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Q. From the following data Obtain the two regression equations:

X	6	2	10	4	8
Y	9	11	5	8	7

The regression equation of Y on X = $Y = a + bX$.

To determine a and 'b' above, the following two normal equations are to be solved —

$$\Sigma Y = Na + b\Sigma X$$
$$\Sigma XY = a\Sigma X + b\Sigma X^2$$

X	Y	X^2	Y^2	XY	$\bar{X}=6$ x	x^2	$\bar{Y}=8$ y	$(y)^2$	xy
6	9	$(6)^2=36$	$(9)^2=81$	$6\times9=54$	$6-6=0$	$(0)^2=0$	$9-8=1$	$(1)^2=1$	$0\times1=0$
2	11	$(2)^2=4$	$(11)^2=121$	$2\times11=22$	$2-6=-4$	$(4)^2=16$	$11-8=3$	$(3)^2=9$	$-4\times3=-12$
10	5	$(10)^2=100$	$(5)^2=25$	$10\times5=50$	$10-6=4$	$(4)^2=16$	$5-8=-3$	$(-3)^2=9$	$4\times-3=-12$
4	8	$(4)^2=16$	$(8)^2=64$	$4\times8=32$	$4-6=-2$	$(-2)^2=4$	$8-8=0$	$(0)^2=0$	$-2\times0=0$
8	7	$(8)^2=64$	$(7)^2=49$	$8\times7=56$	$8-6=+2$	$(2)^2=4$	$7-8=-1$	$(-1)^2=1$	$-2\times1=2$
$\Sigma X=30$	$\Sigma Y=40$	$\Sigma X^2=220$	$\Sigma Y^2=340$	$\Sigma XY=214$	$\Sigma x=0$	$\Sigma x^2=40$	$\Sigma y=0$	$\Sigma y^2=20$	$\Sigma xy=-26$

$$\bar{X} = \frac{\Sigma X}{N} = \frac{30}{5} = 6$$

$$\bar{Y} = \frac{\Sigma Y}{N} = \frac{40}{5} = 8$$

∴ Normal equations will be
$$40 = 5a + 30b \quad \text{——(i)}$$
$$214 = 30a + 220b \quad \text{——(ii)}$$

Multiplying equation (i) by 6,

$40 \times 6 = 5a \times 6 + 30b \times 6$

$240 = 30a + 180b$ —————— (iii)

$\underline{214 = 30a + 220b}$ —————— (ii)

$\overline{26 = \quad\quad\quad -40b}$

$-40b = 26$

$b = -0.65$

Substituting this value in equation (i),

$40 = 5a + 30b$ —————— (i)

$40 = 5a + 30(-0.65) \Rightarrow 40 = 5a - 19.5$

$59.5 = 5a$

$\therefore a = 11.9$

Therefore regression equation of Y on X is

$Y = 11.9 - 0.65X$

* Regression equation of X on Y is

$X = a + bY$

To calculate 'a' and 'b' normal equations are:

$\Sigma X = Na + b\Sigma Y$

$\Sigma XY = a\Sigma Y + b\Sigma Y^2$

$\Sigma X = 30, \Sigma Y = 40, \Sigma XY = 214, \Sigma Y^2 = 340$

$\Sigma X = 30, \Sigma Y = 40$

$N = 5$

$30 = 5a + 40b$ —————— (i)

$214 = 40a + 340b$ —————— (ii)

Multiplying eq^n (i) by 8 and solving it Simult-aneously with (ii) we get :-

$$30 \times 8 = 5a \times 8 + 40b \times 8$$
$$240 = 40a + 320b$$
$$214 = 40a + 340b$$
$$\overline{} \quad - \quad - \quad -$$
$$26 = -20b$$
$$b = -1.3$$

Substituting value of 'b' in eqn. (i)

$$30 = 5a + 40b$$
$$30 = 5a + 40(-1.3) \Rightarrow 30 = 5a - 52$$
$$a = 16.4$$

∴ Regression equation of X on Y will be –

$$X = 16.4 - 1.3Y$$

Note: The above method is very lengthy. Instead the following method can also be used –