



SEMESTER-II  
COURSE 4: RANDOM VARIABLES AND MATHEMATICAL EXPECTATIONS

Theory

Credits: 3

3 hrs/week

**I. Learning Outcomes**

After successful completion of the course students will be able to:

1. To acquaint with the role of statistics in dealing with the univariate random variables.
2. To learn the extension of the univariate data to bivariate data.
3. To learn the measure of randomness mathematically by using expectations.
4. To get the familiarity about the generating functions, law of large numbers and central limit theorem, further to apply in research and allied fields.

**II. Syllabus**

**Unit – 1: Univariate Random Variables**

Definition of random variable (r.v.), discrete and continuous random variables, functions of random variable. Probability mass function, Probability density function, Distribution function and its properties. Calculation of moments, coefficient of skewness and kurtosis for a given pmf and pdf.

**Unit – 2: Bivariate Random Variables**

Bivariate random variable - meaning, joint, marginal and conditional Distributions, independence of random variables and simple problems.

**Unit – 3: Mathematical Expectation**

Mathematical expectation of function a random variable. Moments and covariance using mathematical expectation with examples. Addition and Multiplication theorems on expectation. Properties of expectations, variance, covariance. Chebyshev and Cauchy - Schwartz inequalities and their applications

**Unit – 4: Generating functions**

Definitions of Moment Generating Function, Cumulant Generating Function, Characteristic Function and Probability Generating Function and their properties. Weak Law of Large Numbers (WLLN), Strong Law of Large Numbers (SLLN).

**Unit – 5: Limit Theorems**

Concept – Population, Sample, Parameter, statistic, Sampling distribution, Standard error. Convergence in probability and convergence in distribution, concept of Central limit theorem. Lindberg – Levy CLT and its applications, Statement of Lyapunov's CLT, relationship between CLT and WLLN.



**SEMESTER-II**

**COURSE 4: RANDOM VARIABLES AND MATHEMATICAL EXPECTATIONS**

Practical

Credits: 1

2 hrs/week

**Syllabus**

1. Calculation of moments of univariate random variable to the given pmf.
2. Calculation of coefficient of skewness and kurtosis of univariate random variable to the given pmf.
3. Calculation of moments of univariate random variable to the given pdf.
4. Calculation of coefficient of skewness and kurtosis of univariate random variable to the given pdf.
5. Problem related to jpmf, mpmf and conditional pmf and its independence.
6. Problem related to jpdf, mpdf and conditional pdf and its independence.
7. Chebyshev's inequality application oriented problems.

**III. References**

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
3. P. N. Arora & S. Arora: Quantitative Aptitude Statistics – Vol II, S. Chand & Company Ltd.
4. K. Rohatgi & Ehsanes Saleh: An Introduction to Probability and Statistics, John Wiley & Sons.

**IV. Suggested Co-curricular Activities:**

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc. on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.