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Introduction to Probability and Statistics for Electrical Engineering

EE 364 (3 units) Spring 2016

Lectures: Tue and Thu 12:30-1:50, MHP 105
Tue and Thu 2-3:20, ZHS 252

Discussions: Wed 4-4:50, THH 114
Fri 3:30-4:20, GFS 101

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Course Description

Introduction to concepts of randomness and uncertainty: probability, random variables, and statistics. Applications may be from digital communications, signal processing, automatic control, computer engineering, computer science. *Prerequisite:* MATH 225 or MATH 245.

Textbook: *Probability and Statistics for Engineers and Scientists*, 9th edition, R. E. Walpole, R. H. Myers, S. L. Myers, and K. Ye.
Lecture notes and handouts will be posted on the Blackboard site regularly. Note that these handouts are also required reading!

Classroom Policy: Electronic communication devices (phones, blackberries, and similar) must be turned off or placed away during lectures. Likewise, you should not use instant messenger or similar chat programs during lectures.

Coursework and Grading Breakdown

The course grade will be based on problem sets, two midterm exams, and the final exam. There will be approximately 10 homework assignments, assigned most weeks and due one week later. Late homework will not be accepted except for medical or other emergencies. Collaboration between students in understanding the homework is allowed and encouraged; copying is not.

Problem Sets	20%
Midterm Exam 1	20%
Midterm Exam 2	20%
Final Exam	40%

Exams will be closed book. Calculators and sheets of notes will be permitted. Midterm exams will take place during regular class periods.

Exam Dates

Midterm Exam 1: Thu 18 February 2016 during class
Midterm Exam 2: Tue 29 March 2016 during class
Final Exam: Wed 11 May 2016 2-4 pm

Learning Objectives: Upon successful completion of this course a student will

- Understand probability as a model for uncertainty
- Be able to perform basic set probability relations including conditional probabilities and Bayes' Law
- Understand random variables as models for numerical measurements with uncertainty
- Use the complete statistical characterization of random variables (e.g., distribution and density functions) to compute probabilities
- Develop novel probability distributions given a description of a random experiment.
- Interpret the incomplete statistical characterization of random variables, such as mean and variance, to draw qualitative and quantitative conclusions.
- Be able to apply common distributions such as Gaussian, Poisson, Binomial, Exponential and uniform to solve problems as appropriate.
- Utilize joint distributions and joint moments to compute probabilities and make estimates of random variables.
- Understand the Law of Large Numbers and Central Limit Theorem and their relation to statistical analysis.
- Apply basic confidence interval formulas to characterize the accuracy of estimates from experimental data
- Make decisions between a finite set of hypotheses from experimental data
- Perform linear regression to estimate one variable from another using experimental data.

Course Schedule

Week	Topics	Readings and HW
1	Introduction; probability as uncertainty; probability in science and engineering and elsewhere; experiments, events, sample spaces; set theory and combinatorics.	Secs. 2.1-2 (pp. 35-44)
2	Combinations; set operations and probability; combining probabilities of multiple events; additive rules.	Secs. 2.3-5 (pp. 45-62); HW 1 due
3	Conditional probability; multiplicative and chain rules.	Sec. 2.6 (pp. 62-72); HW 2 due
4	The Bayes rule; random variables and probability distributions/density functions; cumulative distributions.	Secs. 2.7-3.3 (pp. 72-94); HW 3 due
5	Joint probability distributions; marginal densities; conditional densities; statistical correlation and independence.	Secs. 3.4-5 (pp. 94-110); HW 4 due
6	Mean (expectation value) of random variables; **Midterm 1**.	Sec. 4.1 (pp. 111-119)
7	Variance and covariance; mean and variance of linear combinations of random variables.	Secs. 4.2-3 (pp. 119-135)
8	Useful inequalities; Bernoulli processes and binomial distributions; indicator random variables.	Secs. 4.4-5.2 (pp. 135-148); HW 5 due
9	Other discrete distributions; the Poisson distribution; continuous distributions; the uniform distribution.	Secs. 5.2-6.1 (pp. 149-172); HW 6 due
10	The normal (Gaussian) distribution; Gaussian approximation to Binomials; the Gamma and exponential distributions.	Secs. 6.2-6.6 (pp. 172-200); HW 7 due
11	**Midterm Exam 2**; other continuous distributions; functions of random variables.	Secs. 6.7-7.2 (pp. 200-217)
12	Functions of random variables continued; density function method; many-to-one transformations; sums of normals.	Sec. 7.3 (pp. 218-224)
13	Introduction to statistics; law of large numbers; populations and samples; mean, median and mode; variance; sample range.	Chapter 1; HW 8 due
14	The Central Limit Theorem; confidence intervals.	Secs. 8.1-4 (pp. 225-243), Secs. 9.1-7 (265-285); HW 9 due
15	Hypothesis testing; simple linear regression; least squares.	Secs. 10.1-4 (pp. 319-342), Secs. 11.1-5 (389-408); HW 10 due
	Final Exam	

Note that most weeks there will be handouts in addition to the assigned reading in the textbook. These handouts are also required reading.

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.