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The Open University of Sri Lanka

B.Sc/B.Ed. DEGREE, CONTINUING EDUCATION PROGRAMME

~~Open~~ No Book Test (~~OBT~~ NBT) 2023/2024

Level 05 - Applied Mathematics

ADU5301– Regression Analysis I

Date: 10.02.2024 **10.30 a.m. to 11.30 a.m.**

Instructions

- This examination is of **one-hour** duration.
- Answer **all** questions.
- Each of the two questions is allocated equal marks, distributed as indicated. Final total mark will be converted to a mark out of 100.
- Non programmable calculators are permitted.
- Where appropriate, you may use $\widehat{\beta}_1 = \frac{\sum(x_i-\bar{x})(y_i-\bar{y})}{\sum(x_i-\bar{x})^2} = \frac{\sum(x_iy_i)-(\sum x_i)(\sum y_i)/n}{\sum x_i^2-(\sum x_i)^2/n}$ and $\widehat{\beta}_0 = \frac{\sum y_i}{n} - \widehat{\beta}_1\frac{\sum x_i}{n}$., in the usual notation.

1. a) Reaction times (in minutes) of a chemical reaction y, were measured on 40 samples, by adding known amounts of a catalyst (mg), x. Amounts of catalyst added to samples were 0 (no catalyst), 0.2, 0.4, 0.6 and 0.8 milligrams. Eight replicates were collected with each amount of catalyst. Summary statistics calculated from the data are presented below.

$$\sum x_i = 16,\ \sum y_i = 125.0,\ \sum x_i^2 = 9.6\ \sum y_i^2 = 414.78,\ \sum x_iy_i = 41.3.$$

Researcher wants to fit a simple linear regression model, using amount of catalyst as the predictor variable.

i) Calculate the least squares estimates for the slope and intercept parameters in the model equation and obtain the equation of the fitted line.

(40 marks)

ii) Based on the fitted model, estimate the change in the mean reaction time, when amount of catalyst is increased from 0.3 mg to 0.5 mg.

(20 marks)

iii) Based on the fitted model, a student concluded that, when the amount of catalyst is increased from 0.8 mg to 1.2 mg, change in the mean reaction time would be approximately 11 minutes. Comment on the conclusion made by the student.

(20 marks)

(ii) $\underline{m} \cdot \underline{l} + \underline{n} \cdot \underline{m} + \underline{l} \cdot \underline{n}$, where

$$\underline{l} = \frac{\underline{m} \times \underline{n}}{[\underline{l}\ \underline{m}\ \underline{n}]}, \quad \underline{m} = \frac{\underline{n} \times \underline{l}}{[\underline{l}\ \underline{m}\ \underline{n}]}, \quad \underline{n} = \frac{\underline{l} \times \underline{m}}{[\underline{l}\ \underline{m}\ \underline{n}]} \quad \text{and} \quad [\underline{l}\ \underline{m}\ \underline{n}] \neq 0,$$

(b) If $2\underline{i} - \underline{j} + 3\underline{k}$, $3\underline{i} + 2\underline{j} + \underline{k}$, $\underline{i} + m\underline{j} + 4\underline{k}$ are coplanar, find the value of m,

(c) If $\underline{a}$, $\underline{b}$, $\underline{c}$ are three vectors such that $|\underline{a}| = 1, |\underline{b}| = 2, |\underline{c}| = 1$ and $\underline{a} \times (\underline{a} \times \underline{b}) + \underline{c} = 0$, then find the acute angle between $\underline{a}$ and $\underline{b}$.