Course:	**EE 351K: Probability and Random Processes**
Instructor:	**Prof. Jeffrey G. Andrews**
Lecture Hours:	TTH 12:30-1:45 PM, EER 1.516
Office Hours:	Wednesday 2-4pm (tentative)
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Unique Course ID:	16360

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Undergrad TA:	TBD
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Prerequisites

Mathematics 427J or 427K with a grade of at least C-.

Required Course Text

Roy Yates and David Goodman, *Probability and Stochastic Processes*, 3rd Ed. (2014), Wiley.

The book is 100% required. You will need to carefully read this book, go through the examples, and refer to it often in order to do well in this class. You are responsible for all material in the covered chapters (see Syllabus), even if I do not cover those topics explicitly in lecture.

Note that this is not the same textbook that most other UT professors use (Bertsekas and Tsitsiklis). But I prefer this book. It has more examples, and makes a sincere effort to try to connect the concepts with engineering and other real-world problems. It is a probability text written by engineers for engineers, that emphasizes intuition and is very well-written.

Course Objectives

This course will be useful for nearly any future technical career you choose. A wise person even integrates probability into their everyday language – whether they know probability theory or not – by talking about the likelihood or probability that something is so, rather than speaking in certainties. From physics (quantum mechanics), we know that even matter itself is probabilistic. More usefully, probability is essential to many types of engineering including data science /machine learning, communications, and testing/validation, as well as any field requiring predictions such as finance, meteorology, gambling, medicine, or advertising. Probability is the core of statistics, a much-maligned but very important branch of applied mathematics.

In this class most of our effort will be dedicated to learning concepts, terms, rules, models, techniques, tools, and problem-solving skills. However, I will do my best to provide a wide variety of real-world examples that bring the concepts to life. The tentative lecture schedule at the end gives details on the topics we'll cover.

Online and Software Resources

The online class system is Canvas. All handouts will be distributed here. We'll send group e-mails and do online grading as well (so you can view your grades there). We will also use Piazza, which is linked into Canvas. You should ask questions on the homeworks and other general course-related questions here, so that the entire class can see our answers. And of course if you know the answer to a question, you are encouraged to answer it!

We will also use Matlab in this class for modeling and solving problems, doing heavy computations, generating instances of random variables, making plots, and so on. Make sure you have access to a computer with Matlab. However, if you wish to use Python or another similar language (or even Excel) this is also possible as long as you can complete the assignments – we will attempt to make them generic in this regard. Note that the textbook solely utilizes Matlab and so this is the recommended tool. A Matlab tutorial will be provided and there are many good tutorials and resources on the web.

Assignments

Homework will generally be assigned on Tuesday and due the following Tuesday at the start class. There will be weekly quizzes on Thursdays during the last 10-15 minutes of class. Please note that there will be no make-up quizzes, but your two lowest scores will be dropped.

Grading

20% Midterm 1
20% Midterm 2
35% Final Exam
15% Homework
5% Weekly Quizzes (2 lowest scores dropped)
5% To Be Determined (could be a mini project, or added to the final)

Exam Dates

Midterm 1:	October 8
Midterm 2:	November 12
Final:	December 18, 2-5pm (tentative, per registrar)

Regrade Policy

All requests for regrades, on homework or exam, must be submitted in writing within a week of their return to you. No verbal complaints will be considered. Mistakes can be made in the grading process and we will correct those, but it is unlikely that more partial credit will be given. The basic idea here is that we don't want to indirectly penalize those students who don't ask for regrades, since I grade on a curve.

Students with Disabilities

The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TDD or the College of Engineering Director of Students with Disabilities at 471-4382.

Syllabus

- Chapter 1: Introduction to Probability (3-4 Lectures)
  - High level introduction to Probability
  - Sets and Axioms of Probability
  - Conditional Probability
  - Partitions and Law of Total Probability
  - Independence
- Chapter 2: Sequential Experiments (1-2 Lectures)
  - Understanding multi-step experiments using tree diagrams
  - Counting events and outcomes with and without replacement
  - Independent trials
- Chapter 3: Discrete random variables (4 Lectures)
  - Distributions, namely the CDF and PMF
  - Bernoulli, Binomial, Geometric, Uniform, and Poisson RVs
  - Functions of a RV
  - Average (expected value) and variance

Midterm 1, through Chap. 3

- Chapter 4: Continuous random variables (3 lectures)
  - Similar concepts to Chapter 2 but now for continuous distributions
  - Uniform, exponential, and Gaussian RVs
- Chapter 5: Pairs of Random Variables (3 lectures)
  - Joint distributions
  - Marginal distributions
  - Conditioning and independence
  - Correlation and covariance
- Chapter 6: Modeling Two Random Variables (1.5 lectures)
  - Functions of random variables
  - The Sum of two random variables

Midterm 2, through Chap. 6

- Chapter 7: Conditional Probability (2 lectures)
  - Conditioning on an event
  - Conditioning by a random variable
  - Conditional expected values
- Chapter 9: Sums of multiple random variables (3 lectures)
  - Expected values and PDF of summed RVs
  - Moment Generating Functions
  - Central Limit Theorem, i.e. why Gaussians?
- Chapter 10: Sample Means and Law of Large Numbers (2 lectures)
  - Sample means
  - Markov, Chebyshev and Chernoff Bounds

  - Estimates and Mean Squared Error
  - Confidence intervals
- Chapter 12: Estimation of a random variable (as time allows)
  - Minimum Mean Squared Error (MMSE) estimation
  - Linear estimation
  - MAP and Maximum Likelihood (ML) Estimation