ELEC 2600 H Probability and Random Processes in Engineering

Instructor:

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Course Description

An introduction to statistical inference and random processes in electrical engineering, including the necessary probabilistic background, Random variables, distribution and density functions, characteristic functions, conditional statistics, expectation, moments, stochastic processes.

This course may be taken in Year 1, 2 or 3. It is an elective course for BEng (ELEC) students, a core course for BEng (EEIC) students and a required course for BEng (CPEG) students. It is especially recommended for students interested in communications and signal processing. In many applications covered by these areas, the quantities or signals of interest (e.g. noise) may have unknown values, yet have known properties that can be described or modeled in a probabilistic statistical sense. This course introduces the fundamental concepts required for students to understand the mathematical basis of these models and how to manipulate them. The concepts covered here are the basis for applications described in other classes such as ELEC 3100 (Communication Systems), ELEC 4110 (Digital Communication), ELEC 4140 (Speech and Image Compression), ELEC 4150 (Information Theory and Error-Correcting Codes), ELEC 4160 (Introduction to Digital Speech Recognition).

Conceptually, the course can be broken into four parts that build upon one another. The first part (~2-3 weeks) covers basic probability theory. The second part (~3-4 weeks) describes the specification and manipulation of single random variable. The third part (~5 weeks) extends the concept of a single random variable to multiple random variables. The final part (~3 weeks) describes the specification and manipulation of stochastic processes.

Textbook

Probability, Statistics and Random Processes for Electrical Engineering,
Alberto Leon-Garcia, Addison Wesley, 3rd ed., 2009.

List of Topic

Lecture 1: Course Introduction, Probability Models
Lecture 2: Build a Probability Model; Axioms and Corollaries; Out-of-Class Reading: Set Operations
Lecture 3: Conditional Probability, Independence
Lecture 4: Sequential Experiments
Lecture 5: Discrete Random Variables, Probability Mass Function
"Lecture 6: Expected Value and Moments; Important Discrete Random Variables Out-of-Class Reading: Conditional PMF and Expectation"
Lecture 7: Continuous Random Variables, CDF and PDF
Lecture 8: Expected Value and Moments of Continuous RVs; Important Continuous RVs
Lecture 9: Function of a Random Variable
Lecture 10: Pairs of Discrete RVs; Out-of-Class Reading: 2D calculus
Lecture 11: Pairs of Continuous RV's
Lecture 12: Independence; Joint Moments
Lecture 13: Correlation Coefficients and Properties
Lecture 14: Conditional PDF, Conditional Expectation
Lecture 15: Sum of Two RV's
Lecture 16: Pairs of Jointly Gaussian RV's
Lecture 17: More than Two Random Variables
Lecture 18: Laws of Large Numbers
Lecture 19: Central Limit Theorem
Lecture 20: Covariance Estimation and Application (research topic)
Lecture 21: Definition of a Random Process
Lecture 22: Sum Processes and Independent Stationary Increment Processes
Lecture 23: Mean and Autocorrelation of Random Process
Lecture 24: Stationary Random Processes, Ergodic Process

Grading Policy

55% Final Exam
35% Midterm (Oct 18)
10% Homework (There are 4 homework assignments)