



MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MATHEMATICS)

BACHELOR OF SCIENCE (ACTUARIAL SCIENCE)

SMA 366: QUALITY CONTROL METHODS

DATE: 17/8/2021

TIME: 2:00 – 4:00 PM

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
- i) Quality assurance and Quality management
 - ii) Process control and product control
 - iii) Producer's risk and consumer's risk
 - iv) Assignable causes of variations and common causes of variations
 - v) Type I and Type II error in hypothesis testing (10 marks)
- b) A quality control officer in Malc chain stores claims that 70% of the peanut butter in the store are affected by campylobacter bacteria. A random sample of 50 cans showed that 38 of them were affected. Are these sample results consistent with the claim of the officer? Use $\alpha = 0.05$ (4 marks)
- c) 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 | 13.4 | 12.0 | 11.4 | 10.8 | 11.2 | 9.8 | 11.6 | 10.8 | 10.8 | 11.2 |
| Mean | 7 | 4 | 8 | 5 | 7 | 4 | 8 | 4 | 7 | 9 |
- By using mean and range charts determine whether the process is in control (6 marks)
- d) By citing examples distinguish between the control charts for variables and control charts for attributes. (4 marks)

- e) Highlight Six functions of Kenya Bureau of Standards (KEBS) (6 marks)

QUESTION TWO (20 MARKS)

- a) A manufacturer of electric gadgets has known from experience that 5% of the gadgets produced are defective, if random sample of 50 gadgets is examined determine the probability that the proportion defective is between 0.10 to 0.25 (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 | 200 | 214 | 210 | 208 | 211 | 202 | 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 (8 marks)
- d) Highlight any two quality characteristics of a quality control officer (2 marks)

QUESTION FOUR (20 MARKS)

- a) During an examination of equal length of a piece of cloth the following number of defects were observed per sample; 1,3,4,2,5,6,7,4,3,5,4,2,3. Draw the control chart for the number of defects and commend on the state of the process (6 marks)
- b) Discuss any three dimensions of quality characteristics in production industry (6 marks)

- c) The known optimum concentration for a component y in a fattening chemical is 0.16 wt %. The following concentration levels were observed in a randomly sampled 10 bunches of the component whose standard deviation is 0.024.

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

- d) 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)

QUESTION FIVE (20 MARKS)

- a) The mobile phones hard-set covers produced by 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	11.972	11.971	12.118
2	12.039	12.047	12.014	12.113	12.156
3	11.998	12.058	12.058	12.077	12.049
4	12.167	12.127	12.053	12.137	12.212
5	12.048	12.048	11.931	12.083	12.045
6	11.011	12.013	12.062	12.124	11.982

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

(8 marks)

- b) The following information relates to the lifespan electric bulbs manufactured by two companies A and B:

	Company A	Company B
Mean life (in hours)	1300	1288
Standard deviation (in hours)	82	93
Sample size	100	100

Which brand of bulbs would you recommend for a client taking a risk of 5%? (6 marks)

- c) Write down the R script for constructing;

- $\bar{X}$ & R Control Charts, 3σ
- CUSUM and
- Exponentially weighted moving average.

(6 marks)