UGANDA MARTYRS UNIVERSITY

NKOZI

UNIVERSITY EXAMINATIONS

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS & STATISTICS

December, 2022

STA 2102: STATISTICAL QUALITY CONTROL

Bsc.Gen. (II)

DATE: Thursday, 15/12/2022

DURATION: 3HRS (2:00 – 5:00 PM)

VENUE:

Instructions:

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1. *Carefully read through ALL the questions before attempting*
2. ***ANSWER any four Questions***.
3. *Provide all the outputs for all procedures*
4. *Ensure your work is **clear** and **readable**. Untidy work shall be penalized*
5. *Any type of examination Malpractice will lead to automatic disqualification*
6. *Do not write anything on the questions paper.*

QUESTION ONE

(a) Define statistical quality control (SQC) **[1 Mark]**

(b) State the causes of variations in any process **[4 marks]**

© Consider the data below as collected from the industries

		READINGS			
		1	2	3	4
TIME	9:00 am	40	50	55	39
	9:30 am	44	42	38	38
	10:00 am	41	45	47	43
	10:30 am	39	39	41	41
	11:00 am	37	42	46	41
	11:30 am	39	40	39	40

n= 4 A_2 =0.729 d_2 =2.059 D_3 =0 D_4 =2.282

(i) Design a mean chart and interpret it. **[10 marks]**

(ii) On the same diagram, design the range chart and interpret it. **[10 marks]**

QUESTION TWO

(a) List and explain different control charts that are commonly used in different processes.
[10 marks]

(b) A random sample of 100 ball pens was taken from a firm which produces pens and a number of defective pens were noted. This was repeated for 10 times as shown below. Using the information given prepare a 'P' control chart and comment on the results. **[15 marks]**

Sample	1	2	3	4	5	6	7	8	9	10

No. of defectives	8	11	13	8	17	7	7	14	6	9

QUESTION THREE

An automatic machine produces 5.0 millimeter bolts at a high rate of speed. A quality-control program has been started to control the number of defectives.

The quality-control inspector selects 50 bolts at random and determines how many defectives are. The numbers defectives for the first 10 samples follow.

Sample number	1	2	3	4	5	6	7	8	9	10
Size of the sample	50	50	50	50	50	50	50	50	50	50
Number of defectives	3	5	0	4	1	2	6	5	7	7

(a) Design a percent defective chart **[10 marks]**

(b) Plot the number of defects for the first 10 samples on the chart. **[10 marks]**

(c) Interpret the chart. **[5 marks]**

QUESTION FOUR

(a) Define the following terms as applied to SQC

(i) process capability

(ii) process capability ratio **[2 marks@]**

(b) In a sample of 10 units, the lower and upper specification limits were given as 1 and 2 respectively. If the average range in the experiment is 0.325. Estimate the process capability of the machine (d2 = **3.078**). **[8 marks]**

© consider the table of sample observations

Sample number	X_1	X_2	X_3
1	6.0	5.8	6.1
2	5.2	6.4	6.9
3	5.5	5.8	5.2

4	5.0	5.7	6.5
5	6.7	6.5	5.5
6	5.8	5.2	5.0
7	5.6	5.1	5.2
8	6.0	5.8	6.0
9	5.5	4.9	5.7
10	4.3	6.4	6.3
11	6.2	6.9	5.0
12	6.7	7.1	6.2

(i) Plot the sample standard deviations against the sample numbers **[10 marks]**

(ii) Draw the s-chart and comment on the results. **[5 marks]**

QUESTION FIVE

(a) Define the following terms as applied to SQC

(i) OC curve

(ii) Producers risk

(iii) Consumers risk

(iv) Acceptance sampling **[2.5 marks @]**

(b)A firm purchases diskettes from diskettes international. The diskettes are packed in lots of 1000 each. The manager has agreed to accept lots with 10% or fewer defective diskettes. He has directed his inspection department to select a sample of 20 diskettes and examine them carefully. He will accept the lot if it has 2 or fewer defectives in the sample. Develop an OC curve for this inspection plan. What is the probability of accepting a lot that is 10% defective? **[15 marks]**

QUESTION SIX

(a) What is the regression analysis? **[1 mark]**

(b) Write down the least squares equations for estimating the regression constants

[4 marks]

© A machine hire company kept records of the age X (years) and the maintenance costs $ Y of one type of machine. The following table summarizes the data for a random sample of 10 of the machines.

Age (X) years	63	12	34	81	51	14	45	74	24	89
Cost $(Y)	111	25	41	181	64	21	51	145	43	241

(i) Fit an equation of the least squares of Y on X **[5 Marks]**

(ii) Determine the cost of maintenance of a 35 year old machine.**[4 marks]**

(iii) Calculate the product moment correlation coefficient between X and Y **[5 marks]**

(iv) Determine coefficient of determination **[3 Marks]**

(v) Interpret your answers from (ii) and (iii). **[3 marks]**

END