ECE3077 Course Syllabus

ECE3077

Introduction to Probability and Statistics for ECE (3-0-0-3)

CMPE Degree
This course is Elective for the CMPE degree.

EE Degree
This course is Elective for the EE degree.

Lab Hours
0 supervised lab hours and 0 unsupervised lab hours

Course Coordinator
Davenport,Mark Andrew

Prerequisites
MATH 2401/2411/24X1/2605/2551/2561/2X51 and CS 1301/1371 [all courses min C]

Corequisites
None

Catalog Description
Introduction to probability, random variables, distributions, estimation, confidence intervals, linear regression and other tools for describing and managing uncertainty in electrical and computer engineering.

Textbook(s)
Bertsekas & Tsitsiklis, *Introduction to Probability* (2nd edition), Athena Scientific, 2008. ISBN 188652923X, ISBN 978-1886529236 (required)

Course Outcomes
Upon successful completion of this course, students should be able to:

1. Model uncertainty in engineering problems using standard probability distributions
2. Compute the mean, variance, and higher moments of a random variable given its distribution
3. Describe relationships between multiple random variables in terms of their joint distribution
4. Compute the distribution of a function of several random variables
5. Use limit theorems to describe the approximate behavior of the sum of a large number of random variables
6. Estimate parameters and assess the quality of the estimate given multiple observations

Student Outcomes
In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.
“M” for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
“LN” for “little to none” indicates that the course does not contribute significantly to this

outcome.

1. (P) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. (LN) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. (LN) An ability to communicate effectively with a range of audiences
4. (LN) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. (LN) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. (M) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. (M) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

1. Introduction to Probability
   a. sets, axioms of probability
   b. basic combinatorics and counting
   c. independence, conditional probability
   d. inference using Bayes'?? rule
   e. Applications to ECE: radar detection, transmission of digit

2. Random Variables
   a. densities and distribution functions (discrete and continuo
   b. expectation and moments
   c. the moment generating function
   d. example distributions (Bernoulli, Binomial, Geometric, Pois
   e. Applications to ECE: noise in electronic circuits, queueing

3. Multiple Random Variables
   a. joint densities and distributions
   b. conditional densities and conditional expectation
   c. independence, correlation, and covariance
   d. multidimensional Gaussians, covariance matrices
   e. joint functions of random variables
   f. sums of random variables
   g. Applications to ECE: modeling manufacturing variation, mode

4. Limit Theorems
   a. the central limit theorem
   b. law of large numbers
   c. Applications to ECE: analysis and modeling of photodetector

5. Random Sequences
   a. the Bernoulli process
   b. the Poisson process
   c. Markov chains and random walks
   d. Applications to ECE: task scheduling, Markov models of lang

6. Basic Statistics
   a. sample mean and variance
   b. confidence intervals
   c. hypothesis testing
   d. curve-fitting and regression
   e. parameter estimation
   f. Applications to ECE: detection in digital communications, d

7. Further Topics of Probability and Statistics in ECE
   a. generating random numbers
   b. Monte Carlo simulations
   c. entropy and information
   d. average case analysis of algorithms