Maharashtra State Board 12th Commerce Maths Solutions Chapter 3 Linear Regression Ex 3.1

Question 1.
The HRD manager of the company wants to find a measure which he can use to fix the monthly income of persons applying for the job in the production department. As an experimental project. He collected data of 7 persons from that department referring to years of service and their monthly incomes.

Years of service (X)	11	7	9	5	8	6	10
Monthly Income (Rs.1000's) (Y)	10	8	6	5	9	7	11

(i) Find the regression equation of income on years of service.
(ii) What initial start would you recommend for a person applying for the job after having served in a similar capacity in another company for 13 years?
Solution:

	x	y	$(x-\bar{x})$	$(y-\bar{y})$	$(x-\bar{x})(y-\bar{y})$	$(x-\bar{x})^2$
	11	10	3	2	6	9
	7	8	−1	0	0	1
	9	6	1	−2	−2	1
	5	5	−3	−3	9	9
	8	9	0	1	0	0
	6	7	−2	−1	2	4
	10	11	2	3	6	4
Total	**56**	**56**			**21**	**28**

Given, $n = 7$

$$\therefore \quad \bar{x} = \frac{\sum x_i}{n} = \frac{56}{7} = 8$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{56}{7} = 8$$

$$b_{yx} = \frac{\operatorname{Cov}(X, Y)}{\sigma_X^2}$$

$$= \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2}$$

$$\therefore b_{yx} = \frac{21}{28} = \frac{3}{4} = 0.75$$

(i) Regression equation of Y on X is $(Y - \bar{y}) = b_{yx}(x - \bar{x})$

$(Y - 8) = 0.75(x - \bar{x})$

Y = 0.75x + 2
(ii) When x = 13
Y = 0.75(13) + 2 = 11.75
Recommended income for the person is ₹ 11750.

Question 2.
Calculate the regression equations of X on Y and Y on X from the following date:

X	10	12	13	17	18
Y	5	6	7	9	13

Solution:

	x	y	$(x-\bar{x})$	$(y-\bar{y})$	$(x-\bar{x})(y-\bar{y})$	$(x-\bar{x})^2$	$(y-\bar{y})^2$
	10	5	−4	−3	12	16	9
	12	6	−2	−2	4	4	4
	13	7	−1	−1	1	1	1
	17	9	3	1	3	9	1
	18	13	4	5	20	16	25
Total	**70**	**40**			**40**	**46**	**40**

Given, $n = 5$

$$\bar{x} = \frac{\sum x_i}{n} = \frac{70}{5} = 14$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{40}{5} = 8$$

$$b_{xy} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (y-\bar{y})^2}$$

$$= \frac{40}{40} = 1$$

$$b_{yx} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2}$$

$$= \frac{40}{46} = 0.87$$

Regression equation of X on Y is $(X - \bar{x}) = b_{xy} (Y - \bar{y})$

(X – 14) = 1(Y – 8)
X – 14 = Y – 8
X = Y + 6

Regression equation Y on X is $(Y - \bar{y}) = b_{yx} (X - \bar{x})$

(Y – 8) = 0.87(X – 14)
Y – 8 = 0.87X – 12.18
Y = 0.87X – 4.18

Question 3.
For a certain bivariate data on 5 pairs of observations given
$\Sigma x = 20$, $\Sigma y = 20$, $\Sigma x^2 = 90$, $\Sigma y^2 = 90$, $\Sigma xy = 76$
Calculate (i) cov(x, y), (ii) b_{yx} and b_{xy}, (iii) r
Solution:

$$\text{Cov}(x, y) = \frac{\sum (x \cdot y)}{n} - \bar{x} \cdot \bar{y}$$

$$= \frac{\sum (x \cdot y)}{n} - \left(\frac{\sum x}{n}\right)\left(\frac{\sum y}{n}\right)$$

$$= \frac{76}{5} - \left(\frac{20}{5}\right)\left(\frac{20}{5}\right)$$

$$= 15.2 - 16$$

$$= -0.8$$

$$b_{yx} = \frac{n\sum (x \cdot y) - \left(\sum x\right)\left(\sum y\right)}{n\sum x^2 - \left(\sum x\right)^2}$$

$$= \frac{5(76) - (20)(20)}{5(90) - (20)^2} = \frac{380 - 400}{450 - 400} = \frac{-20}{+50} = -0.4$$

$$b_{xy} = \frac{n\sum (x \cdot y) - \left(\sum x\right)\left(\sum y\right)}{n\sum y^2 - \left(\sum y\right)^2}$$

$$= \frac{5(76) - (20)(20)}{5(90) - (20)^2} = \frac{380 - 400}{450 - 400} = \frac{-20}{50} = -0.4$$

Now, $r^2 = b_{yx} \cdot b_{xy}$

$$= (-0.4)(-0.4)$$

$$= 0.16$$

$$\therefore r = \pm 0.4$$

Sine byx and bxy are negative, r = -0.4

Question 4.
From the following data estimate y when x = 125

X	120	115	120	125	126	123
Y	13	15	14	13	12	14

Solution:

Let u = x – 122, v = y – 14

	x	y	u	v	$u \cdot v$	u^2	v^2
	120	13	–2	–1	2	4	1
	115	15	–7	1	–7	49	1
	120	14	–2	0	0	4	0
	125	13	3	–1	–3	9	1
	126	12	4	–2	–8	16	4
	123	14	1	0	0	1	0
Total	**729**	**81**	**–3**	**–3**	**–16**	**83**	**7**

$$\bar{x} = \frac{\sum x_i}{n} = \frac{729}{6} = 121.5$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{81}{6} = 13.5$$

$$b_{yx} = b_{vu} = \frac{n\sum(u \cdot v) - \left(\sum u\right)\left(\sum v\right)}{n\sum u^2 - \left(\sum u\right)^2}$$

$$= \frac{6(-16) - (-3)(-3)}{6(83) - (-3)^2} = \frac{-96 - 9}{498 - 9} = \frac{-105}{489} = -0.21$$

Regression equation of Y on X is

$(Y - \bar{y}) = b_{yx} (X - \bar{x})$

(Y – 13.5) = -0.21(x – 121.5)

Y – 13.5 = -0.21x + 25.52

Y = -0.21x + 39.02

When x = 125

Y = -0.21(125) + 39.02

= -26.25 + 39.02

= 12.77

Question 5.

The following table gives the aptitude test scores and productivity indices of 10 works selected at workers selected randomly.

Obtain the two regression equation and estimate

(i) The productivity index of a worker whose test score is 95.

(ii) The test score when productivity index is 75.

Solution:

	x	y	$(x - \bar{x})$	$(y - \bar{y})$	$(x - \bar{x})(y - \bar{y})$	$(x - \bar{x})^2$	$(y - \bar{y})^2$
	60	68	–5	3	–15	25	9
	62	60	–3	–5	15	9	25
	65	62	0	–3	0	0	9
	70	80	5	15	75	25	225
	72	85	7	20	140	49	400
	48	40	–17	–25	425	289	625
	53	52	–12	–13	156	144	169
	73	62	8	–3	–24	64	9
	65	60	0	–5	0	0	25
	82	81	17	16	272	289	256
Total	**650**	**650**			**1044**	**894**	**1752**

$$\bar{x} = \frac{\sum x_i}{n} = \frac{650}{10} = 65$$
$$\bar{y} = \frac{\sum y_i}{n} = \frac{650}{10} = 65$$
$$b_{yx} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2}$$
$$= \frac{1044}{894} = 1.16$$
$$b_{xy} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (y-\bar{y})^2}$$
$$= \frac{1044}{1752} = 0.59$$

Regression equation of Y on X,
$(Y - \bar{y}) = b_{yx} (X - \bar{y})$
(Y – 65) = 1.16 (x – 65)
Y – 65 = 1.16x – 75.4
Y = 1.16x – 10.4
(i) When x = 95
Y = 1.16(95) – 10.4
= 110.2 – 10.4
= 99.8
Regression equation of X on Y,
$(X - \bar{x}) = b_{xy} (Y - \bar{y})$
(X – 65) = 0.59(y – 65)
(X – 65) = 0.59y – 38.35
X = 0.59y + 26.65
(ii) When y = 75
x = 0.59(75) + 26.65
= 44.25 + 26.65
= 70.9

Question 6.
Compute the appropriate regression equation for the following data.

X [Independent Veriable]	2	4	5	6	8	11
Y [Dependent Veriable]	18	12	10	8	7	5

Solution:
Since x is the independent variable, and y is the dependent variable,
we need to find regression equation of y on x

	x	y	$(x-\bar{x})$	$(y-\bar{y})$	$(x-\bar{x})(y-\bar{y})$	$(x-\bar{x})^2$
	2	18	–4	8	–32	16
	4	12	–2	2	–4	4
	5	10	–1	0	0	1
	6	8	0	–2	0	0
	8	7	2	–3	–6	4
	11	5	5	–5	–25	15
Total	**36**	**60**			**–67**	**50**

$$\bar{x} = \frac{\sum x_i}{n} = \frac{36}{6} = 6$$
$$\bar{y} = \frac{\sum y_i}{n} = \frac{60}{6} = 10$$
$$b_{yx} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2} = \frac{-67}{50} = -1.34$$

Regression equation of y on x is $(y - \bar{y}) = b_{yx}(x - \bar{x})$

$(y - 10) = -13.4(x - 6)$

$y - 10 = -1.34x + 8.04$

$y = -1.34x + 18.04$

Question 7.

The following are the marks obtained by the students in Economic (X) and Mathematics (Y)

X	59	60	61	62	63
Y	78	82	82	79	81

Find the regression equation of Y and X.

Solution:

Let u = x – 61, v = y – 80

	x	y	u	v	$u-v$	u^2
	59	78	−2	−2	4	4
	60	82	−1	2	−2	1
	61	82	0	2	0	0
	62	79	1	−1	−1	1
	63	81	2	1	2	4
Total	305	402	0	2	3	10

$$\bar{x} = \frac{\sum x_i}{n} = \frac{305}{5} = 61$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{402}{5} = 80.4$$

$$b_{yx} = \frac{n\sum(u\cdot v) - (\sum u)(\sum v)}{n\sum u^2 - (\sum u)^2}$$

$$= \frac{5(3) - (0)(2)}{5(10) - (0)^2} = \frac{15}{50} = 0.3$$

Regression equation of Y on X is

$(Y - \bar{y}) = b_{yx}(X - \bar{x})$

$(Y - 80.4) = 0.3(x - 61)$

$Y - 80.4 = 0.3x - 18.3$

$Y = 0.3x + 62.1$

Question 8.

For the following bivariate data obtain the equation of two regressions lines:

X	1	2	3	4	5
Y	5	7	9	11	13

Solution:

	x	y	$(x-\bar{x})$	$(y-\bar{y})$	$(x-\bar{x})(y-\bar{y})$	$(x-\bar{x})^2$	$(y-\bar{y})^2$
	1	5	−2	−4	8	4	16
	2	7	−1	−7	2	1	4
	3	9	0	0	0	0	0
	4	4	1	2	2	1	4
	5	13	2	4	8	4	16
Total	15	45			20	10	40

$$\bar{x} = \frac{\sum x_i}{n} = \frac{15}{5} = 3$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{45}{5} = 9$$

$$b_{yx} = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(x-\bar{x})^2} = \frac{20}{10} = 2$$

$$b_{xy} = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(y-\bar{y})^2} = \frac{20}{40} = 0.5$$

Regression equation of Y on X

$(Y - \bar{y}) = b_{yx} (X - \bar{x})$
(Y – 9) = 2(x – 3)
Y – 9 = 2x – 6
Y = 2x + 3
Regression equation of X on Y
$(X - \bar{x}) = b_{xy} (Y - \bar{y})$
(X – 3) = 0.5(y – 9)
(X – 3) = 0.5y – 4.5
X = 0.5y – 1.5

Question 9.
Find the following data obtain the equation of two regression lines:

Solution:

$$\bar{x} = \frac{\sum x_i}{n} = \frac{30}{5} = 6$$
$$\bar{y} = \frac{\sum y_i}{n} = \frac{40}{5} = 8$$
$$b_{yx} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2} = \frac{-26}{40} = -0.65$$
$$b_{xy} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (y-\bar{y})^2} = \frac{-26}{20} = -1.3$$

Regression of Y on X,
$(Y - \bar{y}) = b_{yx} (X - \bar{x})$
(Y – 8) = 0.65(x – 6)
Y – 8 = -0.65x + 3.9
Y = -0.65x + 11.9
Regression of X on Y
$(X - \bar{x}) = b_{xy} (Y - \bar{y})$
(X – 6) = -1.3(y – 8)
(X – 6) = -1.3y + 10.4
X = -1.3y + 16.4

Question 10.
For the following data, find the regression line of Y on X

X	1	2	3
Y	2	1	6

Hence find the most likely value of y when x = 4
Solution:

	x	y	$(x-\bar{x})$	$(y-\bar{y})$	$(x-\bar{x})(y-\bar{y})$	$(x-\bar{x})^2$
	1	2	−1	−1	1	1
	2	1	0	−2	0	0
	3	6	1	3	3	1
Total	6	9			4	2

$$\bar{x} = \frac{\sum x_i}{n} = \frac{6}{3} = 2$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{9}{3} = 3$$

$$b_{yx} = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2} = \frac{4}{2} = 2$$

Regression equation of Y on X is

$(Y - \bar{y}) = b_{yx}(X - \bar{x})$,

(Y – 3) = 2(x – 2)
Y – 3 = 2x – 4
Y = 2x – 1
When x = 4
Y = 2(4) – 1
= 8 – 1
= 7

Question 11.
Find the following data, find the regression equation of Y on X, and estimate Y when X = 10.

X	1	2	3	4	5	6
Y	2	4	7	6	5	6

Solution:

	x	y	xy	x^2
	1	2	2	1
	2	4	8	4
	3	7	21	9
	4	6	24	16
	5	5	25	25
	6	6	36	36
Total	21	30	116	91

$$\bar{x} = \frac{\sum x_i}{n} = \frac{21}{6} = 3.5$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{30}{6} = 5$$

$$b_{yx} = \frac{n\sum (x \cdot y) - (\sum x)(\sum y)}{n\sum x^2 - (\sum x)^2}$$

$$= \frac{6(116) - (21)(30)}{6(91) - (21)^2}$$

$= 0.63$

Regression equation of Y on X is
$(Y - \bar{y}) = b_{yx}(X - \bar{x})$
(Y – 5) = (0.63)(x – 3.5)
Y – 5 = 0.63x – 2.2
Y = 0.63x + 2.8
When x = 10
Y = 0.63(10) + 2.8
= 6.3 + 2.8
= 9.1

Question 12.
The following sample gave the number of hours of study (X) per day for an examination and marks (Y) obtained by 12 students.

X	3	3	3	4	4	5	5	5	6	6	7	8
Y	45	60	55	60	75	70	80	75	90	80	75	85

Obtain the line of regression of marks on hours of study.
Solution:
Let u = x – 5, v = y – 70

	x	y	u	v	u · v	u^2
	3	45	–2	–25	50	4
	3	60	–2	–10	20	4
	3	55	–2	–15	30	4
	4	60	–1	–10	10	1
	4	75	–1	5	–5	1
	5	70	0	0	0	0
	5	80	0	10	0	0
	5	75	0	5	0	0
	6	90	1	20	20	1
	6	80	1	10	10	1
	7	75	2	5	10	4
	8	85	3	15	45	9
Total	**59**	**850**	**–1**	**10**	**190**	**29**

$$\bar{x} = \frac{\sum x_i}{n} = \frac{59}{12} = 4.92$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{850}{12} = 70.83$$

$$b_{yx} = b_{vu} = \frac{n\sum(u \cdot v) - \left(\sum u\right)\left(\sum v\right)}{n\sum u^2 - \left(\sum u\right)^2}$$

$$= \frac{12(190) - (-1)(10)}{12(29) - (-1)^2} = 6.6$$

∴ Equation of marks on hours of study is
$(Y - \bar{y}) = b_{yx} (X - \bar{x})$
(Y – 70.83) = 6.6(x – 4.92)
Y – 70.83 = 6.6x – 32.47
∴ Y = 6.6x + 38.36

Maharashtra State Board 12th Commerce Maths Solutions Chapter 3 Linear Regression Ex 3.2

Question 1.
For bivariate data.
$\bar{x}$ = 53, $\bar{x}$ = 28, b_{yx} = -1.2, b_{xy} = -0.3
Find,
(i) Correlation coefficient between X and Y.
(ii) Estimate Y for X = 50
(iii) Estimate X for Y = 25
Solution:
(i) $r^2 = b_{yx} \cdot b_{xy}$

$r^2 = (-1.2)(-0.3)$
$r^2 = 0.36$
$r = \pm 0.6$
Since, b_{yx} and bxy are negative, r = -0.6

(ii) Regression equation of Y on X is
$(Y - \bar{y}) = b_{yx} (X - \bar{x})$
Y – 28 = -1.2(50 – 53)
Y – 28 = -1.2(-3)
Y – 28 = 3.6
Y = 31.6

(iii) Regression equation of X on Y is
$(X - \bar{x}) = b_{xy} (Y - \bar{y})$
(X – 53) = -0.3(25 – 28)
X – 53 = -0.3(-3)
X – 53 = 0.9
X = 53.9

Question 2.
From the data of 20 pairs of observation on X and Y, following result are obtained $\bar{x} = 199$, $\bar{y} = 94$, $\Sigma(x_i - \bar{x})^2 = 1200$, $\Sigma(y_i - \bar{y})^2 = 300$
$\Sigma(x_i - \bar{x})(y_i - \bar{y}) = -250$
Find
(i) The line of regression of Y on X.
(ii) The line of regression of X on Y.
(iii) Correlation coefficient between X on Y.
Solution:

$24y - 2256 = -5x + 995$
$5x + 24y = 3251$

(ii) $b_{xy} = \dfrac{\sum(x-\bar{x})(y-\bar{y})}{\sum(y-\bar{y})^2} = \dfrac{-250}{300} = \dfrac{-5}{6}$

Line of regression of X on Y is
$(X - \bar{x}) = b_{xy}(Y - \bar{y})$
$(X - 199) = \dfrac{-5}{6}(Y - 94)$
$6x - 1194 = -5y + 470$
$6x + 5y = 1664$

(iii) $r^2 = b_{yx} \cdot b_{xy}$
$r^2 = \dfrac{-5}{24} \times \dfrac{-5}{6}$
$r^2 = \dfrac{25}{144}$
$\therefore r = \pm\dfrac{5}{12}$
Since b_{yx} and b_{xy} are negative, $\therefore r = -\dfrac{5}{12}$

Question 3.
From the data of 7 pairs of observations on X and Y following results are obtained.
$\Sigma(x_i - 70) = -35$, $\Sigma(y_i - 60) = -7$, $\Sigma(x_i - 70)^2 = 2989$, $\Sigma(y_i - 60)^2 = 476$, $\Sigma(x_i - 70)(y_i - 60) = 1064$ [Given $\sqrt{0.7884} = 0.8879$]

Obtain
(i) The line of regression of Y on X.
(ii) The line of regression of X on Y.
(iii) The correlation coefficient between X and Y.
Solution:

Let $u_i = x_i - 70$, $v_i = y_i - 60$

Given $\Sigma u = -35$, $\Sigma v = -7$

$\Sigma u^2 = 2989$, $\Sigma v^2 = 476$

$\Sigma(u \cdot v) = 1064$

$\bar{u} = \bar{x} - 70$

$\frac{-35}{7} = \bar{x} - 70$

$-5 = \bar{x} - 70$

$\therefore \bar{x} = 65$

$\bar{v} = \bar{y} = -60$

$\frac{-7}{7} = \bar{y} = -60$

$-1 = \bar{y} - 60$

$\bar{y} = 59$

$$b_{yx} = b_{vu} = \frac{n\sum(u \cdot v) - (\sum u)(\sum v)}{n(\sum u^2) - (\sum u)^2}$$

$$= \frac{7(1064) - (-35)(-7)}{7(2989) - (-35)^2} = 0.36$$

$$b_{xy} = b_{uv} = \frac{n\sum(u \cdot v) - (\sum u)(\sum v)}{n(\sum v^2) - (\sum v)^2}$$

$$= \frac{7(1064) - (-35)(-7)}{7(476) - (7)^2} = 2.19$$

(i) Line of regression Y on X is
$(Y - \bar{y}) = b_{yx} (X - \bar{x})$
(Y – 59) = 0.36(x – 65)
(Y – 59) = 0.36x – 23.4
Y = 0.36x + 35.6

(ii) Line of regression X on Y is
$(X - \bar{x}) = b_{xy} (Y - \bar{y})$
(X – 65) = 2.19(y – 59)
(X – 65) = 2.19y – 129.21
X = 2.19y – 64.21

(iii) $r^2 = b_{yx} \cdot b_{xy}$
$r^2 = (0.36)(2.19)$
$r^2 = 0.7884$
r = ±√0.7884 = ±0.8879
Since b_{yx} and b_{xy} are positive.
∴ r = 0.8879

Question 4.
You are given the following information about advertising expenditure and sales.

	Advertisment expenditure (Rs.in lakh) (X)	Sales (Rs.in lakh) (Y)
Arithmetic mean	10	90
Standard deviation	3	12

Correlation coefficient between X and Y is 0.8
(i) Obtain two regression equations.

(ii) What is the likely sales when the advertising budget is ₹ 15 lakh?
(iii) What should be the advertising budget if the company wants to attain sales target of ₹ 120 lakh?
Solution:
Given, $\bar{x}$ = 10, $\bar{y}$ = 90, σ_x = 3, σ_y = 12, r = 0.8

byx = $r\frac{\sigma_y}{\sigma_x} = 0.8 \times \frac{12}{3}$ = 3.2

bxy = $r\frac{\sigma_x}{\sigma_y} = 0.8 \times \frac{3}{12}$ = 0.2

(i) Regression equation of Y on X is
$(Y - \bar{y}) = b_{yx} (X - \bar{x})$
(Y – 90) = 3.2(x – 10)
Y – 90 = 3.2x – 32
Y = 3.2x + 58
Regression equation of X on Y is
$(X - \bar{x}) = b_{xy} (Y - \bar{y})$
(X – 10) = 0.2(y – 90)
X – 10 = 0.2y + 18
X = 0.2y – 8

(ii) When x = 15,
Y = 3.2(15) + 58
= 48 + 58
= 106 lakh

(iii) When y = 120
X = 0.2(120) – 8
= 24 – 8
= 16 lakh

Question 5.
Bring out inconsistency if any, in the following:
(i) $b_{yx} + b_{xy}$ = 1.30 and r = 0.75
(ii) $b_{yx} = b_{xy}$ = 1.50 and r = -0.9
(iii) b_{yx} = 1.9 and b_{xy} = -0.25
(iv) b_{yx} = 2.6 and $b_{xy} = \frac{1}{2.6}$
Solution:
(i) Given, $b_{yx} + b_{xy}$ = 1.30 and r = 0.75
$\frac{b_{yx}+b_{xy}}{2} = \frac{1.30}{2}$ = 0.65
But for regression coefficients b_{yx} and b_{xy}
$\left|\frac{b_{yx}+b_{xy}}{2}\right| \ge r$
Here, 0.65 < r = 0.75
∴ The data is inconsistent
(ii) The signs of b_{yx}, b_{xy} and r must be same (all three positive or all three negative)
∴ The data is inconsistent.

(iii) The signs of b_{yx} and b_{xy} should be same (either both positive or both negative)
∴ The data is consistent.

(iv) $b_{yx} \cdot b_{xy} = 2.6 \times \frac{1}{2.6}$ = 1
∴ $0 \le r^2 \le 1$
∴ The data is consistent.

Question 6.
Two sample from bivariate populations have 15 observation each. The sample means of X and Y are 25 and 18 respectively. The corresponding sum of square of deviations from respective means are 136 and 150. The sum of product of deviations from respective means is 123. Obtain the equation of line of regression of X on Y.
Solution:
Given, n = 15, $\bar{x}$ = 25, $\bar{y}$ = 18, $\Sigma(x - \bar{x})$ = 136, $\Sigma(y - \bar{y})$ = 150, $\Sigma(x - \bar{x})(y - \bar{y})$ = 123
Regression equation of X on Y is $(X - \bar{x})$ = bxy $(Y - \bar{y})$
(X – 25) = 0.82(y – 18)
(X – 25) = 082y – 14.76
X = 0.82y + 10.24

Question 7.
For a certain bivariate data

	X	Y
Mean	25	20
S.D.	4	3

And r = 0.5 estimate y when x = 10 and estimate x when y = 16
Solution:
Given, $\bar{x}$ = 25, $\bar{y}$ = 20, σ_x = 4, σ_y = 3, r = 0.5

$b_{yx} = r\frac{\sigma_y}{\sigma_y} = 0.5 \times \frac{3}{4}$ = 0.375

Regression equation of Y on X is

$(Y - \bar{y}) = b_{yx} (X - \bar{x})$

(Y – 20) = 0.375(x – 25)
Y – 20 = 0.375x – 9.375
Y = 0.375x + 10.625
When, x = 10
Y = 0.375(10) + 10.625
= 3.75 + 10.625
= 14.375

$b_{xy} = r\frac{\sigma_x}{\sigma_y} = 0.5 \times \frac{4}{3}$ = 0.67

Regression equation of X on Y is

$(X - \bar{x}) = b_{yx} (Y - \bar{y})$

(X – 25) = 0.67(y – 20)
(X – 25) = 0.67y – 13.4
X = 0.67y + 11.6
When, Y = 16
x = 0.67(16) + 11.6
= 10.72 + 11.6
= 22.32

Question 8.
Given the following information about the production and demand of a commodity obtain the two regression lines:

	Production (X)	Demand (Y)
Mean	85	90
S.D.	5	6

Coefficient of correlation between X and Y is 0.6. Also estimate the problem when demand is 100.
Solution:
Given $\bar{x}$ = 85, $\bar{y}$ = 90, σ_x = 5, σ_y = 6 and r = 0.6

$bxy = r\frac{\sigma_x}{\sigma_y} = 0.6 \times \frac{5}{6}$ = 0.5

$byx = r\frac{\sigma_y}{\sigma_x} = 0.6 \times \frac{6}{5}$ = 0.72

Regression equation of X on Y is

$(X - \bar{x}) = b_{xy} (Y - \bar{y})$

(X – 85) = 0.5(y – 90)
(X – 85) = 0.5y – 45
X = 0.5y + 40
When y = 100,
x = 0.5 (100) + 40
= 50 + 40
= 90
Regression equation of Y on X is

$(Y - \bar{y}) = b_{yx} (X - \bar{x})$

(Y – 90) = 0.72(x – 85)
(Y – 90) = 0.72x – 61.2
Y = 0.72x + 28.8

Question 9.
Given the following data, obtain linear regression estimate of X for Y = 10
Solution:
$\bar{x}$ = 7.6, $\bar{y}$ = 14.8, σ_x = 3.2, σ_y = 16 and r = 0.7

$b_{xy} = r\frac{\sigma_x}{\sigma_y} = 0.7 \times \frac{3.2}{16}$ = 0.14

Regression equation of X on Y is

$(X - \bar{y}) = b_{xy}(Y - \bar{y})$
(X – 7.6) = 0.14(y – 14.8)
X – 7.6 = 0.14y – 2.072
X = 0.14y + 5.528
When y = 10
x = 0.14(10) + 5.528
= 1.4 + 5.528
= 6.928

Question 10.
An inquiry of 50 families to study the relationship between expenditure on accommodation (₹ x) and expenditure on food and entertainment (₹ y) gave the following result:
$\Sigma x = 8500$, $\Sigma y = 9600$, $\sigma_x = 60$, $\sigma_y = 20$, $r = 0.6$
Estimate the expenditure on food and entertainment when expenditure on accommodation is ₹ 200
Solution:
n = 50 (given)

$$b_{yx} = \frac{r\sigma_y}{\sigma_x} = 0.6 \times \frac{20}{60} = 0.2$$

$$\bar{x} = \frac{\sum x_i}{n} = \frac{8500}{50} = 170$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{9600}{n} = 192$$

Regression equation of Y on X is
$Y - \bar{y} = b_{yx}(X - \bar{x})$
(Y – 192) = 0.2(200 – 170)
Y – 192 = 0.2(30)
Y = 192 + 6
Y = 198

Question 11.
The following data about the sales and advertisement expenditure of a firms is given below (in ₹ crores)

	Sales	Adv. Exp.
Mean	40	6
S.D.	10	1.5

Also correlation coefficient between X and Y is 0.9
(i) Estimate the likely sales for a proposed advertisement expenditure of ₹ 10 crores.
(ii) What should be the advertisement expenditure if the firm proposes a sales target ₹ 60 crores
Let the sales be X and advertisement expenditure be Y
Solution:
Given, $\bar{x} = 40$, $\bar{y} = 6$, $\sigma_x = 10$, $\sigma_y = 1.5$, $r = 0.9$

$b_{yx} = r\sigma_y\sigma_x = 0.9 \times 1.510 = 0.135$

$b_{xy} = r\sigma_x\sigma_y = 0.9 \times 101.5 = 6$

(i) Regression equation of X on Y is
$(X - \bar{x}) = b_{xy}(Y - \bar{y})$
(X – 40) = 6(y – 6)
X – 40 = 6y – 36
X = 6y + 4
When y = 10
x = 6 (10) + 4
= 60 + 4
= 64 crores

(ii) Regression equation Y on X is
$(Y - \bar{y}) = b_{yx}(X - \bar{x})$
(Y – 6) = 0.135 (x – 40)
Y – 6 = 0.135x – 5.4
Y = 0.135x + 0.6
When x = 60
Y = 0.135 (60) + 0.6
= 8.1 + 0.6
= 8.7 crores

Question 12.
For certain bivariate data the following information are available

	X	Y
A.M.	13	17
S.D.	3	2

Correlation coefficient between x and y is 0.6, estimate x when y = 15 and estimate y when x = 10.
Solution:
Given, $\bar{x}$ = 13, $\bar{y}$ = 17, σ_x = 3, σ_y = 2, r = 0.6

$b_{yx} = r\frac{\sigma_y}{\sigma_x} = 0.6 \times \frac{2}{3}$ = 0.4

$b_{xy} = r\frac{\sigma_x}{\sigma_y} = 0.6 \times \frac{3}{2}$ = 0.9

Regression equation of Y on X
$(Y - \bar{y}) = b_{yx} (X - \bar{x})$
Y – 17 = 0.4(x – 13)
Y = 0.4x + 11.8
When x = 10
Y = 0.4(10) + 11.8
= 4 + 11.8
= 15.8
Regression equation of X on Y
$(X - \bar{x}) = b_{xy} (Y - \bar{y})$
(X – 13) = 0.9(y – 17)
X – 13 = 0.9y – 15.3
X = 0.9y – 2.3
When y = 15
X = 0.9(15) – 2.3
= 13.5 – 2.3
= 11.2

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Question 1.
From the two regression equations find r, $\bar{x}$ and $\bar{y}$.
4y = 9x + 15 and 25x = 4y + 17
Solution:
Given 4y = 9x + 15 and 25x = 4y + 17

$y = \frac{9x}{4} + \frac{15}{4}$

$x = \frac{4y}{25} + \frac{17}{25}$

$b_{yx} = \frac{9}{4}$ $b_{xy} = \frac{4}{25}$

$b_{yx} \cdot b_{xy} = \frac{9}{4} \times \frac{4}{25}$

$= \frac{9}{25}$ which belongs to [0, 1]

$\therefore$ Our assumption is correct

$\therefore r^2 = b_{yx} \cdot b_{xy}$

$r^2 = \frac{9}{25}$

$r = \pm\frac{3}{5}$

Since b_{yx} and b_{xy} are positive.
$\therefore r = \frac{3}{5} = 0.6$

$(\bar{x}, \bar{y})$ is the point of intersection of the regression lines
9x – 4y = -15 …….(i)
25x – 4y = 17 ……….(ii)
-16x = -32
x = 2
$\therefore \bar{x} = 2$
Substituting x = 2 in equation (i)
9(2) – 4y = -15
18 + 15 = 4y
33 = 4y
y = 33/4 = 8.25
$\therefore \bar{y} = 8.25$

Question 2.
In a partially destroyed laboratory record of an analysis of regression data, the following data are legible:
Variance of X = 9
Regression equations:
8x – 10y + 66 = 0 And 40x – 18y = 214.
Find on the basis of the above information
(i) The mean values of X and Y.
(ii) Correlation coefficient between X and Y.
(iii) Standard deviation of Y.
Solution:
Given, $\sigma_x^2 = 9, \sigma_x = 3$
(i) $(\bar{x}, \bar{y})$ is the point of intersection of the regression lines
40x – 50y = -330 …….(i)
40x – 50y = +214 ………(ii)
-32y = -544
y = 17
$\therefore \bar{y} = 17$
8x – 10(17) + 66 = 0
8x = 104
x = 13

$\therefore \bar{x} = 13$

(ii) $8x - 10y + 66 = 0, \quad 40x - 18y = 214$

$10y = 8x + 66, \quad 40x = 18y + 214$

$y = \frac{8x}{10} + \frac{66}{10} \quad x = \frac{18}{40} + \frac{214}{40}$

$\therefore b_{yx} = \frac{8}{10} = \frac{4}{5} \quad b_{xy} = \frac{18}{40} + \frac{9}{20}$

$b_{yx} \cdot b_{xy} = \frac{4}{5} \times \frac{9}{20} = \frac{9}{25}$ which belongs to [0, 1]

$\therefore$ Our assumption is correct

$r^2 = b_{yx} \cdot b_{xy}$

$r^2 = \frac{9}{25}$

$r = \pm\frac{3}{5}$

Since b_{yx} and b_{xy} are positive $\therefore r = \frac{3}{5}$

(iii) $b_{yx} = r\frac{\sigma_y}{\sigma_x}$

$\frac{4}{5} = \frac{3}{5} \times \frac{\sigma_y}{3}$

$\sigma_y = 4$

Question 3.
For 50 students of a class, the regression equation of marks in statistics (X) on the marks in Accountancy (Y) is 3y – 5x + 180 = 0. The mean marks in accountancy is 44 and the variance of marks in statistics $(916)th$ of the variance of marks in accountancy. Find the mean in statistics and the correlation coefficient between marks in two subjects.
Solution:
Given, n = 50, $\bar{y} = 44$

$\sigma2x=916\sigma2y$

$\therefore \sigma_x\sigma_x=34$

Since ($\bar{x}$, $\bar{y}$) is the point intersection of the regression line.

$\therefore$ ($\bar{x}$, $\bar{y}$) satisfies the regression equation.

$3\bar{y} - 5\bar{x} + 180 = 0$

$3(44) - 5\bar{x} + 180 = 0$

$\therefore 5\bar{x} = 132 + 180$

$\bar{x} = 3125 = 62.4$

$\therefore$ Mean marks in statistics is 62.4
Regression equation of X on Y is 3y – 5x + 180 = 0
$\therefore$ 5x = 3y + 180

Question 4.
For bivariate data, the regression coefficient of Y on X is 0.4 and the regression coefficient of X on Y is 0.9. Find the value of the variance of Y if the variance of X is 9.

Solution:

Given, $b_{yx} = 0.4$, $b_{xy} = 0.9$, $\sigma_x^2 = 9$, $\sigma_x = 3$

$r^2 = b_{yx} \cdot b_{xy}$

$r^2 = 0.4 \times 0.9$

$r^2 = 0.36$

$r = \pm 0.6$

Since b_{yx} and b_{xy} are positive $\therefore r = 0.6$

$$b_{yx} = \frac{r \cdot \sigma_y}{\sigma_x}$$

$$0.4 = 0.6 \times \frac{\sigma_y}{3}$$

$$\frac{4}{10} = \frac{6}{10} \times \frac{\sigma_y}{3}$$

$\sigma_y = 2$

$\therefore \sigma_y^2 = 4$

$\therefore$ Variance of y is 4.

Question 5.
The equation of two regression lines are 2x + 3y – 6 = 0 and 3x + 2y – 12 = 0
Find (i) Correlation coefficient (ii) $\sigma_x \sigma_y$
Solution:

(i) $2x + 3y = 6$, $\quad 3x + 2y = 12$

$3y = -2x + 6 \quad 3x = -2y + 12$

$$y = \frac{-2}{3}x + 2 \qquad x = \frac{-2}{3}y + 4$$

$$b_{yx} = \frac{-2}{3} \qquad b_{xy} = \frac{-2}{3}$$

$$b_{yx} \cdot b_{xy} = \frac{-2}{3} \times \frac{-2}{3} = \frac{4}{9} \in [0, 1]$$

$\therefore$ Our assumption is correct.

$\therefore r^2 = b_{yx} \cdot b_{xy}$

$$r^2 = \frac{4}{9}$$

$$r = \pm\frac{2}{3}$$

Since b_{yx} and b_{xy} are negative $\therefore r = \frac{-2}{3}$

(ii) $$b_{xy} = \frac{r \cdot \sigma_y}{\sigma_x}$$

$$\frac{-2}{3} = \frac{-2}{3} \cdot \frac{\sigma_x}{\sigma_y}$$

$$\therefore \frac{\sigma_x}{\sigma_y} = 1$$

Question 6.
For a bivariate data $\bar{x}$ = 53, $\bar{y}$ = 28, b_{yx} =-1.5 and b_{xy} = -0.2. Estimate Y when X = 50.
Solution:
Regression equation of Y on X is
$(Y - \bar{y}) = b_{yx} (X - \bar{x})$
(Y – 28) = -1.5(50 – 53)
Y – 28 = -1.5(-3)
Y – 28 = 4.5
Y = 32.5

Question 7.
The equation of two regression lines are x – 4y = 5 and 16y – x = 64. Find means of X and Y. Also, find the correlation coefficient between X and Y.
Solution:

Since ($\bar{x}$, $\bar{y}$) is the point of intersection of the regression lines.
x – 4y = 5 …..(i)
-x + 16y = 64 …….(ii)
12y = 69
y = 5.75
Substituting y = 5.75 in equation (i)
x – 4(5.75) = 5
x – 23 = 5
x = 28
∴ $\bar{x}$ = 28, $\bar{y}$ = 5.75
x – 4y = 5
x = 4y + 5
∴ b_{xy} = 4
16y – x = 64
16y = x + 64
y = $\frac{1}{16}$x + 4
b_{yx} = $\frac{1}{16}$
$b_{yx} . b_{xy}$ = $\frac{1}{16}$ × 4 = $\frac{1}{4}$ ∈ [0, 1]
∴ Our assumption is correct
∴ $r^2 = b_{yx} . b_{xy}$
r^2 = $\frac{1}{4}$
r = ±$\frac{1}{2}$
Since b_{yx} and b_{xy} are positive,
∴ r = $\frac{1}{2}$ = 0.5

Question 8.
In partially destroyed record, the following data are available variance of X = 25. Regression equation of Y on X is 5y – x = 22 and Regression equation of X on Y is 64x – 45y = 22 Find
(i) Mean values of X and Y.
(ii) Standard deviation of Y.
(iii) Coefficient of correlation between X and Y.
Solution:
Given σ_x^2 = 25, ∴ σ_x = 5
(i) Since ($\bar{x}$, $\bar{y}$) is the point of intersection of regression lines
-x + 5y = 22 …….(i)
64x – 45y = 22 ………..(ii)
equation (i) becomes
-9x + 45y = 198
64y – 45y = 22
55x = 220
x = 4
Substituting x = 4 in equation (i)
-4 + 5y = 22
5y = 26
∴ y = 5.2
∴ $\bar{x}$ = 4, $\bar{y}$ = 5.2
Regression equation of X on Y is
64x – 45y – 22
64x = 45y + 22
x = $\frac{45}{64}y + \frac{22}{64}$
bxy = $\frac{45}{64}$
(ii) Regression equation of Y on X is
5y – x = 22

5y = x + 22

$$y = \frac{1}{5}x + \frac{22}{5}$$

$$b_{yx} = \frac{1}{5}$$

$$r^2 = b_{yx} \cdot b_{xy}$$

$$= \frac{1}{5} \times \frac{45}{64}$$

$$= \frac{9}{64}$$

$$r = \pm\frac{3}{8}$$

Since b_{yx} and b_{xy} are positive

$$\therefore\ r = \frac{3}{8} = 0.375$$

(iii) $b_{yx} = \dfrac{r \cdot \sigma_y}{\sigma_x}$

$$\frac{1}{5} = \frac{3}{8} \times \frac{\sigma_y}{5}$$

$$\sigma_y = \frac{8}{3}$$

Question 9.
If the two regression lines for a bivariate data are 2x = y + 15 (x on y) and 4y – 3x + 25 (y on x) find
(i) $\bar{x}$
(ii) $\bar{y}$
(iii) b_{yx}
(iv) b_{xy}
(v) r [Given √0.375 = 0.61]
Solution:
Since ($\bar{x}$, $\bar{y}$) is the point of intersection of the regression line
2x = y + 15
4y = 3x + 25
2x – y = 15 …….(i)
3x – 4y = -25 ……..(ii)
Multiplying equation (i) by 4
8x – 4y = 60
3x – 4y = -25
on Subtracting,
5x = 85
∴ x = 17
Substituting x in equation (i)
2(17) – y = 15
34 – 15 = y
∴ y = 15

$$\bar{x} = 17, \bar{y} = 19$$

$$2x = y + 15 \qquad 4y = 3x + 25$$

$$x = \frac{1}{2}y + 7.5 \qquad y = \frac{3}{4}x + 6.25$$

$$b_{xy} = \frac{1}{2} \qquad b_{yx} = \frac{3}{4}$$

$$b_{xy} \cdot b_{yx} = \frac{1}{2} \times \frac{3}{4} = \frac{3}{8} \in [0, 1]$$

∴ Our assumption is correct

$$r^2 = b_{xy} \cdot b_{yx}$$

$$r^2 = \frac{3}{8}$$

$$= 0.375$$

$$r = \pm\sqrt{0.375} = \pm 0.61$$

Since b_{yx} and b_{xy} are positive, ∴ r = 0.61

Question 10.

The two regression equation are 5x – 6y + 90 = 0 and 15x – 8y – 130 = 0. Find $\bar{x}$, $\bar{y}$, r.

Solution:

Since ($\bar{x}$, $\bar{y}$) is the point of intersection of the regression lines

5x – 6y + 90 = 0 ……(i)
15x – 8y – 130 = 0
15x – 18y + 270 = 0
15x – 8y – 130 = 0
on subtracting,
-10y + 400 = 0
y = 40
Substituting y = 40 in equation (i)
5x – 6(40) + 90 = 0
5x = 150
x = 30
∴ $\bar{x}$ = 30, $\bar{y}$ = 40

$$5x - 6y + 90 = 0 \qquad\qquad 15x - 8y - 130 = 0$$
$$6y = 5x + 90 \qquad\qquad 15x = 8y + 130$$
$$y = \frac{5}{6}x + 15 \qquad\qquad x = \frac{8}{15}y + \frac{130}{15}$$
$$b_{yx} = \frac{5}{6} \qquad\qquad b_{xy} = \frac{8}{15}$$
$$b_{yx} \cdot b_{xy} = \frac{5}{6} \times \frac{8}{15} = \frac{4}{9} \in [0, 1]$$

∴ **Our assumption is correct**

$$\therefore \quad r^2 = b_{yx} \cdot b_{xy}$$
$$= \frac{4}{9}$$
$$\therefore \quad r = \pm\frac{2}{3}$$

Since b_{yx} and b_{xy} are positive
∴ r = 23

Question 11.

Two lines of regression are 10x + 3y – 62 = 0 and 6x + 5y – 50 = 0 Identify the regression equation equation of x on y. Hence find $\bar{x}$, $\bar{y}$, and r.

Solution:

$$10x + 3y = 62 \qquad\qquad 6x + 5y = 50$$
$$10x = -3y + 62 \qquad\qquad 5y = -6x + 50$$
$$x = \frac{-3}{10}y + \frac{62}{10} \qquad\qquad y = \frac{-6}{5}x + 10$$
$$b_{xy} = \frac{-3}{10} \qquad\qquad b_{yx} = \frac{-6}{5}$$
$$b_{xy} \cdot b_{yx} = \frac{-3}{10} \times \frac{-6}{5} = \frac{18}{50} = \frac{9}{25} \in [0, 1]$$

∴ Our assumption is correct.
∴ Regression equation of X on Y is 10x + 3y – 62 = 0
$r^2 = b_{yx} . b_{xy}$
r^2 = 925
r = ±35
Since, byx and bxy are negative, r = −35 = -0.6
Also ($\bar{x}$, $\bar{y}$) is the point of intersection of the regression lines
50x + 15y = 310
18x + 15y = 150
on subtracting
32x = 160
x = 5
Substituting x = 5 in 10x + 3y = 62
10(5) + 3y = 62
3y = 12

$\therefore$ y = 4
$\therefore \bar{x}$ = 5, $\bar{y}$ = 4

Question 12.
For certain X and Y series, which are correlated the two lines of regression are 10y = 3x + 170 and 5x + 70 = 6y. Find the correlation coefficient between them. Find the mean values of X and Y.
Solution:

$$10y = 3x + 170 \qquad\qquad 5x + 70 = 6y$$
$$y = \frac{3}{10}x + 17 \qquad\qquad x = \frac{6}{5}y - 14$$
$$b_{yx} = \frac{3}{10} \qquad\qquad b_{yx} = \frac{6}{5}$$
$$b_{yx} \cdot b_{xy} = \frac{3}{10} \times \frac{6}{5} = \frac{18}{50} = \frac{9}{25} \in [0, 1]$$

$\therefore$ Our assumption is correct

$$r^2 = b_{yx} \cdot b_{xy}$$
$$= \frac{9}{25}$$
$$r = \pm\frac{3}{5}$$

Since byx and bxy are positive,
r = 35 = 0.6
Since, ($\bar{x}$, $\bar{y}$) is the point of intersection of the regression lines
3x – 10y = -170 …….(i)
5x – 6y = -70 ………(ii)
9x – 30y = -510
25x – 30y = -350
on subtracting
-16x = -160
x = 10
Substituting x = 10 in equation (i)
3(10) – 10y = -170
30 + 170 = 10y
200 = 10y
y = 20
$\therefore \bar{x}$ = 10, $\bar{y}$ = 20

Question 13.
Regression equation of two series are 2x – y – 15 = 0 and 4y + 25 = 0 and 3x- 4y + 25 = 0. Find $\bar{x}$, $\bar{y}$ and regression coefficients, Also find coefficients of correlation. [Given √0.375 = 0.61]
Solution:
Since ($\bar{x}$, $\bar{y}$) is the point of intersection of the regression line
2x = y + 15
4y = 3x + 25
2x – y = 15 ……(i)
3x – 4y = -15 ……..(ii)
Multiply equation (i) by 4
8x – 4y = 60
3x – 4y = -25
on subtracting,
5x = 85
x = 17
Substituting x in equation (i)
2(17) – y = 15
34 – 15 = y
y = 15
$\therefore \bar{x}$ = 17, $\bar{y}$ = 19

$$2x = y + 15 \qquad 4y = 3x + 25$$

$$x = \frac{1}{2}y + 7.5 \qquad y = \frac{3}{4}x + 6.25$$

$$b_{xy} = \frac{1}{2} \qquad b_{xy} = \frac{3}{4}$$

$$b_{xy} \cdot b_{yx} = \frac{1}{2} \times \frac{3}{4} = \frac{3}{8} \in [0, 1]$$

∴ Our assumption is correct
$r^2 = b_{xy} . b_{yx}$
$r^2 = \frac{3}{8} = 0.375$
$r = \pm\sqrt{0.375} = \pm 0.61$
Since, b_{yx} and b_{xy} are positive, ∴ r = 0.61

Question 14.
The two regression lines between height (X) in includes and weight (Y) in kgs of girls are 4y – 15x + 500 = 0 and 20x – 3y – 900 = 0. Find the mean height and weight of the group. Also, estimate the weight of a girl whose height is 70 inches.
Solution:
Since $(\bar{x}, \bar{y})$ is the point intersection of the regression lines
15x – 4y = 500 ……(i)
20x – 3y = 900 …….(ii)
60x – 16y – 2000
60x – 9y = 2700
on subtracting,
-7y = -700
y = 100
Substituting y = 100 in equation (i)
15x – 4(100) = 500
15x = 900
x = 60

∴ Our assumption is correct
∴ Regression equation of Y on X is
$Y = \frac{15}{4}x - 125$
When x = 70
$Y = \frac{15}{4} \times 70 = -125$
= 262.5 – 125
= 137.5 kg