University of Massachusetts Amherst
Department of Electrical and Computer Engineering
ECE 313 - Introduction to Probability and Random Processes
Spring 2017 Syllabus

This course provides an introduction to probability and statistics with applications. Topics include probability spaces; conditional probability, Bayes' theorem; combinatorial analysis; random variables (r.v.'s), distribution and density functions, functions of r.v.'s; expected value, moments; multiple r.v.'s, conditional distributions, independent r.v.'s, multivariate Gaussian r.v.'s; parameter estimation, confidence intervals, hypothesis testing.

INSTRUCTION TEAM

Lectures: Prof. Patrick Kelly, Marcus Hall 215B, kelly@ecs.umass.edu
Office Hours: Tuesday 10 AM - noon
Roles: Lectures, Exams

Discussions: Prof. Dennis Goeckel, Marcus Hall 215L, goeckel@ecs.umass.edu
Office Hours: Wednesday 12:30 PM - 2:30 PM
Roles: Discussions, Homeworks

Teaching Assistants:
Natesh Ganesh, ganesh@ecs.umass.edu, Office Hours TBD
Shermin Hamzehei, shamzehei@engin.umass.edu, Office Hours TBD

You are encouraged to come to office hours with any questions about the course. (It is usually much more effective to discuss questions in person than to do it over email.)

COURSE FORMAT

Lecture: 9:05AM - 9:55AM on Monday, Wednesday, and Friday @ Hasbrouck Addition Room 126.

Discussion: One 50-minute session on Friday. Sections: 11:15 AM and 1:25 PM @ ILC Room N111;
2:30 PM @ ILC Room S120.

PREREQUISITES

ECE 313

TEXTBOOK

H. Pishro-Nik, "Introduction to Probability, Statistics, and Random Processes." Available for free online at www.probabilitycourse.com. A printed version is available for purchase at www.amazon.com.

If you would like additional resources, here are two suggestions:

- R. Yates and D. Goodman, "Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers," (2nd ed.), Wiley, 2004.
- H. P. Hsu, "Probability, Random Variables, and Random Processes," (3rd ed.), Schaum's Outline Series, McGraw Hill, 2014. (This book provides a large number of problems and worked-out examples.)

GRADING

- Midterm Exam 1: 25% (Wednesday March 1, 7:00 PM - 9:00 PM, ELab II Room 119)
- Midterm Exam 2: 25% (Thursday April 6, 7:00 PM - 9:00 PM, Room TBD)
- Final Exam: 30% (Date and Time TBD)
- Homework assignments: 15%
- Discussion Applied Probability Exercises (APEs): 5%

HOMEWORK ASSIGNMENTS
There will be approximately nine homework assignments (one every week, except for exam weeks) that will be posted on the Moodle course website at https://moodle.umass.edu. Each assignment will be posted on a Friday and due the following Friday. Assignments must be turned in at the beginning of the class period on the due date. Late submissions will **not** be accepted. Discussion of the problem sets with other students is encouraged, but each student must turn in a unique personal solution. *Homework assignments are preparation for exams*, so do not rely too heavily on other students for help. Homework solutions will be posted online in Moodle after the due deadline.

EXAMS
All exams will be closed-book and closed-notes; calculators will **not** be allowed. Additionally, a **single-sided handwritten** formula sheet will be allowed for midterm exams 1 and 2. A **double-sided handwritten** formula sheet will be allowed for the final exam.

HONORS COLLOQUIUM
The Honors Colloquium will involve team-based projects and will begin meeting a few weeks into the semester. More details will be sent soon to students who have registered for the colloquium.

ACADEMIC HONESTY POLICY
It is expected that all students will abide by the Academic Honesty Policy, available at the Academic Honesty Office (Ombud's Office), or online at http://www.umass.edu/dean_students/codeofconduct/acadhonesty/. Acts of academic dishonesty (such as taking or giving answers in an exam, use of extra crib sheets, submitting another person's work as your own, etc.) will result in a grade of F in the course, and possibly additional sanctions including being placed on probation or suspension for a period of time or being dismissed from the University. All students have the right of appeal through the Academic Honesty Board.

ACCOMMODATION POLICY
The University of Massachusetts-Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological or learning disability on file with Disability Services (DS), Learning Disability Support Services (LDSS) or Psychological Disabilities Services (PDS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify the instructors within the first two weeks of the semester so that we may make appropriate arrangements.

INCLUSIVITY AND DIVERSITY
The diversity of the participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued for any reason, please speak with one of the instructors privately. If you wish to communicate anonymously, you may do so in writing or speak with Dr. Paula Rees, Director of Engineering Diversity Programs (rees@umass.edu, 413.545.6324, Marston 128). We are all members of an academic community where it is our shared responsibility to cultivate a climate where all students/individuals are valued and where both they and their ideas are treated with respect.

TENTATIVE TOPICS LIST

A. Probability

1. Basic Concepts: set theory, random experiments, probability, conditional probability (Book Sections 1.1-1.4)
2. Combinatorics and Counting Methods (Sec. 2.1)
3. Discrete Random Variables: distribution functions, probability mass functions, expected values, functions of random variables, important distribution classes (Sec. 3.1-3.2)

4. Continuous and Mixed Random Variables: continuous random variables: probability density functions, expected values, functions of random variables, important distribution classes; mixed continuous and discrete random variables (Sec. 4.1 - 4.3)
5. Joint Distributions: joint cumulative distribution and density functions for two or more random variables; conditional distribution and independence; functions of joint random variables; covariance and correlation, joint Gaussian distributions (Sec. 5.1 - 5.3, 6.1)
6. Probability Bounds and Limit Theorems: union bound, Markov inequality, Chernoff bound; Law of Large Numbers, Central Limit Theorem (Secs. 6.2, 7.1)

B. Statistics

1. Parameter Estimation: point estimation, maximum likelihood estimates, confidence intervals (Sec. 8.1 - 8.3)
2. Hypothesis Testing: p-values, likelihood ratio tests (Sec. 8.4)
3. Linear Regression and Least Squares (Sec. 8.5)
4. Estimation of Random Variables: Bayesian estimation (Sec. 9.1)