(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION AND BACHELOR OF SCIENCE

COURSE CODE: **STA 421**

COURSE TITLE: MULTIVARIATE ANALYSIS

DATE: 31/08/2022 **TIME:** 9:00 AM - 11:00 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE (30 MARKS

a.) Write down the characteristic function of a multivariate normal distribution (4marks)

b.) With examples differentiate between multiple linear regression and multivariate linear regression. Show your answer in matrix form (6marks)

c.) The observations on two responses are collected for three treatments and the observation vectors are $\begin{pmatrix} X_1 \\ X_2 \end{pmatrix}$

Treatment 1: $\begin{bmatrix} 6 \\ 7 \end{bmatrix}, \begin{bmatrix} 5 \\ 9 \end{bmatrix}, \begin{bmatrix} 8 \\ 6 \end{bmatrix}, \begin{bmatrix} 4 \\ 9 \end{bmatrix}, \begin{bmatrix} 7 \\ 9 \end{bmatrix}$

Treatment 2: $\begin{bmatrix} 3 \\ 3 \end{bmatrix}, \begin{bmatrix} 1 \\ 6 \end{bmatrix}, \begin{bmatrix} 2 \\ 3 \end{bmatrix}$

Treatment 3: $\begin{bmatrix} 2 \\ 3 \end{bmatrix}, \begin{bmatrix} 5 \\ 1 \end{bmatrix}, \begin{bmatrix} 3 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ 3 \end{bmatrix}$

i.) Break up the observations into mean, treatment and residual components (4marks)

ii.) Construct the corresponding arrays for each variables (2marks)

iii.) Using the information in part i.), construct the one-way MANOVA table (6marks)

iv.) Use the wilks lambda to test for treatment effects. $\alpha = 0.01$ (3marks)

v.) Evaluate the test using chi-square approximation with Bartlett's correlation and compare the conclusions (5marks)

QUESTION TWO (20 MARKS)

a.) Outline the use of Discriminant analysis (4marks)

b.) Sate any four assumptions of discriminant analysis (4marks)

c.) Identify the effects of the assumption violations stated in a.) (4marks)

d.) Given that:

$$X_1 = \begin{pmatrix} 42 \\ 52 \\ 48 \\ 58 \end{pmatrix} \qquad X_2 = \begin{pmatrix} 4 \\ 5 \\ 4 \\ 3 \end{pmatrix}$$

Find the arrays

i.) X bar (2marks)

ii.) S_n (4marks)

iii.) **R** (2marks)

QUESTION THREE (20 MARKS)

a.) State the properties of sample correlation r (5marks)

b.) Discuss five objectives of multivariate analysis (5 marks)

c.) In large samples, the distributions of multivariate parameter estimators tend to multivariate normality.

Discuss any five properties of multivariate normal distribution. (10marks)

QUESTION FOUR (20 MARKS)

a.) Define the following;

(i) MANOVA (3 Marks)

(ii) Principal component analysis (3 Marks)

(iii) Canonical analysis (2 Marks)

b.) Consider the following data on one predictor variable X_1 and two responses Y_1.

X_1	-2	-1	0	1	2
Y_1	5	3	4	2	1
Y_2	-3	-1	-1	2	3

i.) Determine the least square estimates of the parameters in the straight line regression model (7marks)

$$Y_1 = \beta_{01} + \beta_{11} Z_{i1} + \varepsilon_{i1}$$

$$Y_2 = \beta_{01} + \beta_{11} Z_{i1} + \varepsilon_{i1} \text{ for } j = 1,2,3,4,5$$

ii.) Calculate matrices of fitted values $Y^\wedge$ and $\varepsilon^\wedge$. (5marks)

QUESTION FIVE (20MARKS)

a.) Write short notes on different types matrices (10marks)

b.) Highlight the objectives of multivariate analysis. (5marks)

c.) If.

$$\mathbf{A} = \begin{pmatrix} 1 & 2 \\ 1 & 3 \end{pmatrix} \qquad \mathbf{B} = \begin{pmatrix} 1 & 4 & 2 \\ 5 & 0 & 3 \end{pmatrix}$$

Verify the following properties of the transpose.

i.) $(A^1)^1 = A$ (2marks)

ii.) $(AB)^1 = B^1 A^1$ (3marks)