University of Massachusetts
Department of Electrical and Computer Engineering

ECE 314 - Introduction to Probability and Random Processes
Spring, 2013

http://www.ecs.umass.edu/∼goeckel/ece314.html

We see . . . that the theory of probabilities is at bottom only common sense reduced to calculation; it makes us appreciate with exactitude what reasonable minds feel by a sort of instinct, often without being able to account it . . .. It is remarkable that [this] science, which originated in the consideration of games of chance, should have become the most important object of human knowledge.

P. Laplace (1749-1827)

Objective: Probability theory is perhaps the most commonly employed tool across electrical engineering. It appears in nearly every branch of electrical engineering and is essential in many areas such as communication systems, computer networking, microwave design, and solid-state electronics. However, unlike many other engineering subjects, it is commonly encountered in our every day lives, impacting decisions from choosing companies in the stock market to choosing a checkout line at the supermarket. The objective of this course is to study the principles and practice of probability and random processes, in particular their applications to electrical engineering problems.

Students taking this course will:

1. Attain an understanding of the foundations of probability theory.
2. Have a working knowledge of single and multiple random variables.
3. Be able to use probability theory and random variables to model and analyze random phenomena encountered in engineering applications.
4. Obtain a working knowledge of statistical analysis of data.
5. (Time permitting) Obtain a working knowledge of random processes encountered in communication systems and other areas of ECE.

Course Format:

- Lecture: Three 50-minute lectures (MWF 10:10 in ELAB 303).
- Recitation: One 50-minute recitation (F 11:15 in ELAB 306, F 1:25 in ELAB 305, or F 2:30 in ELAB 306).

Instructors:

Prof. Dennis Goeckel
Contact: Office: Marcus Hall 215L, Phone: 545-3514, e-mail: goeckel@ecs.umass.edu
Office Hours: Monday, 12:00-1:30pm; Wednesday, 2:00-3:00 pm; Friday, 2:00-3:00pm (or by e-mail appointment)
Role: Lectures, exams.

Prof. Mario Parente
Contact: Office: Knowles Engineering 113D, Phone: 545-6860, e-mail: mparente@ecs.umass.edu
Office Hours: Wednesday, 4:00-5:00pm; Thursday, 4:00-5:00pm (or by e-mail appointment)
Role: Recitations, homework, quizzes.

"Where Everybody Knows Your Name": We will try to learn everybody's name, although you may have to remind us two or three times before we get it. Please come by our office hours during the first two weeks of the semester so that we can meet you.

Prerequisites: ECE 313.

Textbook: None required. You will have electronic access to a supporting text: H. Derin, *Probability and Random Processes for Engineers*, 2001.

Grading: Homework - 15 %
Quizzes: 10 % (in recitation), 5 % (APEs)
Midterm Exam 1 (Date: February 27, 2013, Time: 7:00pm-9:00pm, Place: TBD) - 20 %
Midterm Exam 2 (Date: April 3, 2013, Time: 7:00pm-9:00pm, Place: TBD) - 20 %
Final Exam - 30 %

All exams will be closed-book closed-notes, and calculators will **not** be allowed; however, a single **hand-written** formula sheet will be allowed. The final exam will be cumulative. Homeworks will be collected at the beginning of the **lecture** on the date that they are due. Late homeworks will not be accepted.

Ground Rules: You are allowed to work together on homeworks; however, each student must submit his/her own solutions. Also recall that homeworks are really only preparation for the exams, so do not rely too heavily on other students for help. **Academic dishonesty** (either taking or giving answers on an exam, use of extra crib sheets, theft of another's work, etc.) will be dealt with harshly; you will receive an "F" for the course, and there may be further disciplinary action.

Rough Course Outline

0. Motivation
I. Basics of Probability
    A. Introduction and Set Theory
    B. Probability Spaces
    C. Assigning Probabilities
II. A Single Random Variable
    A. Introduction
    B. Distribution and Density Functions
    C. Examples
    D. Expectations
    E. Functions of a Random Variable
III. Multiple Random Variables
    A. Introduction, Distribution, and Density Functions
    B. Conditional Probability and Independence
    C. Expectations of Functions of Two Random Variables
    D. Jointly Gaussian Random Variables
    E. Sums of Random Variables
IV. Statistics
    A. Confidence Intervals
    B. Estimation
    C. Binary Hypothesis Testing
V. Random Processes (time permitting)
    A. Introduction
    B. Partial Information