DISCIPLINE SPECIFIC CORE COURSE-5B: INTRODUCTION TO STATISTICAL LINEAR MODELS

CREDIT DISTRIBUTION, ELIGIBILITY, AND PRE-REQUISITES OF THE COURSE

Course title & code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lectures	Tutorials	practical		
Introduction to Statistical Linear Models	4	3	0	1		Basic knowledge of Matrix theory and Probability distributions

Learning Objectives:
Learning objectives include:

- Developing a clear understanding of the fundamental concepts of linear models.
- Developing associated skills allows the students to work effectively with them.

Learning Outcomes:
After completion of this course, students should have developed a clear understanding of:

- Theory and estimation of Linear Models.
- Gauss-Markov Theorem and its use.
- Distribution of quadratic forms.
- Simple and Multiple linear regression models and their applications.
- Fitting of these models to real or synthetic data, derivation of confidence and prediction intervals, and a sound scientific interpretation of the results.
- Techniques of Analysis of Variance under fixed effects model.
- Assessment of the quality of the fit using classical diagnostics.

SYLLABUS OF DSC-14

Theory

UNIT I **(12 Hours)**

Introduction

Statistical Linear Models and their classification, Estimability of linear parametric functions, Gauss-Markov setup, Normal equations and Gauss-Markov theorem, full rank case and non-full rank case (without proof)

UNIT II **(8 Hours)**

Distribution of quadratic forms

Cochran's theorem (without proof), Necessary and sufficient conditions for the mutual independence of quadratic forms and for the mutual independence of a linear function and a quadratic form.

UNIT III **(13 Hours)**

Simple and Multiple linear regression: Estimation of parameters and testing of hypotheses, Confidence intervals, Bias in regression estimates Lack of fit and pure error, Residuals and their plot. Techniques for variable selection. Polynomial Regression models: Orthogonal Polynomials.

UNIT IV **(12 Hours)**

Analysis of Variance:

Technique of analysis of variance (ANOVA) in one-way and two-way classifications with an equal number of observations per cell under fixed effect model.

PRACTICAL/LABWORK -30 Hours

List of Practical:

1. Estimability when X is a full rank matrix.
2. Estimability when X is not a full rank matrix.
3. Distribution of Quadratic forms.
4. Simple Linear Regression.
5. Multiple Linear Regression
6. Tests for Linear Hypothesis.
7. Bias in regression estimates.
8. Lack of fit.
9. Orthogonal Polynomials.
10. Analysis of Variance of a one-way classified data.
11. Analysis of Variance of two-way classified data with one observation per cell.
12. Analysis of Variance of two-way classified data with m (> 1) observations per cell.

Practical work to be conducted using electronic spreadsheet / EXCEL/ Statistical Software Package/ SPSS/ calculators.

Essential Readings

- Montgomery, D. C., Peck, E. A. and Vining, G. G. (2012): Introduction to Linear Regression Analysis, 5th Ed., John Wiley and Sons.
- Rencher, A. C. and Schaalje, G. B. (2008): Linear Models in Statistics, 2nd Ed., John Wiley and Sons.
- Draper, N. R. and Smith, H. (1998): Applied Regression Analysis, 3rd Ed., John Wiley and Sons.

Suggestive Readings:

- Weisberg, S. (2005): Applied Linear Regression, 3rd Ed, John Wiley and Sons.
- Rawlings, John O. Pantula Sastry G. Dickey, David A. (1998) Applied Regression Analysis: A Research Tool, Second Edition
- Bapat, R.B.(2012): Linear Algebra and Linear Models, Hindustan Book Agency.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch University of Delhi, from time to time.