



EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE 2004/2005

FIRST SEMESTER (Nov./Dec.'2006)

SPECIAL REPEAT EXAMINATION

ST 303 - REGRESSION ANALYSIS & QUALITY CONTROL

Answer all questions

Time: Three hours

1. What is meant by "simple linear regression"? Distinguish between simple linear regression and multiple regression.
  - (a) Estimate the simple linear regression parameters by the method of least squares.
  - (b) Derive the maximum likelihood estimators to the above parameters.
2. An experiment was run in order to determine the relationship between the fertilizer applied per area (in pounds) and the yield (in bushels) for a certain group. The results are given below.

Fertilizer (lb)	15	15	15	20	20	20	25	25	25
Yield (bushels)	45	43	46	58	62	64	70	78	76

- (a) Fit a linear model and comment on the adequacy of your fit.
- (b) Using the fitted relationship, estimate the mean yield when 16 pounds of fertilizer applied and give the standard error of your estimate.

3. (a) Give an example for a multiple linear regression with two independent variables.  
 (b) For your example write down the model and the assumptions you make.  
 (c) Consider the model:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \varepsilon.$$

It is given that there are  $n = 23$  observations and  $SST = 39.2$  and  $SSE = 20.0$ .

- i. Construct the ANOVA table.
  - ii. State the hypothesis that you will test using the ANOVA table and test the hypothesis at a significance level  $\alpha = 0.05$ .
4. A company uses statistical quality control for its products. 20 samples of 5 items were selected to set up quality control charts. The value of  $\bar{X}$  and  $R$  for each sample are as follows:

$\bar{X}$	$R$	$\bar{X}$	$R$	$\bar{X}$	$R$	$\bar{X}$	$R$
34.0	4	32.2	2	35.8	4	31.6	5
31.6	4	33.0	5	38.4	4	33.0	5
30.8	2	32.6	13	34.0	14	28.2	3
33.0	3	33.8	19	35.0	4	31.8	9
35.0	5	37.8	6	33.8	7	35.6	6

Draw the  $\bar{X}$  and  $R$  charts showing the upper and lower control limits. Plot the 20 values and state whether the system is under statistical control.

5. In a watch glass producing factory, a random sample of 50 items are taken from each days output. Assume that the production of glasses is a continuous process. Results of 15 days past operations are as follows.

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of defectives	4	9	10	11	13	30	26	13	8	23	34	25	18	12	4

Construct a  $P$  chart for future use.

(a) Describe the double sampling plan procedure.

(b) A double sampling plan calls for a first sample of 25 items to be inspected. If no defective are found the lot is accepted. If three or more defectives are found the lot is rejected. Otherwise, a second sample of 100 is drawn and the lot is accepted if the combined number of defectives found doesn't exceed two. If the proportion of defective in the lot is 0.02, what is the probability that the lot will be

- i. accepted on the first sample.
- ii. rejected on the first sample.
- iii. finally accepted.

