UNIVERSITY OF EMBU

2016/2017 ACADEMIC YEAR

SECOND SEMESTER EXAMINATION

SECOND YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN STATISTICS

STA 204: QUALITY CONTROL AND SAMPLING INSPECTION

DATE: APRIL 6, 2017 **TIME: 2:00-4:00 PM**

INSTRUCTIONS:

Answer Question ONE and ANY Other TWO Questions.

QUESTION ONE (30 MARKS)

a) Differentiate between

(i) Producer's Risk and Consumer's Risk as applied in the Sampling plans. (2 Marks)

(ii) A Single Sampling Plan and a Double Sampling Plan (2 Marks)

(iii) Variables and attributes (2 Marks)

b) In establishing the bounds of an $\overline{X}$ - chart, we need to establish the sampling distribution of $\overline{X}$. Compute the **mean** and **standard error** of $\overline{X}$. (2 Marks)

c) Give some two major limitations of $\overline{X}$ - chart and $\overline{R}$ - chart. (2 Marks)

d) The DMAIC is the classic Six Sigma *problem-solving process.* Give a brief description of the DMAIC five steps as a *process improvement* methodology (5 Marks)

e) Explain the term **control chart** as used in statistical quality control. (1 Marks)

f) Briefly point out the four factors which should be decided in a sampling plan. (2 Marks)

g) Give and briefly explain each of the two kinds of variance in the production process (2 Marks)

h) Ten pieces of cloth out of different rolls of equal length contained the following number of defects:

3, 0, 2, 8, 4, 2, 1, 3, 7, 1

(i) Find the central line, lower and upper control limits for a C - chart. (4 Marks)

(ii) Plotting the C - chart, state whether the production process is in a state of statistical control. (2 Marks)

i) The following data refer to visual defects found in the inspection of the first 10 samples of size 100.

Sample No.: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

No. of defectives: 2, 1, 1, 3, 2, 3, 4, 2, 2, 0

Use the data to obtain upper and lower control limits for percentage defective in samples of 100. (4 Marks)

QUESTION TWO (20 MARKS)

a) Other than a quality control chart, discuss other five quality control tools. (10 Marks)

b) Determine and plot the OC Function for a single sampling plan specified by

N = 50, n = 5, c = 2. (10 Marks)

QUESTION THREE (20 MARKS)

a) Determine and plot the OC Function for a single sampling plan specified by

N = infinite in size, or at least very large compared to n

n = 98

C = 2 (10 Marks)

Compare the OC curve for N=500, n=98, c=2. Plot its OC Function on the same graph (3 Marks)

b) A machine is set to deliver packets of a given weight. 10 samples of size 5 each were recorded. Below are given relevant data:

Sample No.:	1	2	3	4	5	6	7	8	9	10
Mean ($\bar{X}$):	15	17	15	18	17	14	18	15	17	16
Range (R):	7	7	4	9	8	7	12	4	11	5

Calculate the values for the central line and the control limits for mean chart and the range chart and then comment on the state of control. (7 Marks)

QUESTION FOUR (20 MARKS)

a) Briefly explain each of the Deming's 14 points on statistical methods in quality improvement. (14 Marks)

b) Measures are taken on the resistance, in ohms, of an electrical component. A sequence of twenty five samples, each of six observations, was drawn. The overall means of the sample observation was 93.2 and the average sample standard deviation was 3.67.

(i) Use an unbiased estimator to find an estimate of the process standard deviation. (1 Marks)

(ii) Find the central line, lower and upper control limits for an X – bar chart. (3 Marks)

(iii) Find the central line, lower and upper control limits for an S – chart. (2 Marks)

QUESTION FIVE (20 MARKS)

a) 20 samples each of size 10 were inspected. The number of defectives detected in each of them is given below:

Sample No. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

No. of defectives: 0, 1, 0, 3, 9, 2, 0, 7, 0, 1, 1, 0, 0, 3, 1, 0, 0, 2, 1, 0

Construct a number defective chart and establish quality standard for the future. (10 Marks)

b) Control charts for $\overline{X}$ and σ are maintained on the resistance in ohms of a certain rheostat coil based on a subgroup size of 5. After 30 subgroups $\sum \overline{X} = 58{,}395$ and $\sum \sigma = 1{,}356$.

(i) Determine the central lines and $3-\sigma$ control limits for this process. (5 Marks)

(ii) Estimate the value of σ' assuming that the process is operating in statistical control. (1 Mark)

(iii) Assuming that the distribution generated by the process is approximately normal, what proportion of the rheostat coils meets the specifications 200 ± 150 ohms? (4 Marks)

END

TABLE: Control Chart Constants

	For Estimating Sigma		For X bar Chart		For X bar Chart (Standard Given)	For *R* Chart		For *R* Chart (Standard Given)		For *s* Chart (Standard Given)			
N	*c*4	*d*2	*A*2	*A*3	*A*	*D*3	*D*4	*D*1	*D*2	*B*3	*B*4	*B*5	*B*6
2.	0.7979	1.128	1.880	2.659	2.121	0	3.267	0	3.686	0	3.267	0	2.606
3.	0.8862	1.693	1.023	1.954	1.732	0	2.575	0	4.358	0	2.568	0	2.276
4.	0.9213	2.059	0.729	1.628	1.500	0	2.282	0	4.698	0	2.266	0	2.088
5.	0.9400	2.326	0.577	1.427	1.342	0	2.115	0	4.918	0	2.089	0	1.964
6.	0.9515	2.534	0.483	1.287	1.225	0	2.004	0	5.078	0.030	1.970	0.029	1.874
7.	0.9594	2.704	0.419	1.182	1.134	0.076	1.924	0.205	5.203	0.118	1.882	0.113	1.806
8.	0.9650	2.847	0.373	1.099	1.061	0.136	1.864	0.387	5.307	0.185	1.815	0.179	1.751
9.	0.9693	2.970	0.337	1.032	1.000	0.184	1.816	0.546	5.394	0.239	1.761	0.232	1.707
10.	0.9727	3.078	0.308	0.975	0.949	0.223	1.777	0.687	5.469	0.284	1.716	0.276	1.669
15.	0.9823	3.472	0.223	0.789	0.775	0.348	1.652	1.207	5.737	0.428	1.572	0.421	1.544
20.	0.9869	3.735	0.180	0.680	0.671	0.414	1.586	1.548	5.922	0.510	1.490	0.504	1.470
25.	0.9896	3.931	0.153	0.606	0.600	0.459	1.541	1.804	6.058	0.565	1.435	0.559	1.420