

TRIBHUVAN UNIVERSITY
INSTITUTE OF SCIENCE AND TECHNOLOGY
SCHOOL OF MATHEMATICAL SCIENCES
Bachelor in Mathematical Sciences (B.Math.Sc.)

Course of Study

Code No.: MSST 201

Paper: **Theory of Probability**

Nature: Theory

Full Mark: 75

Pass Mark: 30

Credit: 3

Course Description:

This course begins with Applications of integration, Techniques of integration, Parametric Equations and Polar Coordinates, and is followed by a comprehensive treatment of Infinite sequence and series.

Learning Objectives:

The main objective of the course is to impart knowledge to students regarding basic probability theories with applications and probability distributions.

Mode of Delivery:

The course will be taught by lecture (48 hrs), and problem solving and class discussion (24 hrs). The use of spreadsheet software for problem solving will be encouraged.

Contents:

Unit 1 Random Variables

5 hrs

Concept of a random variable, types of random variables: Discrete and continuous random variables; Probability distribution of a random variable: probability mass function and probability density function, distribution function and its properties; Functions of random variables, examples of linear and nonlinear transformations.

Unit 2 Mathematical Expectation

10 hrs

Mathematical expectation of a random variable (discrete and continuous) and its function, properties of mathematical expectation of random variables, addition and multiplicative theorems of expectation, covariance and correlation, conditional expectation, conditional variance, variance of a linear combination of random variables; Moments of random variables: Raw and central moments, Generating functions: Moment generating function, probability generating function, cumulant generating function and characteristic function with their properties.

Unit 3 Probability Distributions

18 hrs

Discrete distributions: Bernoulli trial, binomial, Poisson, negative binomial, and hypergeometric distributions; their mass functions, distribution functions, moment generating functions, characteristic functions, moments, properties.

Continuous distributions: normal, uniform and exponential distributions: their probability density functions, distribution functions, moment generating and characteristic functions,

properties and uses, normal distribution as an approximation of binomial and Poisson distributions, standard normal distribution.

Unit 4 Generalized Linear Models

10 hrs

Exponential family of distribution, Conversion of various distribution (Binomial, Poisson, exponential, gamma, normal) into exponential family, mean and variance for an exponential Family, variance function and scale parameters, link and canonical function, Variable and factor taking categorical values, linear predictor, Deviance and scaled deviance, parameters of GLM and its estimation, Pearson and deviance residuals, determination of the acceptability of a fitted model, (Pearson's chi-square test and likelihood ratio test).

Unit 5 Convergence and Limit Theorems

5 hrs

Concepts and modes of convergence: convergence in probability, convergence in r th mean, convergence in distribution and convergence almost sure, Chebyshev inequality, law of large numbers and central limit theorem and its applications.

Reference Books:

1. Shrestha H. B. (2006) *Statistics and Probability: Concepts and Techniques*, Second Edition, EKTA Books
2. Gupta S. C. and Kapoor V. K. (2007) *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons.
3. Rohatgi V. K. and Ehsanes Saleh, A. K. MD (2005) *An Introduction to Probability and Statistics*, John Wiley & Sons
4. HWEI P. HSU (2004) *Schaum's Outline of Theory and Problems of Probability, Random Variables, & Random Processes*, , Tata Mc-Graw Hill Edition

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