BINDURA UNIVERSITY OF SCIENCE EDUCATION MAE510

MScEdMAE

MULTIVARIATE ANALYSIS

Time : 3 hours JAN 2025

Candidates may attempt at most FOUR questions. Full marks can be obtained for complete solutions to FOUR questions. Each question should start on a fresh page.

A1. Evaluate the five applications of Multivariate Methods. [25]

A2. (a) In Principal Component analysis, define the following terms;

(i) population,

(ii) factor,

(iii) scree plot. [2, 2, 2]

(b) The estimated correlation matrix (courtesy of Jodi Barnet)

$$R = \begin{bmatrix} 1 & 0.4919 & 0.2636 & 0.4653 & -0.2277 & 0.0652 \\ 0.4919 & 1 & 0.3127 & 0.3506 & -0.1919 & 0.2045 \\ 0.2636 & 0.3127 & 1 & 0.4108 & 0.0647 & 0.2493 \\ 0.4653 & 0.3506 & 0.4108 & 1 & -0.2249 & 0.2293 \\ -0.2277 & -0.1917 & 0.0647 & -0.2249 & 1 & -0.2144 \\ 0.0652 & 0.2045 & 0.2493 & 0.2293 & -0.2144 & 1 \end{bmatrix}$$

is based on a sample of about 120. Comment on the pattern of correlation within the x_1 through x_5. Using the information how many principal components might are significant and why?. [10, 2, 2]

(c) What is the practical interpretation of Factor Analysis? [5]

A3. (a) Distinguish

(i) multiple regression and multivariate regression. [4]

(ii) Linear Correlation and Linear regression. [4]

(b) The following five measurements where obtained for the dependent variable y and two independent variables x_1 and x_2.

x_1	9	2	6	5	8
x_2	12	8	6	4	10
y	3	4	0	2	1

(i) Use the matrix method to estimate a regression model for the dataset. [12]

(ii) State the null and alternative hypotheses for testing the significance of all the model parameters involved. [5]

A4. A selection of seven receipts from the university bookstore was obtained in order to investigate the nature of book sales. Each receipt provided among other things, the number of books sold and the total amount of each sale. The results are presented below.

variable 1 (dollar sales); 25 32 45 28 28 60

and

variable 2 (number of books); 5 4 6 3 2 9 Calculate;

(a) the mean vector, [4]

(b) variance-covariance matrix, [10]

(c) the correlation matrix and comment on your result, [6]

(d) state any hypotheses that can be tested involving the mean vector. [5]

A5. (a) Distinguish classification and discrimination. [3]

(b) Consider the two datasets.

$$\mathbf{X}_1 = \begin{bmatrix} 3 & 7 \\ 2 & 4 \\ 4 & 7 \end{bmatrix}, \mathbf{X}_2 = \begin{bmatrix} 6 & 9 \\ 5 & 7 \\ 4 & 8 \end{bmatrix} \text{ and}$$

$$\mathbf{S}_{pooled} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$$

(i) Calculate the linear discriminant function. [15]

(ii) Classify the object $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$. [7]

END OF QUESTION PAPER