

EASTERN UNIVERSITY, SRI LANKA

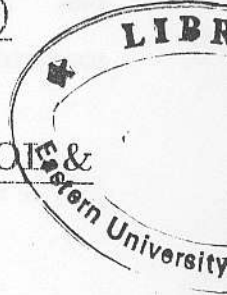
THIRD YEAR SECOND SEMESTER EXAMINATION

IN SCIENCE 2002/2003 & 2002/2003(A)

(Apr./May.'2004)

ST 303 - STATISTICAL QUALITY CONTROL &

REGRESSION ANALYSIS



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Answer all questions

Time : 3 hours

Statistical Tables will be provided

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1. (a) Explain briefly what is meant by "Statistical Quality Control (SQC)".
- (b) Distinguish between "Process Control" and "Product Control".
- (c) State the advantages of SQC in industrial manufacturing process.
- (d) Define "Process Parameters" and state how a testing process of hypothesis on parameters be performed.

[4 × 25 = 100]

2. (a) Distinguish between control charts for "Variables" and "Attributes".
- (b) Define  $3\sigma$ -control limits for controlling variable characteristics in quality control.

- (c) The net contents in ounces(oz) of a canned soft drink is a random variable  $X$  with probability distribution

$$f(x) = \begin{cases} 4(x - 11.75) & ; 11.75 \leq x \leq 12.25 \\ 4(12.75 - x) & ; 12.25 \leq x \leq 12.75 \end{cases}$$

Find the probability that a can contains less than 12 oz of product.

- (d) The inside diameters of bearings produced by a certain manufacturing process are known to have a standard deviation of 0.0001 cm. A random sample of 15 bearings has an average inside diameter of 8.2535 cm. Construct 95% confidence interval on the mean bearing diameter and set up  $3\sigma$  control limits for inside diameters.

$$[20 + 20 + 30 + 30 = 100]$$

3. (a) Draw mean and range charts from the following data and state your conclusions.

Sample Number	1	2	3	4	5	6	7	8	9	10
Mean	12.8	13.1	13.5	12.9	13.2	14.1	12.1	15.5	13.9	14.2
Range	2.1	3.1	3.9	2.1	1.9	3.0	2.5	2.8	2.5	2.0

- (b) A company purchases a small metal bracket in containers of 5000 each. Ten containers have arrived at the unloading facility, and 250 brackets are selected at random from each container. The number of brackets non-conforming in each sample are; 0, 0, 1, 2, 0, 5, 1, 0, 0 and 2.

- i. Construct appropriate control chart for detecting non-conformity.
  - ii. Does the data from this shipment indicate statistical control.
- (c) Define and Distinguish between "Single sampling plan" and "Double sampling plan" for testing product control by acceptance sampling.

$$[40 + 40 + 20 = 100]$$

4. The following information were collected from ten families in finding the relationship between family income and their consumption expenditure.

Weekly family Income (\$)	Weekly family Consumption expenditure (\$)
80	70
100	65
120	90
140	95
160	110
180	115
200	120
220	140
240	155
260	150

- (i) Construct the linear regression line of family consumption expenditure against family income.
  - (ii) Verify its goodness of fit by the coefficient of determination.
- Interpret your results.

- (iii) Interpret the point estimates of intercept and slope parameters. Calculate the standard errors of these parameters and setup 95% confidence interval for your estimators.
- (iv) Is it true that the weekly consumption expenditure is \$25, when there is no weekly income.
- (v) Test whether the rate of change in consumption expenditure is \$0.75 per family per week.

$$[30 + 20 + 20 + 15 + 15 = 100]$$

5. (a) What is meant by non-linear regression models?

Describe briefly about the procedures adopted in fitting simple regression lines for semi-log models and double log models.

- (b) Consider the following data.

X :	1	2	3	4	5	6
Y :	2.98	4.26	5.21	6.10	6.80	7.50

Fit a simple curvi-linear regression model suitable to the above data.

- (c) Propose a least square procedure for fitting a non-linear regression model given by

$$p v^r = k,$$

where  $p$  and  $v$  are the variables describing the price and quantity of a product and  $r$  and  $k$  are constants.

$$[30 + 35 + 35 = 100]$$

6. (a) What is meant by multiple linear regression models?

Define and briefly discuss about "Multi collinearity" and "Heteroscedasticity" problems in fitting multiple regression models.

(b) The following data were recorded for response variable  $Y$  against the explanatory variables  $X_1$  and  $X_2$ .

$Y$ :	11	17	26	28	31	35	41	49	63	69
$X_1$ :	2	4	6	5	8	7	10	11	13	14
$X_2$ :	2	3	4	5	6	7	9	10	11	13

- i. Construct a multiple linear regression line for the above data.
- ii. Interpret the estimates of the regression coefficients and calculate the corresponding standard errors.
- iii. What would be the predicted value of  $Y$  when  $X_1 = 16$  and  $X_2 = 15$ . Calculate the standard errors of your prediction.

[25 + 40 + 20 + 15 = 100]

Annual income	Amount of insurance
47	250
54	300
25	100
37	150
62	500
18	75
39	160
70	400
29	95
48	264

(i) Construct a scatter diagram for these data. Does the scatter diagram show a linear relationship between annual income and amounts of life insurance policies?

(ii) Fit the estimated regression line, with annual income as independent variable and amount of insurance as dependent variable. Use the data