

## Semester-V

### PAPER NO-12: LINEAR MODELS

1. Linear Models
2. Estimability
  - 2.1 Estimability of  $\beta$
  - 2.2 Estimable functions of  $\beta$
3. Gauss Markov Theorem: Full rank and non-full rank cases
  - 3.1 Estimators of  $\lambda'\beta$
  - 3.2 Estimator of  $\sigma^2$
4. Distribution of Quadratic forms for Linear Hypothesis
5. Hypothesis testing in multiple linear regressions
6. Simple Linear Regression
  - 6.1 Model
  - 6.2 Least squares estimation of the parameters
  - 6.3 Hypothesis testing on the slope and the intercept
  - 6.4 Interval estimation
  - 6.5 Prediction
  - 6.6 Coefficient of Determination
  - 6.7 Regression through the origin
  - 6.8 Estimation by Maximum likelihood
7. Fitting of a Straight Line (Matrix Approach)
8. Bias in Regression Estimates
9. Residuals and Outliers
10. Lack of Fit and Pure Error
11. Polynomial Regression Models
  - 11.1 Polynomial models in one variable
  - 11.2 Orthogonal polynomials
12. Analysis of Variance: Fixed Effects Model
  - 12.1 One way classification
  - 12.2 Two way classification with one observation per cell
  - 12.3 Two way classification with more than one observation per cell
13. Analysis of Variance: Random Effects Model
  - 13.1 One way classification
  - 13.2 Two way classification with equal number of observations per cell
14. Analysis of Covariance
  - 14.1 Model
  - 14.2 One way classification with one Covariate
  - 14.3 Two way classification with one Covariate
15. General concept of Indicator Variables

### WEEK-WISE DETAILS

#### Week 1: Linear Models and Estimability

- Rencher, A.C. (2000): *Linear Models in Statistics*, John Wiley and Sons. pp. 112, 265-277

#### Week 2: Gauss Markov Theorem

- Rencher, A.C. (2000): *Linear Models in Statistics*, John Wiley and Sons. pp. 130-135

### **Week 3: Distribution of Quadratic forms**

- Bapat, R.B. (1993): *Linear Algebra and Linear Models*, Hindustan Book Agency. pp. 79-83

### **Week 4: Tests for Linear Hypothesis**

- Montgomery, D.C., Peck, E.A. and Vining, G.G. (2004): *Introduction to Linear Regression Analysis*, John Wiley and Sons. pp.67-69, 87-96

### **Week 5: Simple Linear Regression**

- Montgomery, D.C., Peck, E.A. and Vining, G.G. (2004): *Introduction to Linear Regression Analysis*, John Wiley and Sons. pp. 13-40, 44-50, 65

### **Week 6: Fitting of a straight line (matrix approach) and Bias in regression estimates**

- Draper, N.R. and Smith, H. (2005): *Applied Regression Analysis*, John Wiley and Sons. pp. 124-125, 235-238

### **Week 7: Residuals and outliers, Lack of fit and pure error**

- Montgomery, D.C., Peck, E.A. and Vining, G.G. (2004): *Introduction to Linear Regression Analysis*, John Wiley and Sons. pp.132-133, 158-161

### **Week 8: Polynomial Regression Models**

- Montgomery, D.C., Peck, E.A. and Vining, G.G. (2004): *Introduction to Linear Regression Analysis*, John Wiley and Sons. pp.221-222, 253-255

### **Week 9: Analysis of Variance: Fixed effects model**

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (1980): *An Outline of Statistics, Vol. II*, The World Press Private Ltd. pp.270-275, 277-280

### **Week 10: Analysis of Variance: Random effects model**

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (1980): *An Outline of Statistics, Vol. II*, The World Press Private Ltd. pp. 302-307

### **Week 11: Analysis of Covariance**

- Rencher, A.C. and Schaalje, G.B. (2008): *Linear Models in Statistics*, John Wiley and Sons. pp. 443-444, 449-453, 458-460

### **Week 12: General concept of indicator variables**

- Montgomery, D.C., Peck, E.A. and Vining, G.G. (2004): *Introduction to Linear Regression Analysis*, John Wiley and Sons. pp. 265-279

## **Practical/ Lab work**

### **LIST OF PRACTICALS**

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 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 a two way classified data with one observation per cell
12. Analysis of Variance of a two way classified data with more than one observations per cell
13. Analysis of Covariance of a one way classified data
14. Analysis of Covariance of a two way classified data