CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL EXAMINATION

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE, BACHELOR OF EDUCATION AND BACHELOR OF ARTS

MATH 445/447: APPLIED MULTIVARIATE ANALYSIS

STREAMS: BSC, BED & BA   **TIME: 2 HOURS**

DAY/DATE: TUESDAY 02/11/2021   **11.30 A.M – 1.30 P.M.**

INSTRUCTIONS:

- ***ANSWER ALL THE QUESTIONS.***

QUESTION ONE

a. Let $\bar{X} \sim N(\underline{\mu}, \Sigma)$ with $\underline{\mu} = [50\ 24\ \ 10]$ and $\Sigma = \begin{bmatrix} 64 & 16 & -8 \\ 16 & 16 & 2 \\ -8 & 2 & 4 \end{bmatrix}$

   i. Determine the joint distribution of   [6 marks]
       $Y_1 = X_1 + X_2 - X_3$
       $Y_2 = X_1 - 2X_2$

   ii. Are Y_1 and Y_2 independent? Give reason   [3 marks]

   iii. Determine the standard deviation matrix $V^{\frac{1}{2}}$ and the correlation matrix [5 marks]

b. Let $X \sim N(\mu, \Sigma)$ be tri-variate normal random vector with $\mu = [80\ \ 40\ 10]$ and

$$\Sigma = \begin{bmatrix} 36 & -12 & -6 \\ -12 & 16 & 2 \\ -6 & 2 & 4 \end{bmatrix}$$

   Find

   i. The regression function of X_1 on X_2 and X_3 [8 marks]
   ii. Conditional variance of X_1 when effect of X_2 and X_3 have been eliminated [8 marks]

QUESTION TWO

Observations on three responses are collected for two treatments. The observation vectors are as given below.

Treatment	A	A	B	B	B	B
X_1	4	6	10	4	10	8
X_2	2	2	3	3	0	2
X_3	0	2	6	3	4	3

Find
  i.   The matrix of sum of squares due to treatment   [5marks]
  ii.   The matrix of residual sum of squares   [5marks]
  iii. the Wilk's lambda statistics and use it to test the hypothesis that there is no
        treatment effect at 5% significance level   [6marks]
  iv.   State all the assumptions of MANOVA   [4marks]

QUESTION THREE

The perspiration of 20 healthy female University students was analyzed by Physician in charge of Chuka University Sanatotium. Three components X1=Sweet rate, X2=Sodium Content and X3=Potassium Content, were measured and the results were summarized as follows:

$$\underline{\bar{x}} = \begin{bmatrix} 4.64 \\ 45.4 \\ 9.97 \end{bmatrix} \quad S^{-1} = \begin{bmatrix} 0.566 & -0.022 & 0.258 \\ -0.022 & 0.006 & -0.002 \\ 0.258 & -0.002 & 0.402 \end{bmatrix} \quad S = \begin{bmatrix} 2.879 & 10.002 & -1.810 \\ 10.002 & 199.798 & -5.627 \\ -1.810 & -5.627 & 3.628 \end{bmatrix}$$

Test the hypothesis $H_0: \underline{\mu} = \begin{bmatrix} 4 \\ 50 \\ 10 \end{bmatrix}$ versus $H_1: \underline{\mu} \neq \begin{bmatrix} 4 \\ 50 \\ 10 \end{bmatrix}$ at 5% significance level.   [20 marks]