

**DISCIPLINE SPECIFIC ELECTIVE COURSE-6(iii): MATHEMATICAL STATISTICS**

**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		
Mathematical Statistics	4	3	1	0	Class XII pass with Mathematics	Probability and Statistics, Multivariate Calculus

**Learning Objectives:** The main objective of this course is to introduce the:

- Joint behavior of several random variables theoretically and through illustrative practical examples.
- Theory underlying modern statistics to give the student a solid grounding in (mathematical) statistics and the principles of statistical inference.
- Application of the theory to the statistical modeling of data from real applications, including model identification, estimation, and interpretation.
- Theory and analysis of multivariate data which covers two-factor analysis of variance, multiple linear regression including models for contingency tables.

**Learning Outcomes:** The course will enable the students to:

- Understand joint distributions of random variables including the multivariate normal distribution.
- Estimate model parameters from the statistical inference based on confidence intervals and hypothesis testing.
- Understand the theory of multiple regression models and contingency tables.
- Apply principles and theory to the statistical modeling and analysis of practical problems in a variety of application areas, and to interpret results and draw conclusions in context.

## **SYLLABUS OF DSE-6(iii)**

### **UNIT-I: Joint Probability Distributions (15 hours)**

Joint probability mass function for two discrete random variables, Marginal probability mass function, Joint probability density function for two continuous random variables, Marginal probability density function, Independent random variables; Expected values, covariance, and correlation; Linear combination of random variables, Moment generating functions of linear combination of random variables; Conditional distributions and conditional expectation, The laws of total expectation and variance; Bivariate normal distribution.

### **UNIT-II: Sampling Distributions and Estimation (12 hours)**

Distribution of important statistics such as the sample totals, sample means, and sample proportions; Joint sampling distribution of sample mean and sample variance,  $t$ -statistic and  $F$ -statistic distributions based on normal random samples; Concepts and criteria for point estimation, The method of moments estimators and maximum likelihood estimation; Interval estimation and basic properties of confidence intervals, One-sample  $t$  confidence interval, Confidence intervals for a population proportion and population variance.

### **UNIT-III: Tests of Hypotheses, ANOVA and Multiple Regression Analysis (18 hours)**

Statistical hypotheses and test procedures, One-sample tests about: population mean, population proportion, and population variance;  $P$ -values for tests; Two-sample  $z$ -confidence interval and  $t$ -confidence interval tests; Single-factor ANOVA, Two-factor ANOVA without replication; Multiple linear regression model and estimating parameters; Chi-squared goodness-of-fit tests, Two-way Contingency tables.

### **Essential Reading**

1. Devore, Jay L., Berk, Kenneth N. & Carlton Matthew A. (2021). Modern Mathematical Statistics with Applications. Third edition, Springer.

### **Suggestive Readings**

- Devore, Jay L. (2016). Probability and Statistics for Engineering and the Sciences. Ninth edition, Cengage Learning India Private Limited, Delhi. Fourth impression 2022.
- Hogg, Robert V., McKean, Joseph W., & Craig, Allen T. (2019). Introduction to Mathematical Statistics. Eighth edition, Pearson. Indian Reprint 2020.
- Mood, A.M., Graybill, F.A., & Boes, D.C. (1974). Introduction the Theory of Statistics (3rd ed.). Tata McGraw Hill Pub. Co. Ltd. Reprinted 2017.
- Wackerly, Dennis D., Mendenhall III, William & Scheaffer, Richard L. (2008). Mathematical Statistics with Applications. 7th edition, Cengage Learning.