RUTGERS UNIVERSITY, DEPARTMENT OF ECE
COURSE SYLLABUS: 14:332:226

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Probability theory studies random phenomena in a formal mathematical way. It is essential for all engineering and scientific disciplines dealing with models that depend on chance. Probability provides a well-defined way to quantify the uncertainty of a random event. With this framework, we can analyze the behavior of complex systems and **make informed decisions** (i.e., minimize the negative effect of bad behavior and maximize the positive effect of good behavior). With a long history development of probability theory, it plays a central role in e.g., telecommunications and finance systems. Telecommunications systems strive to provide reliable and secure transmission and storage of information under the uncertainties coming from various types of random noise and adversarial behavior. Finance systems strive to maximize profits in spite of the uncertainties coming from natural and man-made events. The students will learn the fundamentals of probability that are necessary for several ECE courses and related fields and help them prepare for the career in the industry and academia.

Class Time and Place: Monday∼Thursday 10:30am∼12:20pm, Busch SEC-203.
Office Hour: TBD.
Contact: kw414@scarletmail.rutgers.edu.
Prerequisites: Calculus.
Grading:

- Structure:

    - HW Presentation: 20 times×1 credit

    - Exam: 2 times×50 credits

    - Bonus Project: 1 times×20 credits

- Exam Formats:

    - In total 150 points in each exam. Each will convert to 50 credits in final grade.

    - 80 points questions from HW. No partial credit. Need a complete calculation process.

    - 40 points questions modified from HW. No partial credit. Fill the blank.

    - 30 points challenge questions. Multiple-choice. Probability class deserves some randomness.

Textbook and Materials:

1. **(Best For Beginner and Engineer)** Roy D. Yates and David J. Goodman. *Probability and stochastic processes: A friendly introduction for electrical and computer engineers.* 3rd ed. Wiley, 2015
   Student Companion Site

2. **(Beginner Alternative)** Sheldon M. Ross. *A First Course in Probability, Global Edition.* 10th ed. Pearson, 2020

3. **(Online Alternative)** Introduction to Probability, Statistics, and Random Processes by Pishro-Nik

4. **(Modern Alternative)** Introduction to Probability by Grinstead and Snell

Topics Covered By Day:

Day 1 Course Introduction and Review of Calculus

Day 2 Combinatorics Analysis, Counting Methods

Day 3 Examples and Exercises

Day 4 Set Theory, Axioms of Probability, Bayes, Independence, Venn Diagrams, Tree Diagrams

Day 5 Examples and Exercises

Day 6 PMF, Discrete Random Variables, CDF, Derived Random Variable, Expectation

Day 7 Examples and Exercises

Day 8 CDF, Continuous Random Variables, PDF, Gaussian Random Variable, Delta Function

Day 9 Examples and Exercises

Day 10 Review

Day 11 Exam 1

Day 12 Joint CDF, Joint Random Variables, Joint PMF, Joint PDF, Marginal PMF, Marginal PDF, Joint Expectation, Covariance, Correlation, Linear Independence

Day 13 Examples and Exercises

Day 14 Discrete/Continuous Functions of multiple Random Variables yielding Discrete/Continuous Outputs

Day 15 Examples and Exercises

Day 16 Conditional Probability Model

Day 17 Examples and Exercises

Day 18 Sum of Random Variables and Moment Generating Function

Day 19 Examples and Exercises

Day 20 Review

Day 21 Exam 2

Day 22 Random Vector, Convergence and Intro to Stochastic Process

Day 23 Bonus Presentation