# DEPARTMENT OF STATISTICS
# B. Sc. (H) Statistics
# SEM-V

## Category I

**DISCIPLINE SPECIFIC CORE COURSE – 13: THEORY OF ESTIMATION**

**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) |
|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical/ Practice | | |
| Theory of Estimation | 4 | 3 | 0 | 1 | Class XII pass with Mathematics | knowledge of probability, probability distributions and sampling distributions |

### Learning Objectives

The learning objectives include:

- Characterisation of the population based on sample information
- Understanding process of learning and determining the population characteristics based the available data.
- Strength and weakness of various methods for obtaining point and interval estimators with respect to optimal/desirable properties.

### Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

- List desirable properties of point estimators based on an unknown parameter of a distribution viz. Unbiasedness, Consistency, Efficiency and Sufficiency.
- Derive the UMVUE of a parameter or function of a parameter (Using Cramer- Rao inequality, Rao-Blackwell theorem, and Lehmann- Scheffe Theorem).
- Understand and apply different techniques of finding optimal point estimators such as Maximum Likelihood Estimation, Method of Least Squares, Method of moments and the method of minimum Chi-Square
- Construct interval estimators, pivot method (Confidence Intervals) for unknown population parameters.

### SYLLABUS OF DSC-13

**Theory**

**UNIT I** **(18 hours)**

**Estimation**

Estimation: Concepts of estimation, unbiasedness, sufficiency, consistency and efficiency. Fisher-Neyman Criterion (statement and applications), Factorization theorem. Complete statistic, Minimum variance unbiased estimator (MVUE), Rao-Blackwell and Lehmann-Scheffe theorems and their applications. Cramer-Rao inequality, Minimum Variance Bound estimators (MVBE) and their applications.

**UNIT II** **(10 hours)**

**Methods of Estimations**

Methods of Estimation: Method of moments, method of maximum likelihood estimation and method of minimum Chi-square.

**UNIT III** **(12 hours)**

**Interval estimation**

Interval estimation - Confidence intervals for parameters of various distributions, confidence interval for Binomial proportion, confidence interval for population correlation coefficient for Bivariate Normal distribution, pivotal quantity method of constructing confidence intervals, shortest length confidence intervals, large sample confidence intervals.

**UNIT IV** **(5 hours)**

**Censored Data**

Failure censored samples, time censored sample, estimation of expected lifetime in failure censored samples for one parameter exponential lifetime distribution

**PRACTICAL/LABWORK (30 hours):**

**List of Practical**

1. Unbiased estimators (including unbiased but absurd estimators)
2. Consistent estimators, efficient estimators and relative efficiency of estimators.
3. Cramer-Rao inequality and MVB estimators
4. Sufficient Estimators – Factorization Theorem, Complete Sufficient estimators, Rao-Blackwell theorem.
5. Lehman-Scheffe theorem and UMVUE
6. Maximum Likelihood Estimation
7. Asymptotic distribution of maximum likelihood estimators
8. Estimation by the method of moments,
9. Estimation by method of minimum Chi-square
10. Confidence interval based on large sample test
11. Confidence interval based on exact sample test

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

**ESSENTIAL READINGS:**


- Gun, A.M.; Gupta, M.K.; Dasgupta, B. (2013).: An Out Line of Statistical Theory, Volume 2, The World Press, Kolkata.

- Gupta, S.C. and Kapoor, V.K.(2020): Fundamental of Mathematical Statistics, 12th Edn. Sultan Chand and Sons.
- Sinha, S.K. (1986):Reliability and Life testing; Wiley Eastern.


**SUGGESTIVE READINGS:**


- Hogg, R.V. and Craig, A.T (2018): Introduction to Mathematical Statistics, 8th Edn. Pearson Education.
- Casella, G. and Berger, R.L. (2002): Statistical Inference. 2nd Edition, Duxbury Press, Pacific Grove.
- Hogg, R.V. and Tanis, E.A. (1988): Probability and statistical Inference, 6th Edn. Pearson Education
- Rohatgi V.K, (2013): Statistical Inference- Dover Publication, New York.


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

## DISCIPLINE SPECIFIC CORE COURSE-14: 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 | | |
| Linear Models | **4** | **3** | **0** | **1** | Class XII pass with Mathematics | Basic knowledge of matrix theory, probability distributions and sampling distributions |

### Learning Objectives:

learning objectives include:

- Developing a clear understanding of the fundamental concepts of linear models.
- Developing associated skills allowing 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 and Covariance under fixed effects model.