Course number : CS511
Course Name : Applied Probability
Credit Distribution : 2-0-0-2
Intended for : MTech (CSE), MS, PhD
Prerequisite : None
Mutual Exclusion : EE534, MA524

1. Preamble:

The main objective of this course is to provide students a basic foundation in probabilistic and statistical methods. Upon completion of this course students should have the necessary prerequisite background in the topics related to probability and statistics to pursue courses in Machine Learning and Data Science.

2. Course Modules with quantitative lecture hours:

1. Sigma field. Review of axiomatic probability, conditional probability, and independence, Bayes' rule and applications. (3 hours)

2. Recap of random variables, discrete and continuous random variables, and functions of random variables. (2 hours)

3. Joint, marginal, and conditional distribution, Covariance and correlation, Multinomial, Multivariate Normal, Conditional Expectations. (2 hours)

4. Probability generating function, moment generating function and characteristic functions – properties and applications. (3 hours)

5. Markov chains, classification of states and chains, stationary distribution and limit theorem, Poisson process. Application of Markov Chain in Page Rank, text summarization etc. (4 hours)

6. The convergence of random variables – basic results, inequalities (Markov and Chebyshev), the law of large numbers (weak and strong), central limit theorem,

hypothesis testing, (5 hours)

7. Concentration inequalities – Chernoff's bound, Hoeffding's inequality and their applications in parameter estimation and confidence interval of parameters. (3 hours)

8. Random vectors and covariance matrix. Random processes. Autocorrelation, cross correlation, power spectral density. Basic notion of ergodicity. (6 hours)

Laboratory/practical/tutorial Modules: NA

3. Text books:

1. Grimmett and Stirzaker, "Probability and Random Processes", 4/e, Oxford University Press, 2020.
2. Papoulis and Pillai, "Probability, Random variables and Stochastic processes", 4/e McGrawHill Europe, 2002.

4. References:

1. Erhan Cinlar, "Introduction to Stochastic Processes", Dover Books on Mathematics, 2013.
2. R. G. Gallager, "Stochastic Processes: Theory for applications", 1/e, Cambridge University Press, 2014.
3. S. M. Ross, "Stochastic processes", 2/e, John Wiley, New York, 1996.
4. J. R. Norris, "Markov chains", Cambridge University Press, Cambridge, 1999.
5. Joseph K. Blitzstein and Jessica Hwang, "Introduction to Probability", CRC Press.com
6. Kishor S Trivedi, "Probability & Statistics with Reliability, Queuing, and Computer Science Applications", Prentice Hall.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

Course Code	Course Name	Overlap (%)
EE 534	Probability and Random Processes	>30%
IC210	Probability, Statistics and Random Processes	>30%
MA524	Probability and Statistics	>30%

6. Justification of new course proposal if cumulative similarity content is >30%:

It is a subset of the existing course EE534 with topics relevant for MTech CSE. The 2 credit structure for this course is already approved in the senate document for CSE MTech.