EE 364
Introduction to Probability and Statistics for EE and CS
Spring 2019

Lecture: Tue-Thu 12:30PM-1:50 PM (VHE 217)/3:30-4:50pm (WPH 207)
Discussion: Mondays 3:00-3:50pm (KAP 163)/6-6:50pm (VHE 210)
Instructor: Prof. Rahul Jain
Office Hours: Tuesday and Thursday, 2:00PM-3:00PM, and by appointment
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TA1: Oliver Adigun, adigun@usc.edu
Office Hours: Mon 4:30pm - 5:30pm, Wed 1 - 3 pm (EEB420)
TA2: Mukul Gagrani <mgagrani@usc.edu>
Office Hours: Tue 1 - 3 pm (PHE 316)

Webpages: Piazza Class Page for everything except grades, and USC Blackboard Class Page for grades. All HWs, handouts, etc. will be posted there. Student has the responsibility to stay current with webpage material

Prerequisites: MATH 225 or MATH 245

Grading:
1. Home Works 15%
2. Quizzes and Class Attendance 10%
2. Two Mid-Term Exams: 20% and 20%
3. Final Exam: 35%

Final grades will be assigned by a combination of student score distribution (curve) and the discretion of the instructor. Final grades are nonnegotiable.

Exam Dates:
• Midterm Exam 1: Feb 21, time TBD

• Midterm Exam 2: April 2, time TBD

• Final Exam: Tuesday, May 7, time TBD

Note on Piazza vs Email: If you have a question about the material or logistics of the class and wish to ask it electronically, please post it on the piazza page (not e-mail). You may post

privately if you wish. Often times, if one student has a question/comment, other also have a similar question/comment. Use e-mail with the professor and TAs only for issues that are specific to you individually (e.g., a scheduling issue, or grade issue).

Homework Policy

– Homework will be assigned/collected weekly.
– Show your work in your HW solution; the correct answer alone is worth only partial credit.
– HWs are due at the beginning of a lecture the day they are due. You are encouraged to do each and every problem even if after submission. In general, late HW will not be accepted. At most **two** HWs may be submitted at most 24 hours late for 50% of credit. After that, zero credit.
– Homework collaboration: You may discuss problems with other students but you must solve and write the solutions yourselves. **Any plagiarism, howsoever minor, will result in severe penalties (independent of who copied from whom) including one-level lower letter grade for each case of plagiarism.**

Quiz Policy

– There will be 0-5 quizzes, some announced, some pop-quizzes at the discretion of the instructor.

Exam Policy

– Make-up Exams: No make-up exams will be given. If you cannot make the above dates due to a class schedule conflict, you must notify me by the last day to add/drop. If I cannot accommodate your schedule, you must drop the class. In the case of a medical emergency, a signed letter from your doctor is required. This letter must include the telephone number of your doctor.
– Exams will be closed book (possibly with a crib sheet allowed).
– All exams are cumulative, but with an emphasis on material presented since the last exam.

Class Attendance

– Lecture attendance is mandatory. Students are responsible for all material presented in lecture.

Catalogue Description: Introduction to concepts of randomness and uncertainty: probability, random variables, statistics. Applications to digital communications, signal processing, automatic control, computer engineering and computer science.

Course Description: Probability and statistics form the foundation for a large number of fields and techniques in electrical engineering and computer science, e.g., adaptive signal processing and machine learning, information theory and communications, decision theory, classification, noise modeling and mitigation, etc. Probability uses models to inform us about the outcome of an experiment to be conducted. For example, given a good model, we can determine how probable it is that Seeds will have more than 4 people in line tomorrow at noon. Statistics is concerned with empirical data and informs the design of experiments and the validity of conclusions that can be drawn from experiments. For example, if you are taking a political poll, statistics tells us

the relationship between the number of people polled and the accuracy of the poll (e.g., notice how political polls usually have a ±3% footnote). Statistics and probability are closely connected and rely on one another. In this class we will begin with probably and develop the basic concepts including set probability, conditional probability, random variables, estimation, and decision making. We will then connect to an introduction to statistics through limit theorems. My approach to teaching this class is to introduce general concepts through problems.

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.

Textbooks:
Required: A. Leon-Garcia, *Probability, Statistics and Random Processes for Electrical Engineers, third edition,* Pearson/Prentice-Hall.

Optional:

1. D. Bertsekas and J. Tsitsiklis, Introduction to Probability, second edition, Athena Scientific.

2. Robert V. Hogg and Elliot A. Tanis, Probability and Statistical Inference, 8th Ed., Prentice-Hall.

Course Outline

1. Probability Models and Basic Concepts
   (i) Motivation and Introduction
   (ii) Sample Space and Axioms of Probability
   (iii) Conditional Probability and Bayes' Rule
   (iv) Statistical Independence

2. Discrete Random Variables
   (i) Complete Statistical descriptions (Distribution, mass function)
   (ii) Expectation, mean and variance
   (iii) Joint, marginal and conditional distributions
   (iv) Generation of discrete random variables

3. Continuous/General Random Variables
   (i) Complete Statistical descriptions (distribution, density)
   (ii) Functions of Random Variables
   (iii) Important continuous random variables
   (iv) Transform Methods

4. Multiple Random Variables and Vectors
   (i) Joint pdfs of Multiple Random Variables
   (ii) Conditional Expectation and Probability
   (iii) Covariance and Correlation
   (iv) Functions of multiple random variables

5. Sums of Random Variables and Long-term Averages
   (i) Markov and Chebyshev Inequalities
   (ii) Sums of Random Variables
   (iii) Weak Law of Large Numbers and Sample Mean
   (iv) Central Limit Theorem and Gaussian Distribution

6. Elements of Statistics
   (i) Samples and sampling distributions
   (ii) Confidence Intervals
   (iii) Maximum Likelihood Estimation
   (iv) Bayesian Estimation

7. Statistical Inference (if time permits)
   (i) Parameter Estimation
   (ii) Linear Regression
   (iii) Binary Hypothesis Testing
   (iv) Significance Testing

Statement for Students with Disabilities: Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity: USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect ones own academic work from misuse by others as well as to avoid using anothers work as ones own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at http://www.usc.edu/student-affairs/SJACS/.

Emergency Preparedness/Course Continuity in a Crisis. In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.