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DPP-11 Maths-4 Unit-3

Topic- Regression liner

Q-1- From the data given. Find the equation of liner of regression of x on y and y on x. Calculate correlation co-efficint

x	2	4	6	8	10
y	5	7	9	8	11

Sol-

x	y	x^2	y^2	xy
2	5	4	25	10
4	7	16	49	28
6	9	36	81	54
8	8	64	64	64
10	11	100	121	110
$\Sigma x = 30$	$\Sigma y = 40$	$\Sigma x^2 = 220$	$\Sigma y^2 = 340$	$\Sigma xy = 266$

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

$$= \frac{5 \times 266 - 30 \times 40}{5 \times 220 - (30)^2}$$

$$= \frac{1330 - 1200}{1100 - 900}$$

$$b_{yx} = \frac{130}{200} = 0.65$$

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$$b_{xy} = \frac{n\Sigma xy - \Sigma x \Sigma y}{n\Sigma y^2 - (\Sigma y)^2}$$

$$= \frac{266 \times 5 - 30 \times 40}{5 \times 340 - (40)^2}$$

$$= \frac{130}{100}$$

$$\boxed{b_{xy} = 1.3}$$

$$r = \sqrt{b_{xy} \times b_{yx}}$$

$$r = \sqrt{0.65 \times 1.3}$$

$$\boxed{r = 0.919}$$

$$\bar{x} = \frac{\Sigma x}{n} = \frac{30}{5} = 6$$

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

Regression line

y on x $\Rightarrow$ $(y - \bar{y}) = b_{yx}(x - \bar{x})$

$$y - 8 = 0.65(x - 6)$$

$$y - 8 = 0.65x - 3.9$$

$$\boxed{y = 0.65x + 4.1}$$

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x on $y \Rightarrow$ $(x - \bar{x}) = b_{xy}(y - \bar{y})$

$x - 6 = 1.3(y - 8)$

$x - 6 = 1.3y - 10.4$

$\boxed{x = 1.3y - 4.4}$

Q-2- For two random variables, x and y with the same mean, two regression equations are $y = ax + b$ and $x = \alpha y + \beta$. Show that $\frac{b}{\beta} = \frac{1-a}{1-\alpha}$. Find also common mean.

Sol:- $y = ax + b$ — (1)

$b_{yx} = a$

$x = \alpha y + b$ — (2)

$b_{xy} = \alpha$

Let the common mean be m, then regression liner

y on $x \Rightarrow$ $y - m = a(x - m)$

$\boxed{y = ax + m(1-a)}$ — (3)

x on $y \Rightarrow$ $x - m = \alpha(y - m)$

$\boxed{x = \alpha y + m(1-\alpha)}$ — (4)

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Comparing equation (1) and (3) we get,

$$\boxed{b = m(1-a)}$$

Comparing equation (2) and (4) we get,

$$\boxed{\beta = m(1-\alpha)}$$

$$\therefore \boxed{\frac{b}{\beta} = \frac{1-a}{1-\alpha}}$$

Proved

Since regression lines pass through mean,

$\bar{x} = \alpha\bar{y} + \beta$ and $\bar{y} = a\bar{x} + b$

We assume common mean = m

$m = \alpha m + \beta$ and $m = am + b$

$\therefore \alpha m + \beta = am + b$

$\alpha m - am = b - \beta$

$m(\alpha - a) = b - \beta$

$$\boxed{m = \frac{b-\beta}{\alpha-a}}$$

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Q-3- The following data regarding the heights (y) and weights (x) of 100 college students are given-

$\Sigma x = 15000$, $\Sigma x^2 = 2272500$, $\Sigma y = 6800$, $\Sigma y^2 = 463025$
$\Sigma xy = 1022250$

Find the equation of regression line of height on weight.

Sol- $$\bar{x} = \frac{\Sigma x}{n} = \frac{15000}{100}$$

$$\boxed{\bar{x} = 150}$$

$$\bar{y} = \frac{\Sigma y}{n} = \frac{6800}{100}$$

$$\boxed{\bar{y} = 68}$$

Regression coefficient of y on x,

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

$$= \frac{(100 \times 1022250) - (15000 \times 6800)}{(100 \times 2272500) - (15000)^2} = 0.1$$

Regression line of height (y) on weight (x) is given by

$$y - \bar{y} = b_{yx}(x - \bar{x})$$
$$y - 68 = 0.1(x - 150)$$
$$\boxed{y = 0.1x + 53}$$ Ans

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Q- The equations of two regression lines, obtained in a correlation analysis of 60 observations are $5x = 6y + 24$ and $1000y = 768x - 3608$

What is the correlation coefficient? Show that the ratio of coefficient of variability of x to y is 5/24. What is the ratio of variance of x and y?

Sol- Regression line of x on y is

$$5x = 6y + 24$$
$$x = \frac{6}{5}y + \frac{24}{5}$$

$$\boxed{b_{xy} = \frac{6}{5}}$$

Regression line of y on x is:-

$$1000y = 768x - 3608$$
$$y = 0.768x - 3.608$$

$$\boxed{b_{yx} = 0.768}$$

We know, $r = \sqrt{b_{xy} \times b_{yx}}$

$$r = \sqrt{1.2 \times 0.768}$$

$$r = \sqrt{0.921}$$

$$\boxed{r = 0.96}$$

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We know,

$$b_{xy} = r\frac{\sigma_x}{\sigma_y}$$

$$\frac{6}{5} = 0.96\,\frac{\sigma_x}{\sigma_y}$$

$$\frac{6}{4.8} = \frac{\sigma_x}{\sigma_y}$$

$$\boxed{\frac{\sigma_x}{\sigma_y} = 1.25}$$

Since mean satisfies the regression lines,

$$5\bar{x} = 6\bar{y} + 24 \quad \text{—(1)}$$

$$1000\bar{y} = 768\bar{x} - 3608 \quad \text{—(2)}$$

By solving eq (1) and (2) we get,

$$\boxed{\bar{x} = 6} \text{ and } \boxed{\bar{y} = 1}$$

Coefficient of variability of $x = \frac{\sigma_x}{\bar{x}}$

Coefficient of variability of $y = \frac{\sigma_y}{\bar{y}}$

$$\text{Required ratio} = \frac{\sigma_x}{\bar{x}} \times \frac{\bar{y}}{\sigma_y} = \frac{\bar{y}}{\bar{x}} \times \frac{\sigma_x}{\sigma_y} = \frac{1}{6} \times \frac{5}{4} = \frac{5}{24}$$

Proved

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