

EE 503: Probability for Electrical and Computer Engineers

Instructor: Mohammad Reza Rajati, PhD

Fall 2017

Although the instructor does not expect this syllabus to drastically change, he reserves every right to change this syllabus any time in the semester.

Course Description: Rigorous coverage of probability, discrete and continuous random variables, functions of multiple random variables, covariance, correlation, random sequences, Markov chains, estimation, and introduction to statistics.

Prerequisites: Prior courses in multivariate calculus, linear algebra, and linear system theory.

Note This course is a prerequisite to many courses including EE 511, 512, 517, 535, 555, 556, 559, 562, 563, 564, 565, 583, 649, and 660.

Credit Hours: 4

Instructor: Mohammad Reza Rajati, PhD

Email: rajati@usc.edu

Lectures and Location:

Secion 30627R: Monday, Wednesday 8-9:50, SSL 150

Section 31113R: Monday, Wednesday 12-1:50, LVL 16

Office Hours: Monday 2:00 pm-4:00 pm

Office: PHE 414

Course Website: piazza.com, blackboard.usc.edu

TA 1: Hossein Shahabi

Email: hshahabi@usc.edu

TA 1's Office Hours: Tuesday 4:00 pm-6:00 pm

TA 1's Office: PHE 320

TA 2: Yu-Chen (Ethan) Sung

Email: yuchens@usc.edu

TA 2's Office Hours: Monday, Wednesday 2:30 pm - 4:30 pm

TA 2's Office: PHE 320

Discussion Section 30670R Time and Location: Friday 3:00-3:50 pm, ZHS 163

Discussion Section 30699R Time and Location: TBA, TBA

Required Texts:

Probability and Random Processes, 3rd Edition

Authors: Geoffery R. Grimmet and David R. Stirzaker; Oxford University Press; 2001. **ISBN-13:** 978-0198572220

Probability and Random Processes for Electrical and Computer Engineers, 1st Edition

Author: John A. Gubner; Cambridge University Press, 2006. **ISBN-13:** 978-0511220234

Recommended Texts:

Introduction to Probability, 2nd Edition

Authors: Dimitri P. Bertsekas and John N. Tsitsiklis; Athena Scientific, 2008. **ISBN-13:** 978-1886529236

Introduction to Probability Models, 11th Edition

Authors: Sheldon M. Ross, Academic Press, 2010. **ISBN-13:** 978-0124079489

One Thousand Exercises in Probability, 1st Edition

Authors: Geoffery R. Grimmet and David R. Stirzaker; Oxford University Press; 2001. **ISBN-13:** 978-0198572213

Schaum's Outline of Probability, Random Variables, and Random Processes, 3rd Edition

Author: Hwei P. Hsu; McGraw-Hill Education; 2014. **ISBN-13:** 978-0071368100

Schaum's Outline of Probability and Statistics, 4th Edition

Authors: John J. Schiller Jr., R. Alu Srinivasan, Murray R Spiegel; McGraw-Hill Education; 2012. **ISBN-13:** 978-0071795579

Course Objectives:

At the completion of this course, students are expected to:

1. Understand the rigorous mathematical foundations of probability and random variables, due to exposure to introductory measure-theoretic concepts
2. Develop probabilistic reasoning skills to deal with probabilistic uncertainty

3. Precisely formulate real-world engineering problems via the framework of probability
4. Obtain adequate mathematical maturity to be prepared for future courses including those in controls, signal processing, communications, statistics, data analysis, bioinformatics, and machine learning

Tentative Grade Distribution:

Assignments	15%
Three Midterm Exams	45%
Final Exam	40%
Participation on Piazza	5%

Letter Grade Distribution:

≥ 93.00	A	73.00 - 76.99	C
90.00 - 92.99	A-	70.00 - 72.99	C-
87.00 - 89.99	B+	67.00 - 69.99	D+
83.00 - 86.99	B	63.00 - 66.99	D
80.00 - 82.99	B-	60.00 - 62.99	D-
77.00 - 79.99	C+	≤ 59.99	F

Midterm Exam 1: Wk 5 (Monday evening, TBA).

Midterm Exam 2: Wk 9 (Monday evening, TBA).

Midterm Exam 3: Wk 12 (Monday evening, TBA).

Final Exam: TBA.

Important Notes:

1. Students are required to attend all the lectures and discussion sessions and actively participate in class discussions. Use of cellphones and laptops is prohibited in the classroom. If you need your electronic devices to take notes, you should discuss with the instructor at the beginning of the semester.
2. Textbooks are secondary to the lecture notes and homework assignments.
3. Handouts and course material will be distributed.
4. Please use your USC email to register on Piazza and to contact the instructor and TAs.
5. Posting the homework assignments and their solutions to online forums or sharing them with other students is strictly prohibited and infringes the copyright of the instructor. Instances will be reported to USC officials as academic dishonesty for disciplinary action.
6. Students are encouraged to discuss homework problems with one another, but each student must do their own work and submit individual solutions written in their own hand. Copying the solutions or submitting identical homework sets is written evidence of cheating. The penalty ranges from F on the homework or exam, to an F in the course, to recommended expulsion.

7. No make-up exams will be given. In the case of a required business trip or a medical emergency, a signed letter from your manager or physician has to be submitted. This letter must include the contact of your physician or manager.
8. The letter grade distribution table guarantees the *minimum* grade each student will receive based on their final score. When appropriate, relative performance measures will be used to assign the final grade, at the discretion of the instructor.
9. Homework is assigned on Wednesdays and is due on the Wednesday of the next week. *Absolutely no late homework will be accepted.*
10. Homework should be *scanned* using scanners or mobile scanner applications like CamScan and uploaded on blackboard (photos taken by cell-phone cameras and in formats other than pdf will NOT be accepted).
11. Three of your lowest homework grades will be dropped from the final grade.
12. Midterms and final exams will be closed book and notes. No calculators are allowed nor are computers and cell-phones or any devices that have internet capability. One letter size cheat sheet (back and front) is allowed for each midterm. Two letter size cheat sheets (back and front) are allowed for the final.
13. The lowest score of your midterms will be dropped from the final grade.
14. Participation on Piazza has up to 5% extra credit, which is granted on a competitive basis at the discretion of the instructor.

Tentative Course Outline

Week	Content	Gubner	G&S
Wk. 1: Aug 21, 23	<ul style="list-style-type: none"> • Introduction • Logic, Set Theory, Sample Space, σ-Algebra of Events 	Ch. 1	Ch. 1
Wk. 2: Aug 28, 30	<ul style="list-style-type: none"> • Probability as An Additive Measure • Probability Models: Total Probability, Continuity of Probability • Conditional Probability 	Ch. 1	Ch. 1
Wk. 3: Sep 4, 6	<ul style="list-style-type: none"> • Labor Day • Independence • Probability Models and Independence: The Bayes' Rule, The Multiplication Rule • The Borel-Cantelli Lemmas • Random Variables: Definitions, CDFs, Borel Sets, Independence 	Ch. 1	Chs. 1
Wk. 4: Sep 11, 13	<ul style="list-style-type: none"> • Random Variables: Definitions, CDFs, Borel Sets, Independence • Combinatorics 	Chs. 2, 5	Ch. 2

Wk. 5: Sep 18, 20	Ch. 2	Ch. 3
<ul style="list-style-type: none">• Midterm 1• Discrete Random Variables, PMFs, Joint PMFs, Marginal PMFs• Famous Discrete Random Variables• Conditional PMFs and Independence		
Wk. 6: Sep 25, 27	Ch. 2	Ch. 3
<ul style="list-style-type: none">• Expectation and Moments of Discrete Random Variables• Derived Distributions• Covariance and Correlation• Existence and Properties of Moments• Expectation As Norm and Inner Product, The Cauchy-Schwartz-Bunyakovsky Lemma		
Wk. 7: Oct 2, 4	Ch. 3	Ch. 3
<ul style="list-style-type: none">• Conditional Expectation• Conditional Expectation as A Random Variable• Principle of Orthogonality		

Wk. 8: Oct 9, 11	Ch. 4	Ch. 4
	<ul style="list-style-type: none">• Continuous Random Variables: Definitions• PDFs• Important Continuous Random Variables• Joint Distributions• Independence of Continuous Random Variables	
Wk. 9: Oct 16, 18	Chs. 4, 7	Ch. 4
	<ul style="list-style-type: none">• Midterm 2• Important Continuous Random Variables• Joint Distributions	
Wk. 10: Oct 23, 25	Ch. 7	Ch. 4
	<ul style="list-style-type: none">• Moments of Continuous Random Variables• Examples: Using PDFs and CDFs of Continuous R.V.'s to Calculate Moments and Probabilities	
Wk. 11: Oct 30, Nov 1	Ch. 7	Ch. 4
	<ul style="list-style-type: none">• The Bivariate Normal Distribution• Mixed Versions of The Bayes' Rule• Derived Distributions	

Wk. 12: Nov 6, 8	Chs. 7, 5, 4, 13, 14	Chs. 4, 5
<ul style="list-style-type: none"> • Midterm 3 • Derived Distributions • Rayleigh Distribution and Simulation of Normal Random Variables • Generating Functions • Concentration Inequalities • Convergence of Random Variables 		
Wk. 13: Nov 13, 15	Ch. 3, 5, 13, 14	Chs. 5, 7
<ul style="list-style-type: none"> • Convergence of Random Variables • Limit Theorems: Laws of Large Numbers and The Central Limit Theorem 		
Wk. 14: Nov 20, 22	Ch. 6	–
<ul style="list-style-type: none"> • Introduction to Statistics: Confidence Intervals and Hypothesis Testing • Thanksgiving Holiday 		
Wk. 15: Nov 27, 29	Chs. 6, 12*	Ch. 6*
<ul style="list-style-type: none"> • Frequentist and Bayesian Parameter Estimation: Method of Moments, Maximum Likelihood, and Maximum A-Posteriori Estimates • Markov Chains* 		

*If time permits.

Statement of 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 one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. SCampus, the Student Guidebook, contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A. See: <http://scampus.usc.edu>

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. See the university's site on Campus Safety and Emergency Preparedness: <http://preparedness.usc.edu>

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.

DSP Contact Information

Website: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html
(213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

The weekly coverage might change as it depends on the progress of the class. However, you must keep up with the reading assignments.