



# MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (MATHEMATICS)

BACHELOR OF EDUCATION

SST 407: QUALITY CONTROL METHODS

DATE:

TIME:

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## INSTRUCTIONS

Answer question one and any other two

Time:

### 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 (8 marks)
- b) A quality control officer in Mwami chain stores claims that 75% of the peanut butter in the store are affected by campylobacter bacteria. A random sample of 50 cans showed that 20 of them were affected. Are these sample results consistent with the claim of the officer? Use  $\alpha = 0.01$  (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  |
| Range      | 210 | 215 | 200 | 214 | 210 | 208 | 211 | 202 | 204 | 220 |
| Mean       | 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) 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 250 gadgets is examined determine the probability that the proportion defective is between 0.10 to 0.35 (5 marks)
- b) In a random sample of 100 items taken from machine A, 60 are found to be defective. In another sample of 200 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? (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) Highlight four quality characteristics of a quality control officer (4 marks)
- d) The following information relates to the lifespan electric bulbs manufactured by two companies A and B:

|                               | Company A | Company B |
|-------------------------------|-----------|-----------|
| Mean life (in hours)          | 1350      | 1285      |
| Standard deviation (in hours) | 85        | 65        |
| Sample size                   | 150       | 100       |

Which brand of bulbs would you recommend for a client taking a risk of 5%?

(6 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 five dimensions of quality characteristics in production industry (10 marks)
- c)  $\bar{X}$ -Control chart with 3-sigma control limits has the parameters;

UCL=104, CL=100, ICL=96 and  $n=5$ . Suppose the measured characteristic is normally distributed  $N(\mu, \sigma)$  with a true average 98 and  $\sigma=8$ . Determine the probability that the control chart will raise an out of control alarm after a maximum of 3 samples (4 marks)

### QUESTION FIVE (20 MARKS)

- a) The mobile phones batteries produced by a certain machines were examined and the following table shows the distribution of defective batteries per sample

|    |   |    |    |    |    |    |   |   |       |
|----|---|----|----|----|----|----|---|---|-------|
| 0  | 1 | 2  | 3  | 4  | 5  | 6  | 7 | 8 | Total |
| 11 | 7 | 27 | 56 | 70 | 54 | 22 | 8 | 1 | 256   |

Fit a binomial distribution and hence determine the expected

- Frequencies
  - Mean
  - Standard deviation
- (8 marks)

- b) The table below shows the mean and range for 10 samples each of size 5

|            |      |      |      |      |      |     |      |     |      |      |
|------------|------|------|------|------|------|-----|------|-----|------|------|
| Sample no. | 1    | 2    | 3    | 4    | 5    | 6   | 7    | 8   | 9    | 10   |
| Range      | 11.4 | 12.0 | 11.0 | 11.8 | 11.2 | 9.8 | 10.6 | 9.8 | 10.8 | 10.2 |
| 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)

- c) Write down the R script for constructing;
- $\bar{X}$  & R Control Charts,  $3\sigma$
  - $\bar{X}$  & S Control Charts,  $3\sigma$
  - CUSUM and Exponentially weighted moving average.
- (6 marks)