Dr. Narendra Kr.

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATION- 2016

B.Tech IV Semester

COURSE CODE: 10B12MA421 MAX. MARKS: 15

COURSE NAME: BIOSTATISTICS

COURSE CREDITS: 05 MAX. TIME: 1 HR

Note: *All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.*

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1. A set of experimental runs was made to determine a way of predicting cooking time Y at various level of oven width x_1, and flue temperature x_2. Write the normal equations using matrix notations for the given multiple linear regression equation. $\boldsymbol{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2}$
   For the data set we obtained;

   $\boldsymbol{n = 10,\ \sum X_1 = 50,\ \sum X_2 = 150,\ \sum X_1^2 = 450,\ \sum X_1 X_2 = 1250,\ \sum X_2^2 = 4000}$
   $\boldsymbol{\sum Y = 450\ \sum X_1 Y = 3875,\ \sum X_2 Y = 11750\ and\ \sum Y^2 = 36340}$

   (a) Write the multiple linear regression model $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2$ in matrix form $\boldsymbol{Y = X\beta}$ writing all matrices $\boldsymbol{Y, X\ and\ \beta}$. Write normal equations in matrix form which gives estimates $\hat{\boldsymbol{\beta}}$.
   Further we have $(X'X)^{-1}$ obtained as:

$$(X'X)^{-1} = \begin{bmatrix} 0.2375 & -0.0125 & -0.005 \\ -0.0125 & 0.0175 & -0.005 \\ -0.005 & -0.005 & 0.002 \end{bmatrix}$$

   (b) Find all estimates $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2$.
   (c) Find $SE(\hat{\sigma})$ and $SE(\hat{\beta}_1)$;
   (d) Test at 5% level of significance that $\boldsymbol{H_0: \beta_1 = 0\ vs\ H_a: \beta_1 \neq 0}$. Also infer at 1% level.
   Given that for two sided test tabulated $\boldsymbol{t_{\alpha=5\%,df=7} = 1.895, t_{\alpha=1\%,df=7} = 2.365.}$ **Marks 4**

2. Using Fisher test, find two sided 95% confidence interval for the population correlation coefficient ρ . Whereas from 12 pairs, obtained sample correlation is 0.6. From this CI can we conclude at 5% level of significance that $H_0: \rho = 0.4$. **Marks 2.5**

3. Due to the fact that carbon dioxide and water in the air react together to form carbonic acid. Thus, rainwater is only considered acidic if the pH level is less than **5.2.** remote region in Rajasthan State, an environmental biologist measured the pH levels of rainwater and obtained the following data for 20 rainwater samples on 20 different dates:
   Is there reason to believe that the rainwater from this region is considered acidic (less than 5.2)?
   Use the sign test to infer $\boldsymbol{H_0: \tilde{\mu} = 5.2\ vs\ H_a: \tilde{\mu} < 5.2}$, at 10% as well as at 5% level of significance. Also find **p-value**, normalizing the sign test and compare the inference.

4.73	5.28	4.87	5.26	5.04	5.06	5.07	5.09	5.16	5.11
5.15	4.79	5.21	4.88	5.11	5.3	4.81	5.28	5.38	4.97

Marks 2.5

(25)

4. Quality control chart has been maintained for the weights of paint cans taken from a conveyor belt at a fixed point in a production line. Sixteen (16) weights obtained on a particular day, in order of time, are as follows:

67.6	68.6	64.7	65.3	70.4	65	63.6	69.3
71.6	64.2	70.1	71.6	66.8	68.9	68.9	68.2

Using Normalized run test, determine at 5% level of significance, whether the weights of the paint cans on the conveyor belt deviate from randomness. Also conclude the inference at 5% level of significance. Given that $\Phi(1.96) = P(Z \leq 1.96) = 0.975$, $\Phi(2.56) = P(Z \leq 2.56) = 0.995$.

Marks 2.5

5. To answer the query: does physical exercise alleviate depression? We find some depressed people and check that they are all equivalently depressed to begin with. Then we allocate each person randomly to one of three groups: no exercise; 20 minutes of jogging per day; or 60 minutes of jogging per day. At the end of a month, we ask each participant to rate how depressed they now feel, on a Likert scale that runs from 1 ("totally miserable") through to 100 ("ecstatically happy").

Rating on depression scale:

No exercise	23	26	51	49	58	37	29	44
Jogging for 20 minutes	22	27	39	29	46	48	49	65
Jogging for 60 minutes	59	66	38	49	56	60	56	62

Using **Kruskal-Wallis** test conclude if there is a difference of some kind between three groups at 5% as well as 1% level of significance. Given **that** $\chi^2_{\alpha=5\%,2} = 5.99$, $\chi^2_{\alpha=1\%,2} = 9.21$

Marks 3.5