MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS

2023/ 2024 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER
SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES.
M.SC (APPLIED STATISTICS)

COURSE CODE: STA 8211

COURSE TITLE: MULTIVARIATE METHODS I

DATE: TIME:

INSTRUCTIONS TO CANDIDATES

Answer Question ONE and any other TWO questions

This paper consists of FOUR printed pages. Please turn over.

QUESTION ONE (20 MARKS)

Three drugs X_1, X_2, and X_3 are to lead to changes in the level of a certain biochemical compound found in the brain. Thirty mice of the same stain were randomly divided into three groups and received drugs. The amount of the compound (in micrograms per gram of brain tissue) is recorded before and after the treatments. The responses are given in the following table. Test the hypothesis of no treatment effect at 5% level of significance.

Before treatment			After treatment		
x_{1i1}	x_{1i2}	x_{1i3}	x_{2i1}	x_{2i2}	x_{2i3}
1.21	0.61	0.70	1.26	0.50	0.81
0.92	0.43	0.71	1.07	0.39	0.69
0.80	0.35	0.71	1.33	0.24	0.70
0.85	0.48	0.68	1.39	0.37	0.72
0.98	0.42	0.71	1.38	0.42	0.71
1.15	0.52	0.72	0.98	0.49	0.70
1.10	0.50	0.75	1.41	0.41	0.70
1.02	0.53	0.70	1.30	0.47	0.67
1.18	0.45	0.70	1.22	0.29	0.68
1.09	0.40	0.69	1.00	0.30	0.70

(20 marks)

QUESTION TWO (20 MARKS)

You are given the following data which is about academic performance of students both at high school and at the university scored out of 100 for high school and out of 4.00 for university.

Female		Male	
97	3.40	86	3.90
95	3.45	84	3.75
85	3.50	70	2.25
		80	3.05
		75	2.80

Test the equality of the population mean vectors between the two groups. Take $\alpha = 0.05$

(20 marks)

QUESTION THREE (20 MARKS)

In factor analysis, we consider a joint distribution on (X, Z) where $Z \sim N(0,1)$ and $X|Z \sim N(\mu + \Lambda z, \varphi)$.

We also consider factor analysis according to:

$$Z \sim N(0,1)$$

$$\varepsilon \sim N(0, \varphi)$$

$$x = \mu + \Lambda z + \varepsilon$$

a. (i) Work out E(X)   (2 marks)

(ii) Show that $E[(Z - E(Z))(X - E(X)')] = \Lambda'$ (3 marks)

(iii) Show also that $E[(X - E(X))(X - E(X)')] = \Lambda\Lambda' + \varphi$ (3 marks)

b. A researcher conducted three indices measuring severity of heart attacks. The values of the indices for n = 40 heart-attack patients arriving at a hospital emergency room produced the following summary statistics.

$$\bar{x} = \begin{bmatrix} 46.1 \\ 57.3 \\ 50.4 \end{bmatrix} \text{ and } S = \begin{bmatrix} 101.3 & 63.0 & 71.0 \\ 63.0 & 80.2 & 55.6 \\ 71.0 & 55.6 & 97.4 \end{bmatrix}$$

Test the equality of the mean indices and judge the differences in pairs of mean indices.

(12 marks)

QUESTION FOUR (20 MARKS

Given the following observation vectors on two responses collected for three treatments:

	Treatment 1					Treatment 2				Treatment 3		
6	5	8	4	7		3	1	2		2	5	3	2
7	9	6	9	9		3	6	3		3	1	1	3

Construct a one-way MANOVA and test for the treatment effect at 5% significance level.

(20 marks)