PnS 2 Assignment
Unit 3 & 4.

Roll 89.

Q1)

	1	2	3	4	5	6	7	8	9	10
x	40	10	100	110	120	150	20	90	80	130
y	56	62	195	240	170	270	48	196	214	286
xy	2240	620	19500	26400	20400	40500	960	17640	17120	37180
x^2	1600	100	10000	12100	14400	22500	400	8100	6400	16900

Total

x	850
y	1737
xy	182560
x^2	92500

(a) $\therefore S_{xy} = \Sigma x_i y_i - \dfrac{\Sigma x_i \Sigma y_i}{n}$

$$= 182560 - \frac{850 \times 1737}{10}$$

$$= \underline{\underline{34915}}$$

$$S_{xx} = \Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}$$

$$= 92500 - \frac{850^2}{10}$$

$$= \underline{\underline{20250}}$$

$$\hat{b} = \frac{S_{xy}}{S_{xx}} = \underline{\underline{1.72}}$$

$$\hat{a} = \frac{y}{n} - \hat{b}\left(\frac{x}{n}\right) = \frac{1737}{10} - 1.72\left(\frac{850}{10}\right)$$

$$= \underline{\underline{27.14}}$$

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$\therefore y = 27.14 + 1.72x$

(b) Hence, the gradient represents the amt of hours spent per rupee.

Q2)

(i) $Sxx = \Sigma x_i^2 - n\bar{x}^2$

$= \underline{301.66}$

$Sxy = \Sigma xy - n\bar{x}\bar{y}$

$= \underline{875.16}$

$\hat{\beta} = \frac{Sxy}{Sxx}$

$= \underline{2.901147}$

$Syy = \Sigma y^2 - n\bar{y}^2$

$= \underline{1409.712}$

$\alpha = \underline{3.748182}$

$\therefore$ Equation $y = 3.748182 + 2.901147 x_i$

(ii) 95% C.I :-

$$\hat{\beta} \pm t_{0.025,10}\sqrt{\frac{\sigma^2}{Sxx}}$$

$$\therefore \sigma^2 = \frac{1}{n-2}\left(Syy - \frac{S_{xy}^2}{Sxx}\right)$$

$= 6155.816$

$\therefore$ 95% C.I is $\underline{(-7.16351, 12.965)}$

Q3)

(i) Even though the centres of all distributions are different, variance of all cities is almost same.

(ii) Assumptions:-

- observations are independent
- Must have common variance
- Population must be normal.

(iii) H_0: Mean is same

v/s

H_1: Mean is not same

$\therefore SS_T = 1495 - \frac{103^2}{28}$

$= \underline{1116.11}$

$\therefore SS_{Reg} = \frac{1}{7}\left(64^2 + 44^2 + 8^2 + (-13)^2\right) - \frac{103^2}{28}$

$= \underline{516.11}$

$\therefore SS_{Res} = SS_T - SS_{Reg}$

$= \underline{600}$

ANOVA Table:-

Source	df	SS	MSS	F
Regression	3	516.11	172.04	6.88
Residual	24	600	25	
Total	27	1116.11		

$F = 6.88$; $F_{3,24} = 3.009$ at 5%

$\therefore$ we reject H_0.

Q5)

source	df	SS	MSS	F
Regression	3	21.153	7.051	45.638
Residual	8	1.236	0.155	
Total	11	22.38		

$F_{3,8,5\%} = 7.951$

$\therefore$ we reject H_0

Q6) $r = \dfrac{S_{xy}}{\sqrt{S_{xx} \cdot S_{yy}}}$

$S_{xx} = \Sigma x_i^2 - n\bar{x}^2$
$= 54.9$

$S_{yy} = \Sigma y_i^2 - n\bar{y}^2$
$= 8923.6$

$S_{xy} = \Sigma xy - n\bar{x}\bar{y}$
$= 661.2$

(i) $r = 0.9446$

(ii) $\beta = \dfrac{S_{xy}}{S_{xx}} = 12.04372$

$\alpha = \bar{y} - \beta\bar{x} = 9.2295$

$\therefore y = 9.2295 + 12.0437 x_i$

$SS_{Tot} = S_{yy}$

$= \cancel{8917.28}\ 8923.6$

$SS_{Reg} = \frac{S^2_{xy}}{S_{xx}}$

$= 7963.305$

$SS_{Res} = SS_{Tot} - SS_{Reg}$

$= 960.295$

$R^2 = \frac{SS_{Reg}}{SS_{Tot}}$

$= 0.8923$

Both of them show the relationship

Q7) $S_{xy} = 2176.84$ — given

$S_{xx} = \Sigma x_i^2 - n\bar{x}^2$

$= 4789.422$

$S_{yy} = \Sigma y_i^2 - n\bar{y}^2$

$= 1189.208$

(i) $\beta = \frac{S_{xy}}{S_{xx}}$

$= 0.4545$

$\alpha = \bar{y} - \hat{\beta}\bar{x}$

$= 10.7905$

$\therefore y = 10.79056 + 0.4545x_i$

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(ii) $\sigma^2 = \frac{1}{11-2}\left(S_{yy} - \frac{S^2_{xy}}{S_{xx}}\right)$

$= 22.201$

$H_0 : \beta = 0$ V/S $H_1 : \beta \neq 0$

$$\frac{\hat{\beta} - \beta}{\sqrt{\sigma^2 / S_{xx}}} \sim t_{n-2}$$

$$\therefore \frac{0.4545}{\sqrt{\frac{22.201}{4789.422}}} = \underline{6.675675}$$

$t_{9, 0.025} = 2.262$

$\therefore$ we reject Ho.

Hence, there is a linear relationship.

(iii) $r = \frac{S^2_{xy}}{\sqrt{S_{xx} \cdot S_{yy}}}$

$= \underline{0.912129}$

Q8)

(ii)

PC	Diagonal Entry (PC)	PCi / sum (PCi)
PC1	0.456	65%
PC2	0.137	18.5%
PC3	0.08	11.4%
PC4	0.0165	2.4%
PC5	0.013	1.7%
	0.1015	100%

Q9)

(i) Seems negatively correlated

(ii) $S_{xx} = 75$

$S_{yy} = 2482.4$

$S_{xy} = -296$

$$r = \frac{S_{xy}}{\sqrt{S_{xx} \cdot S_{yy}}}$$

$= 0.686$

$\therefore$ -vely correlated.

(iii) $H_0 : \rho = 0$; $H_1 : \rho < 0$

$\therefore \tanh^{-1}(r) - \tanh^{-1}(\rho) \sim N\left(0, \frac{1}{n-3}\right)$

$$\frac{\tanh^{-1}(r) - \tanh^{-1}(\rho)}{\sqrt{\frac{1}{n-3}}}$$

$Z_{cal} = -2.0789$

$Z_{5\%} = 1.6449$

$\therefore$ We reject H_0

$\therefore \rho < 0$

(iv) $\hat{\beta} = \frac{S_{xy}}{S_{xx}} = -3.94667$

$\hat{\alpha} = \bar{y} - \hat{\beta}\bar{x}$

$= 82.16$

$\hat{y} = 82.16 - 3.9466x_i$

(v) $R^2 = \frac{S_{xy}}{S_{xx} \cdot S_{yy}} = 47.05\%$

$\therefore$ Not a good fit.

(vi) $x_0 = 1$

$y_0 = \hat{\alpha} - \hat{\beta} x_0$

$= 78 - 2133$

Q10) $S_{xx} = 0.0042$

$S_{yy} = 0.00126$

$S_{xy} = 0.0022$

$SS_{Tot} = 0.00126$

$SS_{Reg} = \frac{S^2_{xy}}{S_{xx}} = 0.00115$

$SS_{Res} = SS_{Tot} - SS_{Reg}$

$= 0.0011$

ANOVA Table :-

Source	df	SS	MSS	F
Regression	1	0.00115	0.00115	10.454
Residual	1	0.00011	0.00011	
Total	2	0.00126		

$H_0 : \beta = 0$; $H_1 : \beta \neq 0$

$F_{1,1,5\%} = 161.4$

$\therefore F_{cal} < F_{tab}$

$\therefore$ we will not reject H_0.

$\therefore \beta = 0$

—X—O—X—