Probability and Distributions - Web course

COURSE OUTLINE

This course will be suitable for the following students: (i) M.Sc.(Integrated)-Mathematics; B.Tech/ B.E. (all disciplines). This will be an introductory course on Probability and Statistics and will cover the following topics:

Module-1 (Probability)
Module-2 (Random Variable and Its Distribution
Module-3 (Function of a Random Variable and Its Distribution
Module-4 (Special Discrete Distributions and Their Properties)
Module-5 (Special Absolutely Continuous Distributions and Their Properties
Module-6 (Random Vector and Its Joint Distribution)
Module-7 (Asymptotic Distribution)
Module-8 (Point Estimation)
Module-9 (Interval Estimation)
Module-10 (Testing of Hypotheses)

COURSE DETAIL

Module	Topics and Contents	Lectures
1	**(Probability):** Relative frequency interpretation of probability; Axiomatic definition of probability measure and its properties; Conditional probability; Theorem of total probability; Baye's theorem, Independence of events; Sequences of events and their limits; Continuity of probability measures.	5
2	**(Random Variable and Its Distribution):** Random variables and induced probability measures; Distribution function and its properties; Discrete random variable and probability mass function; Continuous random variable; Absolutely continuous random variable and probability density function.	2
3	**(Function of a Random Variable and Its Distribution):** Function of a random	4

NP-TEL

NPTEL

http://nptel.ac.in

Mathematics

Pre-requisites:

Calculus

Additional Reading:

1. An Introduction to Probability and Statistics, Second Edition, by V. K. Rohatgi and Md. E. Saleh, Wiley.
2. Modern Mathematical Statistics, by E. J. Dudewicz and S. N. Mishra, John Wiley & Sons.

Coordinators:

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	variables and its distribution; Expectation; Moments; Moment generating function and its uniqueness; Properties of moment generating function; Markov's and Chebyshev's inequalities; Characteristics of probability distributions (measures of central tendency; measures of skewness; measures of skewness and measures of kurtosis).	
4	**(Special Discrete Distributions and Their Properties):** Bernoulli and binomial distribution; Geometric and negative binomial distribution; Hypergeometric distribution; Poisson distribution; Discrete uniform distribution.	2
5	**(Special Absolutely Continuous Distributions and Their Properties):** Uniform distribution; Exponential and gamma distribution; Chi-square distribution; Beta distribution; Normal distribution; Student's-t and Snedcor's-F distributions.	3
6	**(Random Vector and Its Joint Distribution):** Random vectors; Joint distribution; Marginal and conditional distributions of a random vector; Independent random vectors/variables; Discrete random vector and its probability mass function; Multinomial distribution and its properties; Continuous random vector; Absolutely continuous random vector and its probability density function; Expectation of a function of a random vector; Joint moments; Joint moment generating function and its uniqueness; Properties of joint moment and joint cumulant generating functions; Covariance; Correlation; Bivariate normal distribution and its properties; Distribution of functions of random vectors; Distribution of order statistics; Joint distribution of sample mean and sample variance based on a random sample from normal population).	7
7	**(Asymptotic Distribution):** Convergence in distribution; Convergence in probability; Continuity theorem of moment generating function; Weak law of large numbers; Central limit theorem; Slutsky's theorem; Delta method.	3

8	**(Point Estimation):** Introduction to statistical inference problems; Parametric and nonparametric statistical inference problems; Point estimation problems; Method of moments; Method of maximum likelihood; Invariance of maximum likelihood estimators; Large sample properties of maximum likelihood estimators; Unbiased estimators; Consistent estimators; Criteria for comparing estimators.	5
9	**(Interval Estimation):** Interval estimation problems; Confidence intervals; Average length of confidence intervals; Problem of finding Confidence interval with smallest average length; Confidence intervals for normal population(s): mean, difference of means, variance and ratio of variance, Confidence intervals for proportion and difference of proportions.	5
10	**(Testing of Hypotheses):** Tests of hypothesis; Neyman-Pearson lemma; Most powerful and uniformly most powerful tests and their examples; p-value; Likelihood ratio tests; Likelihood ratio tests for statistical hypotheses in one and two sample problems involving normal populations; Tests for proportions; Relationship between confidence intervals and tests of hypotheses; Chi-square goodness of fit test; Contingency tables.	7

References:

1. Mathematical Statistics, by Steven F. Arnold, Prentice Hall.
2. An Introduction to Mathematical Statistics, Sixth Edition, by R. V. Hogg, J. W. McKean and A. T. Craig, Pearson Education.