The Open University of Sri Lanka
B.Sc./B.Ed. Degree Programme
Closed Book Test (CBT) - 2010/2011
Applied Mathematics – Level 04
APU2141 –Regression Analysis I

Date: 02nd May 2011 Time: 4.00pm – 5.30pm

Answer All Questions.

Statistical Tables are provided. Non programmable calculators are permitted

01. The following observations were collected in an agricultural experiment that focused on studying the effect of a fertilizer on the dried weight of a medicinal plant. Let x denote the amount of fertilizer added (in milligrams) and y denote the dried weight of the plant (in grams) after three weeks of adding the fertilizer.

x	5	5	5	6	6	8	8	8	9	10	10	10
y	3.0	3.1	3.2	3.5	3.4	4.1	4.3	4.0	4.7	5.1	5.0	5.2

x	10	11	11	11	12	12	12	12	13	14	14	14
y	5.1	5.6	5.5	5.5	5.4	5.7	5.8	5.8	6.1	6.4	6.8	6.7

Suppose, in the usual notation, the model $y = \beta_0 + \beta_1 x + \varepsilon$ is appropriate for the relationship between x and y.

i) In relation to this study, clearly state the assumptions you make in fitting the model using the method of least squares.

ii) Estimate the expected dried weight of a randomly chosen plant that had received 7 milligrams of fertilizer.

iii) Estimate the change in the expected dried weight, if the amount of fertilizer is increased from 7 grams to 7.5 grams.

02. A student fitted a simple linear regression model $y = \beta_0 + \beta_1 x + \varepsilon$ using the method of least squares for the observations collected in an experiment designed to study the effect of diet, x, on the weight gain of rats, y. The following are summary statistics computed from the data.

$$\sum x_i = 86.1; \qquad \sum y_i = 88.11; \qquad \sum x_i y_i = 318.332$$
$$\sum x_i^2 = 337.73; \qquad \sum y_i^2 = 319.10.$$

The student reported that the mean squared error (MSE) is 0.296.

i) Estimate the slope parameter β_1.

ii) Construct a 95% confidence interval for β_1. (You may use $V(\hat{\beta}) = \frac{\sigma^2}{\sum (x_i - \bar{x})^2}$).

iii) Using Part (ii) or otherwise, determine whether the diet has a significant effect on the weight gain of rats. Give reasons for your answer.

03. State whether the following statements are true of false for fitting a simple linear regression model. In each case, give reasons for your answer.

a) Plots of residuals against the fitted values and plots of residuals against the predictor variable will have the same pattern.

b) If the observations are uncorrelated, plots of residuals against the predictor variable will have no specific pattern.

c) If the variables have a positive linear association, the estimate for the slope parameter will be positive.

d) Extreme observations always give large residuals.