MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR
THIRD YEAR SECOND SEMESTER

SCHOOL OF SCIENCE
BACHELOR OF SCIENCE IN APPLIED STATISTICS WITH COMPUTING

COURSE CODE: STA 3228-1
COURSE TITLE: DESIGN AND ANALYSIS OF EXPERIMENTS I

DATE: 31/5/24 **TIME: 1430-1630HRS**

INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions from section A and any **TWO** from section B.
2. Use of sketch diagrams where necessary and brief illustrations are encouraged.
3. Read the instructions on the answer booklet keenly and adhere to them.

*This paper consists of **four** printed pages. Please turn over.*

SECTION A (20 MARKS)

QUESTION ONE (20 MARKS)

(a) Explain clearly the assumptions you need when analyzing an experiment. Why are these assumptions important? **[4Mks]**

(b) Explain the following terms as they are used in design and analysis of experiments. Use simple illustrations.

(i) A contrast **[1Mk]**

(ii) Orthogonal contrasts **[1Mk]**

(iii) Level of a factor **[1Mk]**

(iv) Why are orthogonal contrasts important? **[1Mk]**

(c) For a one-way classification

(i) Write the usual mathematical model **[1Mk]**

(ii) Obtain least squares estimators for terms of the model **[2Mks]**

(iii) Show clearly the analysis of one-way classification and construct ANOVA table **[3Mks]**

(d) A researcher calculated the following entries in analysis of variance table for some data collected from a randomized block design. The investments average was 45, 72, 60, 55 and 50. The ANOVA table constructed was as follows;

sv	df	ss	ms	f
$Treatment$	$-$	630	$-$	$-$
$Block$	4	450	$-$	
$Residual$	$-$	$-$		
$Total$	24	1320		

(i) Complete the ANOVA table **[3Mks]**

(ii) Formulate hypothesis that can be tested in this experiment **[1Mk]**

(iii) At 1% level of significance, draw statistical conclusions **[2Mks]**

SECTION B (30 MARKS)

QUESTION TWO (15 MARKS)

a) In an experiment, 4 fertilizers A, B, C and D were investigated while the effect of soil type was being controlled and the following observations were made.

	Fertilizer			
Soil type	**A**	**B**	**C**	**D**
1	5,3	6,8	8,12	15,10
2	4,8	8,10	10,15	16,14
3	3,9	14,10	12,14	12,18

(i) Describe briefly the design used in this experiment **[2Mks]**

(ii) Write the mathematical model for this experiment and explain each term **[4Mks]**

(iii) When is this design appropriate and why? **[3Mks]**

(iv) Analyze the data at 5% level of significance and draw necessary statistical conclusions. **[6Mks]**

QUESTION THREE (15 MARKS)

(a) Define 2^2 factorial experiment **[2Mks]**

(b) Give two main advantages of factorial experiment **[2Mks]**

(c) In 2^3 factorial experiment, the following data were recorded.

	C_0		C_1		
	a_0	a_1		a_0	a_1
b_0	5,6,3	10,15,13	b_0	10,4,6	12,18,14
b_1	20,18,24	8,10,4		22,16,18	9,6,10

Construct ANOVA table when

(i) ABC is confounded. Show that $ABC_{ss} = Blocks_{ss}$ **[3Mks]**

(ii) BC is confounded. Show that $BC_{ss} = Blocks_{ss}$ **[3Mks]**

(iii) AC is confounded. Draw statistical conclusions at 5% level of significance **[5Mks]**

QUESTION FOUR (15 MARKS)

(a) Describe the three main principles of design and analysis of experiments. What is their importance?
[4Mks]

(b) What do you understand by the following terms in design and analysis of experiments?

(i) Block of units **[1Mk]**

(ii) Complete block **[1Mk]**

(iii) Randomized block **[1Mk]**

(iv) Restricted randomization **[1Mk]**

(c) Consider four different makes of cars chosen at random. The four cars of each make were put on road and driven at different speeds of S_1, S_2, S_3, S_4 and S_5 respectively. If the problem was to estimate the petrol consumption rate of different makes of cars for suitable average speed and compare them, the procedure was adopted for each of the four makes of cars and for each car the distance covered per gallon of petrol was observed. The table below indicates the observations made on miles per gallon of petrol.

	Speed of cars in km/h				
Make of a car	**30**	**50**	**65**	**80**	**90**
A	20.6	19.5	18.1	17.9	16.0
B	19.5	19.0	15.6	16.7	14.1
C	20.5	18.5	16.3	15.2	13.7
D	16.2	16.5	15.7	14.8	12.7

(i) Describe briefly the design used in this experiment **[2Mks]**

(ii) Formulate hypothesis that can be tested **[1Mk]**

(iii) Analyze the experiment at 1% level of significance **[4Mks]**

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