

UGANDA MARTYRS UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS AND STATISTICS

UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATIONS

2014/2015

Third Year Bachelor of Science General

STA 3102: Experimental Design and Industrial Statistics Modelling

Date : Tuesday 4th Aug, 2015

Time : 3 Hours (10:00 am - 1:00pm)

Instructions

1. Read and follow instructions on the answer booklet
2. Do not write any thing on this question paper:
3. Attempt **Four** (4) questions, **Question 1** is compulsory

Question 1

(a) Define the following terms

(i) Design of an experiment

[2 marks]

(ii) Experimental unit

[2marks]

(b) The following is sample information

Treatment 1	Treatment 2	Treatment 3
8	5	5
5	3	4
10	4	6
8	3	4

(i) Enter the data into an Excel spreadsheet and

follow the normal procedures to test the hypothesis that the treatment means are equal at the 0.05 significance level.

[12 marks]

Hence use your table to answer the following:

(ii) State the null hypothesis and the alternate hypothesis

[3 marks]

(iii) State SST, SSE, and SS total

[4 marks]

(iv) State your decision regarding the null hypothesis

[2 marks]

Question 2

(a) State the main objective of statistical quality control

[2 marks]

(b) Discuss the role of quality control in the production and service operations

[8 marks]

(c) Describe the difference between assignable variation and chance variation

[4 marks]

(d) Samples of size $n=4$ are selected from a production line.

(i) What is the value of A_2 factor used to determine the upper and lower control limits or the mean?

[5 marks]

- (ii) What are the values of the D_3 and D_4 factors used to determine the upper and lower control limits for the range? [6 marks]

Question 3

- (a) Define the following terms;

(i) Total variation

[2 marks]

(ii) Treatment variation

[2 marks]

(iii) Blocking variable

[2 marks]

- (b) The following data are given for a two-factor ANOVA.

	Treatment	
Block	1	2
A	46	31
B	37	26
C	44	35

Conduct a test of hypothesis to determine whether the block and treatment means differ using 0.05 significance level and;

- (i) State the null and alternative hypotheses for the treatments

[1 marks]

- (ii) State the decision rule for treatments

[1 marks]

- (iii) State the null and alternate hypotheses for the blocks. Also state the decision rule for blocks

[3 marks]

- (iv) Compute SST, SSB, SS total and SSE

[8 marks]

- (v) Complete the ANOVA table

[4 marks]

- (vi) What is your decision regarding the two sets of hypothesis?

[2 marks]

Question 4

- (a) State assumptions underlying ANOVA analysis

[4 marks]

- (b) Complete the following ANOVA table and answer the questions relating to it. [4 marks]

Source of Variation	Sum of Squares	Degrees of Freedom	Variance	Variance Ratio
Factor A	170
Factor B	450	1
AB interaction	14	2
Within interaction	14	24
Total	648	29		

- (i) How many levels does factor A have? [2 marks]
- (ii) How many observations per cell were, assuming an equal number per cell? [2 marks]
- (iii) Can the hypothesis of no interaction be rejected? Explain [5 marks]
- (iv) Is there a difference in the treatment means of factor A? Explain. [4 marks]
- (v) Is there a difference in the means of factor B? Explain [4 marks]

Question 5

- (a) Using an example distinguish between Completely Randomised Design (CRD) and the least squares design (LSD). [4 marks]
- (b) The data in the Table below gives the number of hours of pain relief provided by four different types of headache tablets administered to 24 people. The 24 experimental units were randomly divided into 4 groups and each group was treated with a different type/brand.

Brands			
1	2	3	4
12	9	8	6
9	10	12	6
11	7	5	5
13	8	8	3
10	5	7	8
9	11	12	7

Do the different drug types give significantly different hours of pain relief using 0.01 level of significance? [21 marks]

END