Discipline-Specific Elective (DSC) Course: 3b Multivariate Analysis

Structure 1: PG Curricular Structure with only Course Work
Structure 2: PG Curricular Structure with Course Work + Research

Course Title & Code	Credits	Credit Distribution of the Course			Eligibility Criteria	Prerequisite of the course (if any)
		Lecture (45 Hours)	Tutorial (15 Hours)	Practical (00 Hours)		
DSC 3b: Multivariate Analysis	4	3	1	0	NIL	NIL

Course Objectives:

- To introduce students to the analysis of observations on several correlated random variables for a number of individuals.
- Explore applications of multivariate techniques in fields such as Anthropology, Psychology, Biology, Medicine, Education, Agriculture, and Economics.

Course Learning Outcomes: After successful completion of this course, students will be able to:

- Explain and apply fundamental theorems and concepts in multivariate analysis.
- Summarize, visualize, and interpret multivariate data.
- Appreciate the range of multivariate techniques available and their interconnections.
- Understand the relationship between multivariate and corresponding univariate techniques.
- Conduct statistical inference about multivariate means-including hypothesis testing and confidence regions.
- Use multivariate techniques appropriately and draw valid conclusions.

Unit I (12 Hours)

Multivariate normal distribution, its properties and characterization. Random sampling from a multivariate normal distribution, Maximum likelihood estimators of parameters, Distribution of sample mean vector, Inference concerning the mean vector when the covariance matrix is known, Matrix of normal distribution, Multivariate central limit theorem.

Unit II (10 Hours)

Wishart matrix, its distribution and properties, Distribution of sample generalized variance, Hotelling's T^2 statistic, its distribution and properties, applications in tests on mean vector for one and two multivariate normal populations, Mahalanobis' D^2 statistic.

Unit III (10 Hours)

Likelihood ratio test criteria for testing equality of mean and covariance matrices, Distribution of the matrix of sample regression coefficients and the matrix of residual sum of squares and cross products, Rao's U-statistic, its distribution and applications.

Unit IV (13 Hours)

Classification and Discrimination procedures for discrimination between two multivariate normal populations, Sample discriminant function, Classification rule based on expected cost of misclassification (ECM), Canonical Correlation Analysis, Principal Components Analysis, Elements of factor analysis and cluster analysis, Multivariate Analysis of Variance (MANOVA) of one-way classified data, Wilk's Lambda criterion.

Tutorial:

Tutorial sessions will include at least one activity such as group discussion/presentation/ problem solving exercise based on the material covered in the lectures along with scholastic work related to the conceptual understanding of the subject.

Essential Readings:

1. Anderson, T.W. (2003). *An Introduction to Multivariate Statistical Analysis*, John Wiley & Sons.
2. Muirhead, R.J. (1982). *Aspects of Multivariate Statistical Theory*, John Wiley & Sons.
3. Rencher, A.C. and Christensen, W.F. (2012). *Methods of Multivariate Analysis*, John Wiley & Sons.

Suggested Readings:

1. Giri, N.C. (1977). *Multivariate Statistical Inference*, Academic Press.
2. Hair, J.F., Babin, B.J., Anderson, R.E. and Black, W.C. (2022). *Multivariate Data Analysis*, Cengage Learning.
3. Hardle, W.K. and Simar, L. (2015). *Applied Multivariate Statistical Analysis*, Springer.

4. Johnson, R.A. and Wichern, D.W. (2015). *Applied Multivariate Statistical Analysis*, Pearson.
5. Kshirsagar, A.M. (1996). *Multivariate Analysis*, Marcel Dekker.
6. Lawley, D.N. and Maxwell, A.E. (1971). *Factor Analysis as a Statistical Method*, Butterworths.
7. Rao, C.R. (1973). *Linear Statistical Inference and Its Applications*, John Wiley & Sons.