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Assignment - 2

0.1) A)

$\Sigma x^2 = 925000 \mid \Sigma y^2 = 372717 \mid \Sigma xy = 182560$

$\Sigma x = 850 \mid \Sigma y = 1737$

$S_{xx} = 852750 \mid S_{yy} = 71000.1 \mid S_{xy} = 34915$

$\beta = 0.040944$

$\alpha = 170.219$

$\alpha + \beta x$

$= 170.219 + 0.040944x$

b) β is 0.040944

Viewing the above one and taking into consideration, β is close to 0 & and so it is not much significant.

2) $\Sigma x^2 = 12666.58 \mid \Sigma y^2 = 119026.9 \mid \Sigma x = 385.2 \mid \Sigma y = 1162.5$

$\Sigma xy = 38191.41$

$S_{xx} = 301.66 \mid S_{xy} = 875.16 \mid S_{yy} = 6409.7125$

$\beta = 2.9011$

$\alpha =$ ~~11624~~ 3.7496

$\therefore \alpha + \beta x = 3.7496 + 2.9011x$

When the time to perform arrives, the time to prepare has passed.

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2) ii) $\sigma^2 = 387.0744$

$\hat{\beta}$ follows normal distribution

$$\hat{\beta} \sim N\left(\beta, \frac{\sigma^2}{S_{xx}}\right)$$

$$95\%\ CI = \beta \pm t_{0.025,12}\left(\frac{\sigma}{\sqrt{S_{xx}}}\right)$$

$$= 2.9011 \pm (2.228)(1.132)$$

$$95\%\ CI = (5.4232, 0.379)$$

iii) $$Y_i \sim N\left(\hat{\alpha} + \beta x_0, \left(\frac{1}{n} + \frac{(x_0 - \bar{x})^2}{S_{xx}}\right)\cdot\sigma^2\right)$$

$$E(\mu_0) = \hat{\alpha} + \hat{\beta} x_0$$

$$= 119.7936$$

$$CI = \mu_0 \pm t_{\alpha/2, n-2} \sqrt{\left(\frac{1}{n} + \frac{(x_0 - \bar{x})^2}{S_{xx}}\right)\cdot\hat{\sigma}^2}$$

$$= 119.7936 \pm 2.228 \cdot \sqrt{\frac{1}{12} + \frac{(40 - 32.1)^2}{301.66}\cdot 387.0745}$$

$$= 119.7936 \pm 22.1431$$

$$CI = (97.6504, 141.9368)$$

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3)i) Looking at the plot, we can conclude that travelling from city A and city B will take much more time than usual and it will be busy. However, travelling in city C the time taken will be similar but in city D, we can say that people might reach early in this case. Thus, to conclude, government can check upon city A or city B.

~~ii) Anova assumes that the data is normally distributed~~

i) $\Sigma x = 39$ | $\Sigma y = 562$

$\Sigma x^2 = 207$ | $\Sigma y^2 = 40508$

$S_{xx} = 54.9$

$S_{xy} = 8923.6$

$S_{yy} = 661.2$

i) correlation coefficient $= \frac{S_{xy}}{\sqrt{S_{xx} \cdot S_{yy}}} = 0.944662$

ii) $\beta = 12.0437$

$\alpha = 9.2296$

$\therefore$ Equation $= 12.0437x + 9.2296$

c)iii) $SS_{Reg} = \frac{S^2_{xy}}{S_{xx}} = 7963.30$

$SS_{Res} = S_{xx} - \frac{S^2_{xy}}{S_{xx}} = 960.295$

$\therefore SS_{TOT} = SS_{Reg} + SS_{Res}$

$SS_{TOT} = 8923.595$

iv) $R^2 = \frac{S^2_{xy}}{S_{xx} \cdot S_{yy}}$

$R^2 = 0.8923$

v) $\Sigma x = 174.13 \mid \Sigma y = 197.84$

$\Sigma x^2 = 7545.90 \mid \Sigma y^2 = 4747.45$

$S_{xy} = 2176.84 \mid S_{xx} = 4789.4221$

$S_{yy} = 1189.2076$

i) $\beta = \frac{S_{xy}}{S_{xx}} = 2.20017$

$\alpha = -16.8432$

$\therefore \hat{y} = 2.20017x - 16.8432$

ii) ~~$H_0 : \beta = 0$~~

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7)ii) $H_0 : \beta = 0$

$H_1 : \beta \neq 0$

$\hat{\sigma}^2 = 199.8121$

$t_{cal} = \dfrac{\hat{\beta} - \beta}{\hat{\sigma} / \sqrt{S_{xx}}}$

$= 10.7718$

$t_{tab} = 2.776$

$\therefore \quad 10.7718 > 2.776$

$t_{cal} > t_{tab}$

$\therefore$ Reject H_0

This reflects that there is a linear relationship between x and y.

7)iii) $r = 0.912128$

a) $\Sigma x = 45 \quad | \quad \Sigma y = 644 \quad | \quad \Sigma xy = 2602$

$\Sigma x^2 = 277.5 \quad | \quad \Sigma y^2 = 43956$

$S_{xx} = 75$

$S_{yy} = 2482.4$

$S_{xy} = -296$

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9) i) The plot shows a Negative correlation between x and y.

ii) $r = -0.686$

This states a strong Negative correlation

iii) ~~tanh⁻¹~~ $\tanh^{-1} r \sim N(\tanh^{-1}\rho, \frac{1}{n-3})$

$H_0 : \rho = 0$

$H_1 : \rho < 0$

$$\frac{\tanh^{-1} r - \tanh^{-1}\rho}{\sqrt{1/n-3}} = Z_{cal}$$

$$Z_{cal} = \frac{-0.84036 - 0}{\sqrt{1/7}}$$

$$Z_{cal} = -2.22338$$

$Z_{tab} = Z_{2.5} = 1.96$

$Z_{0.5} = 2.58$

Above one states that, at 5% Level of significance, we Reject H_0.

However, at 1% Level of significance, we do not Reject H_0.

~~The~~ This helps to know that there is Negative correlation at 5% Level of significance.

However, at 1% Level of significance, there is no correlation.

3)ii) The Assumptions required to carry out ANOVA are :-

a) plot must ~~be~~ have Normal Distribution

b) population should have common values.

c) ~~Sa~~ observations should be Independent

3)iii) Ho : difference is same

H_1 : difference is not same

$$SS_{TOT} = \Sigma y^2 - \left(\frac{\Sigma y}{n}\right)^2$$

$$SS_{Tot} = 1116.11$$

$$SS_{Reg} = \left((64)^2 + (44)^2 + (8)^2 + (-13)^2\right) - \frac{(103)^2}{(20)}$$

$$SS_{Reg} = 516.11$$

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

$$SS_{Res} = 1116.11 - 516.11$$

$$SS_{Res} = 600$$

Anova Testing :

$$f = \frac{MSS_{Reg}}{MSS_{Res}}$$

$$F = \frac{172.04}{25}$$

$$F = 6.88$$

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3) iii) Test statistics = 6.88

$F_{3,24;5\%} = 3.009$

Thus, we can conclude with the evidence found out, Reject H_0 at 5% level of significance.

10)

x	y
0.27	0.05
0.36	0.10
0.30	0.08

$S_{XX} = 0.0072$ | $S_{YY} = 0.0012$ | $S_{XY} = 0.0022$

$\therefore SS_{TOT} = 0.00126$

$SS_{Reg} = 0.0011$

$SS_{Res} = 0.0001$

Anova Table :

1	0.00115
1	0.00041
2	0.001

$H_0 : \beta = 0$

$H_1 : \beta \neq 0$

Test statistic $= \frac{MSS_{Reg}}{MSS_{Res}} = 10.24$

$F_{1,5\%} = 16.4$

$\therefore$ Do not Reject

8.4)

a) The assumption is that the variables are independent and identically distributed.

b) $n_1 = 7 \mid n_2 = 8 \mid n_3 = 6 \mid n_4 = 7 \mid n_5 = 5 \mid$ Total $n = 33$

$SS_{TOT} = 69930.00$

$SS_{Reg} = 227325.60$

$SS_{Res} = 64604.37$

Test statistic $= \dfrac{MSS_{Reg}}{MSS_{Res}} = 3.283$

$F_{4,28,0.05} = 2.714$

Thus, we have sufficient proof to Reject H_0.