



MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FOURTH YEAR SEMESTER EXAMINATIONS FOR

BACHELOR OF SCIENCE (MATHEMATICS)

SST 407: QUALITY CONTROL METHODS

DATE:

TIME:

INSTRUCTION: Answer Question **ONE** which is compulsory and any other **TWO** Questions

QUESTION ONE (COMPULSORY)(30 MARKS)

- a) Distinguish the following terms as used in statistical quality control
- Quality assurance and Quality management
 - Process control and product control
 - Producer's risk and consumer's risk (6 marks)
- b) Given that $EWMA_0 = 50$, $S = 2.05$, $\lambda = 0.4$ and $k = 3$ determine the Upper and Lower control limits for the Exponentially Weighted Moving Average. (5 marks)
- c) A quality control officer in Malco chain stores claims that 75% of the peanut butter in the store are affected by campylobacter bacteria. A random sample of 48 cans showed that 12 of them were affected. Are these sample results consistent with the claim of the officer at $\alpha = 0.05$ (5 marks)

- d) The table below shows the KQ products' length mean and range for 10 randomly taken samples each of size 5

Sample no.	1	2	3	4	5	6	7	8	9	10
Range	1.5	1.9	1.4	1.8	1.6	0.8	1.6	1.3	1.9	1.2
Mean	7	4	8	5	6	4	7	4	7	8

- By using mean and range charts determine whether the process is in control (6 marks)
- e) By citing examples distinguish between the control charts for variables and control charts for attributes. (4 marks)
- f) A fiftyfold measurement of a cylinder volume had mean of 19.842 mL and the standard deviation 0.0627 mL. Determine the 99% confidence interval of the mean, assuming a normally distributed data collected. (4 marks)

QUESTION TWO (20 MARKS)

- a) The following were the element K concentration in grams per kilogram of a certain fertilizer: 10.4, 11.6, 10.8, 9.6, 11.2, 11.9, 9.1, 10.4, 10.3, 11.6, if its standard deviation $s = 0.91$ determine the Warning limits and Action Limits for $\bar{X} - \text{chart}$ when set at 2 and 3 standard deviations respectively. (5 marks)
- b) In a random sample of 150 items taken from machine A, 50 are found to be defective. In another sample of 250 items taken from machine B, 100 items are found to be defective. Do the data reveal significant difference between the two machines as far as the quality output is concerned, at $\alpha = 0.05$? (5 marks)
- c) Given $N=500$, $n=150$ and $c=3$ construct OC curve for $0.01 \leq p \leq 0.06$ based on Poisson distribution (10 marks)

QUESTION THREE (20 MARKS)

- a) Discuss briefly the meaning of single, double and multiple acceptance sampling plans (6 marks)
- b) Highlight four advantages of Cusum control charts over Shewart control charts (4 marks)

- c) The following data shows the number of defectives and items sampled

Sample no.	1	2	3	4	5	6	7	8	9	10
Sampled	210	215	205	214	210	208	211	203	204	220
Defectives	7	4	8	5	7	4	8	4	7	9

Construct the fractional defective chart and commend whether the process is under control or not (10 marks)

QUESTION FOUR (20 MARKS)

- a) Distinguish between assignable causes of variations and common causes of variations in quality control methods (4 marks)
- b) Highlight four limitations of acceptance sampling (4 marks)
- c) During an examination of the electric gadgets the following number of defectives were observed per sample; 1,3,4,2,4,3,6,5,4,3,5,1,4,2,3,0,1. Draw the control chart for the number of defectives and commend on the state of the process. (6 marks)
- d) The target value of the Calcium content in a certain food supplement was 34.0 mg/kg. The results from 15 randomly sampled one kilogram packets of the food supplements in the market gave $\bar{X} = 31.6 \text{ mg/kg}$ and $s = 5.6$. Determine whether the sample results were consistent with the target value at $\alpha = 0.05$ (6 marks)

QUESTION FIVE (20 MARKS)

- a) Highlight four advantages of CUSUM quality control charts over the shewharts quality control charts (4 marks)
- b) The known optimum concentration for a component y in a fattening chemical is 0.18 wt %. The following concentration levels were observed in a randomly sampled 10 bunches of the component whose standard deviation is 0.020.

Sample	1	2	3	4	5	6	7	8	9	10
Conc' %	0.18	0.15	0.19	0.21	0.14	0.21	0.16	0.17	0.16	0.19

By using the allowable slack and action limit as 0.5 and 4 times the standard deviation construct CUSUM control chart and state whether the process is in or out of control. (8 marks)

- c) The mobile phones hard-set covers produced by a certain machines were examined and the following table shows the lengths of randomly selected covers per sample

Sample no	Covers length in millimeters				
1	12.016	12.088	11.072	11.971	12.118
2	12.039	12.047	12.214	12.113	12.156
3	11.908	12.058	12.258	12.077	12.149
4	12.167	12.127	12.053	12.137	12.212
5	12.048	12.048	11.731	12.083	12.045
6	11.211	12.013	12.162	12.124	11.682
7	12.908	11.058	12.158	11.177	11.249

Using the X-bar and range charts test the state of the process based on the 5 sample size.

(8 marks)