RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES
DEPARTMENT OF PHYSICAL SCIENCES

B.Sc. (General) Degree in Applied Sciences
Third Year – Semester II Examination – April/May 2016

MAT 3312 – Statistical Quality Control

Answer **All** questions Time allowed: **3 hours**

Statistical Tables will be provided

1. Derive the control limits of the c – chart.

   Surface defects have been counted on 20 rectangular steel plates, and the numbers of defects on the 20 plates are as follows:
   10, 10, 5, 10 14, 9, 16, 12, 8, 10, 6, 9, 13, 10, 8, 9, 10, 13, 10, 7

   Using Minitab statistical software, set up a c-chart for monitoring the number of defects using these data and $\alpha = 0.0027$. Does the process producing the plates appear to be in statistical control? If it is out-of-control, assume that there are assignable causes, revise the control limits.

   If the average number of defects shifts to 12, what is the probability of detecting in the second sample after the shift?

   What is the Average Run Length when the process is in-control and out-of-control?
   If LSL = 9 and USL = 11, then find the process capability.

[P.T.O.]

2. Derive control limits of the p – chart.

   Number of defectives from each sample of size 50 is given below:
   4, 5, 9, 6, 5, 9, 6, 5, 11, 4, 7, 8, 3, 7, 9, 6, 10, 7, 8, 5

   Using Minitab statistical software plot the p – chart for the above data. Is the process control?
   Construct an OC curve for the above p – chart using Excel.

   (i) What is the sample size so that there is 50% chance of detecting an out-of-control?

   (ii) What is the minimum sample so that Lower Control Limit is positive?

3. Discuss the following topics:

   (i) Quality costs.

   (ii) Magnificent seven tools.

   (iii) Total quality management.

4. A bank monitors the time required to serve customers at the drive – by window because it is an important quality factor in competing with other banks in the city. After analyzing the data gathered, bank determined that the mean time to process a customer at the peak demand period has been 5 minutes, with a standard deviation of 1.5 minutes. Assume that the process variability is in statistical control. Design an $\bar{x}$ - chart that has a type I error of 5 percent.

   (i) After several weeks of sampling, two successive samples came in at 3.70 and 3.68 minutes. Is the customer service process in statistical control?

   (ii) If the process specifications are 5 ± 1.5 minutes, find the process capability and process capability ratio.

   (iii) Construct an Operating characteristic curve for the $\bar{x}$ - chart.

5. Derive ***R***-chart and $\bar{x}$ - chart.

The western Electric Company produces light bulbs. The following data on the number of lumens for 40-watt bulbs were collected when the process was in control:

Observations

Sample	*1*	*2*	*3*	*4*
1	604	612	588	600
2	597	601	607	603
3	581	570	585	592
4	620	605	595	588
5	590	614	608	604

(i) Calculate control limits for an ***R***-chart and an $\bar{x}$ - chart.

(ii) Since these data were collected, some new employees were hired. A new sample obtained the following readings: 570, 603, 623, and 583. Is the process is still in control?

(iii) Estimate the process standard deviation.

(iv) Without calculating the sample standard deviations, estimate the control limits of *S*-chart.