma y =$ 548	$\Sigma dy =$ 4	$\Sigma dy^2 =$ 42	$\Sigma dx dy =$ 26

$$\begin{aligned}
 r &= \frac{N \Sigma dx dy - (\Sigma dx)(\Sigma dy)}{\sqrt{N \Sigma dx^2 - (\Sigma dx)^2} \sqrt{N \Sigma dy^2 - (\Sigma dy)^2}} \\
 &= \frac{(8 \times 26) - (10 \times 4)}{\sqrt{(8 \times 62) - (10)^2} \sqrt{(8 \times 42) - (4)^2}} \\
 &= \frac{168}{355.98} = 0.472
 \end{aligned}$$

Heights of fathers and their respective sons are positively correlated.