

**DEPARTMENT OF STATISTICS**  
**B. Sc. (H) Statistics**  
**SEM-II**  
**Category-I**

**DISCIPLINE SPECIFIC CORE COURSE-4:**  
**THEORY OF PROBABILITY DISTRIBUTIONS**

**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 probability distributions	4	3	0	1	Class XII pass with Mathematics	Descriptive Statistics, Probability Theory, Calculus

**Learning Objectives**

The learning objectives of this course are as follows:

- Acquaint students with requisite tools for problem-solving available in statistical methodology.
- Prepare students to handle two/three-dimensional data and familiarize them with different measures of association as well as regression.
- Introduction to various discrete and continuous distributions and their properties.

**Learning Outcomes**

The learning outcomes of this course are as follows:

- Understand the role of expectation and its usefulness. Get familiar with different kind of generating functions and their strength and weaknesses
- Handle problems based on two-dimensional random variables using Jacobians and bivariate transformations.
- Understand and exploit various measures of correlation and regression for problem-solving.
- Familiarize with the concept of partial and multiple correlation coefficients and their properties
- Get acquainted with various discrete and continuous distributions their properties and interrelations and solve problems based on them.

## **SYLLABUS OF DSC-4**

### **Theory**

#### **UNIT I**

**(09 Hours)**

##### **Expectation**

Mathematical Expectation: Conditional expectations and its properties. Bivariate transformations with illustrations. Moments, moment generating function and its properties. Cumulants, cumulant generating function and its properties. Characteristic function and its properties. Inversion theorem for continuous random variables (without proof) along with applications.

#### **UNIT II**

**(12 Hours)**

##### **Expectation (contd.)**

Some inequalities involving expectation - Cauchy Schwartz Inequality, Jensen's inequality.

Two-dimensional random variables: Joint probability mass function/ Joint probability density function, marginal and conditional probability mass function/ probability density function, independence of random variables, examples based on joint/marginal/conditional pmf/pdf.

Conditional expectation and variance, Jacobian of transformation, Bivariate transformation of random variables, and Examples based on bivariate transformation.

#### **UNIT III**

**(09 Hours)**

##### **Correlation and Regression**

Properties of various measures of correlation and regression using expectation, Correlation Ratio, Intra-class correlation, Partial and multiple correlations – definition, Yule's notation, the plane of regression, properties of residuals, multiple and partial correlation coefficients and their properties (derivation based on three variables), the relationship between multiple, partial and total correlations and examples based on them.

#### **UNIT IV**

**(15 Hours)**

##### **Probability Distributions**

Discrete probability distribution – Binomial, Poisson- measures of central tendency, dispersion, skewness and kurtosis, recurrence relations based on moments, moment generating function, cumulant generating function, characteristic function, additive property, fitting of distribution, and examples based on application.

Continuous Probability distribution - Normal - measures of central tendency, dispersion, skewness and kurtosis, recurrence relations based on moments, moment generating function, cumulant generating function, characteristic function, additive property fitting of distribution and examples based on application, Uniform distribution – moments, mgf, mean deviation and examples based on bivariate transformations.

### **PRACTICAL – 30 Hours**

#### **List of Practicals:**

1. Practical based on regression lines and properties of regression coefficients.
2. Practical based on Correlation ratio.
3. Practical based on Intra-class correlation.
4. Practical based on multiple correlation coefficient.
5. Practical based on partial correlation coefficient

6. Practical based on planes of regression.
7. Word problems based on applications of Binomial distribution.
8. Practical based on fitting of Binomial distribution (when parameters are given).
9. Practical based on fitting of Binomial distribution (when parameters are not given).
10. Practical based on calculation of area under the normal curve.
11. Practical based on calculation of ordinates given area under the normal curve.
12. Practical based on fitting of the normal curve when parameters are not given.
13. Practical based on use of normal approximation to the binomial distribution.

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

#### **ESSENTIAL READINGS**

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2016). *An Outline of Statistical Theory*, Vol. I, The World Press, Kolkata.
- Gupta, S. C. and Kapoor, V. K. (2020). *Fundamentals of Mathematical Statistics*, 12<sup>th</sup> Edn., S. Chand and Sons. Delhi.
- Hogg, R.V., Tanis, E.A. and Rao, J.M. (2009). *Probability and Statistical Inference*, 7th Ed., Pearson Education, New Delhi.
- Miller, I. and Miller, M. (2006). *John E. Freund's Mathematical Statistics with Applications*, 8th Ed., Pearson Education, Asia.
- Mukhopadhyay, P. (2016). *Mathematical Statistics*. Books And Allied, India.

#### **SUGGESTED READINGS**

- Mood, A.M. Graybill, F.A. and Boes, D.C. (2007). *Introduction to the Theory of Statistics*, 3rd Ed., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
- Rohatgi, V. K and Saleh M. E. (2015). *An Introduction to Probability and Statistics*, 3<sup>rd</sup> Edn. John Wiley & Sons, Inc., New Jersey.

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

#### **DISCIPLINE SPECIFIC CORE COURSE-5:**

#### **APPLIED STATISTICS I**

#### **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		
Applied Statistics I	4	3	0	1	Class XII pass with Mathematics	Descriptive Statistics