- Bernstein, S. and Bernstein, R. (2020). Schaums: Outline of Elements of Statistics I Descriptive Statistics and Probability. McGraw Hill.
- Heumann, C., Schomaker, M. and Shalabh (2016). Introduction to Statistics and Data Analysis with Exercises, Solutions and Applications in R. Springer.

Suggestive Readings

- Tukey, J.W. (1977). Exploratory Data Analysis, Addison-Wesley Pub. Co. N.Y.
- Myatt, G, J. and Johnson, W.P. (2014). Making sense of data: A practical guide to
- exploratory data analysis and data mining. 2nd Edn, John Wiley & Sons, Inc. N. J.
- Agresti, A., Christine Franklin, C. and Klingenberg, B. (2017). Statistics: the art and science of learning from data. Pearson. Boston.
- Dudewicz, E. and Mishra, S. N. (1988). Modern Mathematical Statistics. Wiley.

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

DISCIPLINE SPECIFIC CORE COURSE – 2:

INTRODUCTION TO PROBABILITY

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		
Introduction to Probability	4	3	0	1	Class XII pass with Mathematics	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- Familiarize students with the mathematical basis of probability theory.
- Prepare students with important tools for statistical analyses at the undergraduate level.
- Promote understanding through real-world statistical applications.

Learning Outcomes

The Learning Outcomes of this course are as follows:

- Understand the meaning of probability and probabilistic experiment. Familiarize with the four approaches to probability theory and particularly, the axiomatic approach, use and manipulate the four axioms of probability comfortably to derive the results of other set operations.
- Understand and use addition and multiplicative laws of probability, understand the meaning of conditional probability, conditioning, and reduced sample space, compute joint and conditional

probabilities. independence, total probability, Bayes' rule and applications.

- Understand the concept of a random variable, differentiate between independent and uncorrelated random variables, distinguish between discrete and continuous, random variables and be able to represent them using probability mass, probability density, and cumulative distribution functions. Acquaint with Univariate transformation and its application.
- Understand expectation and its properties, Compute variance and covariance in terms of expectation. Solve problems based on expectation and its properties.
- SYLLABUS OF DSC - 2

Theory

Unit – 1 **(12 hours)**

Elements of Probability

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – Classical, Statistical. Limitations of Classical definition. Probability of union and intersection of events, Probability of occurrence of exactly m and at least m events out of n events, Examples based on classical approach and repeated trials, Kolmogorov's Axiomatic definition and problems based on it, Matching problems.

Unit – 2 **(09 hours)**

Laws of Probability

Conditional Probability, laws of addition and multiplication, theorem of total probability, Examples based on conditional probability and laws of addition and multiplication, independent events – Pairwise mutual independence, Bayes' theorem and its applications, Geometric probability.

Unit – 3 **(15 hours)**

Random variables

Distribution function and properties, Discrete random variables - p.m.f., discrete distribution function, Continuous random variables - p.d.f, illustrations and properties of random variables. Measures of central tendency, dispersion, skewness and kurtosis for continuous probability distributions, Examples based on random variables, Continuous distribution functions and their properties, Univariate transformation of random variables, Examples based on univariate transformations.

Unit – 4 **(09 hours)**

Mathematical Expectation

Expectation of random variable and its properties (addition and multiplication theorem of expectation), Variance and Covariance in terms of expectation and their properties, Examples based on Expectation and its properties.

Practical – 30 Hours

List of Practicals:

1. Problem based long run relative frequency to establish statistical definition of probability
2. Problem based on geometric probability.
3. Problem based on permutations and combinations when all objects are distinguishable.
4. Problem based on permutations and combinations when not all objects are different.
5. Computation of probability related to occurrence of exactly m and at least m events out of n events.
6. Computation of probabilities related to matching problems
7. Computation of conditional probabilities using addition and multiplication laws.
8. Problem related to application of Bayes Theorem.
9. Computation of distribution function of discrete and continuous random variables and calculations of probabilities of events thereof.
10. Graphical representation of probability function and distribution function of discrete/continuous arbitrary random variables.
11. Finding expectation, variance and covariances of discrete as well as continuous random variables
12. Finding expectation, variance and covariances of linear function of discrete as well as continuous random variables.
13. Constructing sample space for two-dimensional random variable.

Essential Readings

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. I, 8th Ed. The World Press, Kolkata.
- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2017). An Outline of statistical theory, Vol. I, The World Press, Kolkata.
- Gupta, S. C. and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics, 12th Edn., S. Chand and Sons. Delhi.
- Ross, S.M. (2002). A first course in Probability, 6th Ed., Pearson.
- Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia.

Suggestive Readings

- Chung, K.L. (2000). A Course in Probability Theory, 3rd Edn. Academic Press.
- Parzen, E. (1960). Modern probability theory and its applications. John Wiley.
- Feller, W. (1968) An introduction to probability theory and its applications. Vol. I, 3rd Edn. John Wiley & Sons Inc., New York.
- Blake, I. F. (1987). Introduction to Applied Probability. Krieger Publishing Co.

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