



(Knowledge for Development)

KIBABII UNIVERSITY
UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR
THIRD YEAR SECOND SEMESTER
SPECIAL/SUPPLEMENTARY EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: STA 323

COURSE TITLE: QUALITY CONTROL AND ACCEPTANCE SAMPLING

DATE: 21/01/2022

TIME: 2:00 - 4:00 PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION 1: (30 Marks) (COMPULSORY)

- a) Give the three main objectives of a control chart [3mks]
- b) What are the main applications of a control chart [4mks]
- c) A large batch of items to be inspected using a single sampling scheme specified by the following values $n = 40$, $c = 2$, $\theta_1 = 0.02$, and $\theta_2 = 0.1$
- i. Define the operating characteristic of this sampling plan [2mks]
 - ii. Find the probability of accepting a lot of quality $\theta = 0.05$ [3mks]
 - iii. Find the consumer's risk and the producer's risk [4mks]
- d) Workout the O.C curve and the ARL function for S^2 -chart with upper warning limits given by $P[\sum(x_i - \bar{x})^2 > k] \leq 0.05$ and action is taken only if two consecutive values of S^2 fall beyond the upper warning limit (take $n = 12$, $\theta = \frac{\sigma^{2*}}{\sigma}$ and $\theta \rightarrow (-\infty, 0, \infty)$) [6mks]
- e) suppose that the mean has shifted from μ to μ^* but σ^2 remain unchanged assuming normality (take $\alpha = 0.002$)
- i. Find the probability that the process is under control for the \bar{x} - chart [4mks]
 - ii. Show that the Average Run Length function of the \bar{x} - chart is given by $\frac{1}{1-P(\theta)}$. Assuming that samples taken from the process are independent, where θ is the incoming quality [4mks]

QUESTION 2: (20 Marks)

- a) Explain each of the following concepts
- i. Average sampling numbers [ASN] [2mks]
 - ii. Average outgoing quality [AOQ] [3mks]
 - iii. Lot tolerance percent defective (LTPD) [3mks]
 - iv. Acceptance Quality Level [AQL] [2mks]
- b) What do you understand by the moving average chart? Explain clearly how you can use it to determine whether a system is out of control or not. [5mks]
- c) When do we use S^2 - chart? Explain clearly how you can use it to determine whether a system is out of control or not. If $n = 4$ and $\alpha = 0.02$, obtain its upper action and warning limits. [5mks]

QUESTION 3: (20 Marks)

- a) If n is large and p is moderately small and we let $\lambda = np$, obtain C-chart for the number of defectives per unit. (Take $\alpha = 0.001$ for action limit and $\alpha = 0.025$ for warning limit) [7mks]
- b) Obtain a single sampling for the proportion of defectives, fixing the producer's risk $\alpha = 0.09$ at $\theta_1 = 0.05$ and the consumer's risk $\beta = 0.1$ at $\theta_1 = 0.1$ and hence give your conclusion [6mks]
- c) A large batch of items is to be tested by using double sampling inspection scheme specified by the following numbers $n_1 = 20$, $n_2 = 40$, $c_1 = 0$, $c_2 = c_3 = 2$
- i. Obtain an expression for the probability of accepting a batch in which the true proportion of defective is θ [4mks]
 - ii. Obtain the value of this probability when $\theta = 0.05$ and $\theta = 0.1$ [3mks]

QUESTION 4: (20 Marks)

- a) Briefly describe the important steps in constructing an $\bar{x} - chart$ [5mks]
- b) Briefly compare the single sampling plan and the double sampling plan [3mks]
- c) The data below are samples means and sample ranges for ten consecutive samples, each sample consisting of five measurements of a continuous random variable x . Assuming x is normally distributed plot $\bar{x} - control chart$ and comment on the degree of control

Sample No.	1	2	3	4	5	6	7	8	9	10
Sample mean	126.2	127.4	126.6	129.8	126.0	125.0	126.8	132.0	127.4	126.2
Sample Range	8	6	7	6	8	7	6	19	6	7

$a_n = 0.4299$ for $n = 5$

[6mks]

- d) Explain briefly how you use control chart for fractional defective ($p - chart$) to determine whether the process is in control or not and hence show its warning and action limit on a $p - chart$. (take $\alpha = 0.002$ for action limit and $\alpha = 0.05$ for warning limit) [6mks]

QUESTION 5: (20 Marks)

- a) i. Construction a sequential sampling plan from a Bernoulli population that following values $\theta_0 = 0.02$, $\theta_1 = 0.08$, $\alpha = 0.05$ and $\beta = 0.1$ [3mks]
- ii. An inspector test 40 units from a large lot. Would he have come to a decision to reject or accept the lot if he found the 10th, 18th, and 23rd unit defective. [3mks]
- b) A company purchases large lots of items using a single sampling plan for which $n = 4$ and $c = 0$
- i. Find the probability of acceptance of a lot in terms of proportion of defective items it contains. [2mks]
- ii. What is the probability of
1. A lot containing 50% defective being accepted [2mks]
 2. A lot containing 10% defective being rejected [2mks]
- iii. Estimate the AQL (θ) corresponding to a producers risk of 5% and LTPD (θ) corresponding to consumer's risk of 10% [3mks]
- iv. If rectification is agreed on, find the expression for the average outgoing quality (AOQ) in terms of the incoming quality. Find AOQ if $\theta = 0.05$ [2mks]
- v. Calculate the average total inspection (ATI) of lots of size 100 of quality $\theta = 0.05$ [3mks]