



# TECHNICAL UNIVERSITY OF MOMBASA

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Faculty of applied and Health Sciences

DEPARTMENT OF MATHEMATICS AND PHYSICS

## UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN STATISTICS AND COMPUTER SCIENCE (BSSC)

**AMA 4309: Quality Control and Sample Survey**

**SPECIAL/ SUPPLIMENTARY EXAMINATIONS**

**SERIES: September 2018**

**TIME: 2 HOURS**

**DATE: September 2018**

### Instructions to Candidates

You should have the following for this examination

*-Answer Booklet, examination pass and student ID*

This paper consists of 5 questions. Section A is compulsory. Answer any other two questions

**Do not write on the question paper.**

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### QUESTION 1 (30 MARKS)

- a) What is a  $c$  - chart. When and where it is used. (2 marks)
- b) Distinguish between multiple sampling plans and double sampling plans. (4 marks)
- c) Explain the terms:
  - a. Control limits (2 marks)
  - b. Tolerance limits (2 marks)
  - c. Specification limits. (2 marks)
- d) Define the terms:
  - a.  $AQL$  (2 marks)

- b. *LTPD* (2 marks)
  - c. Producers risk (2 marks)
  - d. Consumers risk. (2 marks)
- e) Twenty five samples of size 5 are drawn from a process at one hour intervals and the following data obtained.

$$\sum_{i=1}^{35} X_i = 362.5 \quad \sum_{i=1}^{35} r_i = 8.6 \quad \sum_{i=1}^{35} S_i = 3.64$$

- Find the trial control limit for X bar and S charts. (6 marks)
- f) In an electronic manufacturing process, a current has a specification of  $100 \pm 10$  mA. The process mean and standard deviation are 107.0 and 1.5 respectively. Calculate the process capability ratio and use it to make decisions about the specification limits (4 marks)
  - g) Control charts have had a long history of use in industry. State five reasons for their popularity. (5 marks)

## SECTION B

### QUESTION 2 (20 marks)

- a. State and briefly explain the four major methods of probability sampling (8 marks)
- b. Define non probability sampling and give an example (2 marks)
- c. Differentiate between a longitudinal and a cross-sectional study (2 marks)
- d. List three disadvantages of a cross-sectional study (3 marks)
- e. Define randomized response (2 marks)
- f. State three causes of non-response (3 marks)

### QUESTION 3 (20 marks)

- a) 20 tape recorders were examined for quality control test. The number of defects for each tape recorder are recorded below:

2, 4, 3, 1, 1, 2, 5, 3, 6, 7, 3, 1, 4, 2, 1, 3, 4, 6, 1, 1

Prepare a c-chart. What can you draw from it? (10 marks)

- b) Printed circuits boards are assembled by a combination of manual assembly and automation. A flow soldier machine is used to make the mechanical and electrical connections of the leaded components to the board. The boards are run through the flow

soldier process almost continuously and every hour five boards are selected and inspected for process control purposes. The number of defects in each sample of five boards is noted. Results for 20 samples are shown below. Find the control limits and plot a u chart of defects per unit on printed circuit boards. Use your plot to determine if the process is in control or out of control (10 marks)

Sample	Number of defects	Defects per unit
1	6	1.2
2	4	0.8
3	8	1.6
4	10	2
5	9	1.8
6	12	2.4
7	16	3.2
8	2	0.4
9	3	0.6
10	10	2
11	9	1.8
12	15	3
13	8	1.6
14	10	2
15	8	1.6
16	2	0.4
17	7	1.4
18	1	0.2
19	7	1.4
20	13	2.6

**QUESTION 4 (20 marks)**

- Control charts have had a long history of use in industry. State five reasons for their popularity. (5 marks)
- A component for a jet aircraft engine is manufactured by an investment casting process. The vane opening on this casting is an important functional parameter of the part. The table below represents 10 samples of five parts each.

Sample number	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$
1	33	29	31	32	33
2	33	31	35	37	31

3	35	37	33	34	36
4	30	31	33	34	33
5	33	34	35	33	34
6	38	37	39	40	38
7	30	31	32	34	31
8	29	39	38	39	39
9	28	33	35	36	43
10	38	33	32	35	32

Find the trial control limits for bar X and R charts

(15 marks)

**QUESTION 5 (20 marks)**

- a. State 5 elements that are usually present in all successful efforts intended to implement a statistical control process program. (5 marks)
- b. The philosophy of W. Edward Deming provides an important framework in implementing quality and productivity improvement. State 7 of W. Edward Deming's points for management. (7 marks)
- c. Describe any four situations where the sample size used for process control may consist from an individual unit. (8 marks)