PROBABILITY FOUNDATIONS FOR ELECTRICAL ENGINEERS

PROF. KRISHNA JAGANNATHAN
Department of Electrical Engineering
IIT Madras

PRE-REQUISITES : There will be no official pre-requisites. Although the course will build up from the basics, it will be taught at a fairly sophisticated level. Familiarity with concepts from real analysis will also be useful. Perhaps the most important prerequisite for this class is an intangible one, namely mathematical maturity.

INTENDED AUDIENCE : M.Tech/M.S/PhD students, who plan to specialize in communications, networks, signal processing, stochastic control, machine learning, or related areas.

INDUSTRIES APPLICABLE TO : Research labs

COURSE OUTLINE :
This is a graduate level class on probability theory, geared towards students who are interested in a rigorous development of the subject. It is likely to be useful for students specializing in communications, networks, signal processing, stochastic control, machine learning, and related areas. In general, the course is not so much about computing probabilities, expectations, densities etc. Instead, we will focus on the ‘nuts and bolts’ of probability theory and aim to develop a more intricate understanding of the subject. For example, emphasis will be placed on deriving and proving fundamental results, starting from the basic axioms.

ABOUT INSTRUCTOR :
Prof. Krishna Jagannathan obtained his B. Tech. in Electrical Engineering from IIT Madras in 2004, and the S.M. and Ph.D. degrees in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology (MIT) in 2006 and 2010 respectively. During 2010-2011, he was a visiting post-doctoral scholar in Computing and Mathematical Sciences at Caltech, and an off-campus post-doctoral fellow at MIT. Since November 2011, he has been with the Department of Electrical Engineering, IIT Madras, where he is currently an Associate Professor.

COURSE PLAN :

Week 1: Introduction, Cardinality and Countability, Probability Space

Week 2: Properties of Probability Space, Discrete Probability Space, Generated sigma-algebra

Week 3: Borel sets, Caratheodory’s extension theorem, Lebesgue Measure, Infinite coin toss model

Week 4: Conditional probability, Independence, Borel-Cantelli Lemmas

Week 5: Random variables, Distribution function, Types of random variables

Week 6: Discrete Random variables, Continuous random variables, Singular random variables

Week 7: Several random variables, joint distribution, independent random variables

Week 8: Transformation of random variables

Week 9: Integration and Expectation, properties of integrals, Monotone convergence, Dominated convergence, Expectation over different spaces

Week 10: Variance, covariance, and conditional expectation

Week 11: Transform techniques: moment generating function, characteristic function

Week 12: Convergence of random variables, Laws of large numbers, Central limit theorem