

29:960:575: Introduction to Probability

Fall 2018

1WP Room 303, Newark campus

Wednesdays 10:00-12:50

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Office Hours: By appointment

COURSE DESCRIPTION

This is a first course in probability that does not assume any previous knowledge of probability. It will provide an introduction to advanced mathematical concepts and methods that find extensive use in many fields of modern Data Science and Operations Research. The course will have a theoretical focus, but theory will be motivated and illustrated with several examples from areas such as business and engineering. The course will broadly follow Ross's *A First Course in Probability*, with classes providing intuition and elaboration.

COURSE MATERIALS

- Required text:

- S. M. Ross, *A First Course in Probability*, 9th Edition (2014).
This introductory text has a very clear exposition, numerous exercises, and applications of probability theory to everyday problems and situations.

- Recommended texts:

- W. Feller, *An Introduction to Probability Theory and Its Applications*. Third Edition, J. Wiley & Sons (1967).
- R. Weber, [Probability](#).
- S. M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, Fifth Edition (2014).

- Check Blackboard (blackboard.rutgers.edu) and your official Rutgers email account regularly.

LEARNING GOALS AND OBJECTIVES

This course is designed to help students develop skills and knowledge in the following areas:

- Information Technology Knowledge. Students graduating with a Master of Information Technology degree will be able to demonstrate information technology knowledge.
- Critical Thinking Skills. Students graduating with a Master of Information Technology degree will be able to understand complex business situations and provide solutions to improve current business practices.
- Communication Skills. Students graduating with a Master of Information Technology degree will be able to effectively communicate in a way that demonstrates sensitivity to an audience's needs.

Students who complete this course will demonstrate the following:

- Ability to analyze and solve information technology problems.
- Ability to identify problems in a situation.
- Ability to find innovative solutions.
- Ability to communicate relatively complex ideas in a clear, concise manner.

Students develop these skills and knowledge through the following course activities and assignments:

- Weekly assigned readings and recommended optional readings.
 - Written assignments.
 - A midterm exam.
 - A final exam.
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PREREQUISITES

Graduate students who have finished a basic course in calculus are allowed to take the course. In particular, students must know:

- Basic differentiation and partial differentiation of standard functions and how to use the chain rule and product rule.
 - Definite and indefinite integrals using integration by parts and substitution.
 - How to evaluate a basic double integral
 - L'Hôpital's rule
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ACADEMIC INTEGRITY

I do NOT tolerate cheating. Students are responsible for understanding the RU Academic Integrity Policy (https://slwordpress.rutgers.edu/academicintegrity/wp-content/uploads/sites/41/2014/11/AI_Policy_2013.pdf). I will strongly enforce this Policy and pursue *all* violations. On all examinations, students must sign the RU Honor Pledge, which states, "On my honor, I have neither received nor given any unauthorized assistance on this examination or assignment." Don't let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

ATTENDANCE AND PREPARATION POLICY

- Expect me to attend all class sessions. I expect the same of you. If I am to be absent, my department chair or I will send you notice via email and Blackboard as far in advance as possible. If you are to be absent, report your absence in advance at <https://sims.rutgers.edu/ssra/>. If your absence is due to religious observance, a Rutgers-approved activity, illness, or family emergency/death and you seek makeup work, also send me an email with full details and supporting documentation within 3 days of your first absence.

- For weather emergencies, consult the campus home page. If the campus is open, class will be held.
- Expect me to arrive on time for each class session. I expect the same of you.

- Expect me to remain for the entirety of each class session. I expect the same of you.
 - Expect me to prepare properly for each class session. I expect the same of you. Complete all background reading and assignments. You cannot learn if you are not prepared. The minimum expectation is that for each class, you have prepared by studying for at least twice as many hours.
 - Expect me to participate fully in each class session. I expect the same of you. Stay focused and involved. You cannot learn if you are not paying attention.
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CLASSROOM CONDUCT

- Do not call out in class. If you have a question, raise your hand.
- No food or drink in class.
- No side conversations or use of cell phones in class.
- Use the bathroom before class to avoid the necessity of bathroom breaks.

EXAM DATES AND POLICIES

There are **two** exams in this course. The exam dates are:

- Midterm exam: **Wednesday October 17th**
- Final exam: **Wednesday December 12th**

During the exam, the following rules apply:

- If you have a disability that influences testing procedures, provide me an official letter from the Office of Disability Services **at the start of the semester**.
- No cell phones or other electronics are allowed in the testing room.
- You must show a valid Rutgers photo ID to enter the room and to turn in the exam.
- Alternate seating; do not sit next to another student or in your usual seat. A new seat will be assigned on a random basis.
- Use the bathroom prior to the exam start; bathroom breaks, if essential, will be escorted.
- Your exam will not be accepted unless you sign the Honor Pledge

Make-up exam policy:

- **Allowances for make-up exams** “Make-up” exams are allowed only for those students whose absence on a class exam date was due to a legitimate illness or emergency (i.e., circumstances beyond their control). MSIS Department Coordinator Office ultimately determines what does or does not constitute a “legitimate” illness/emergency.
 - **Procedures for obtaining authorization to take a make-up exam:** If your absence is due to illness, the MSIS Department Coordinator Office will require you to provide them with a document from your doctor indicating that you were indeed sick that day. If you do not provide the MSIS Department Coordinator Office with a doctor's note, they cannot in turn provide me with the proper authorization to allow a make-up exam.
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GRADING POLICY

There will be 6-7 homework assignments, issued on a Wednesday after class. Each assignment should be submitted online on Blackboard, in any legible format (scans of handwritten solutions are fine). All

homework assignments are to be completed on your own. You are welcome to discuss homework problems with me during office hours. Should a student copy the homework of another student, both of them will get only half grade.

All homework assignments and exams will be graded on a scale from A to F. To calculate your final grade, the individual grades will be converted to a number, and a weighted average will be taken according to the following weights.

- 20% Assignments
- 30% Midterm Exam
- 50% Final Exam

Your final grade is not subject to negotiation. If you feel I have made an error, submit your written argument to me within one week of receiving your final grade. Clarify the precise error I made and provide all due supporting documentation. If I have made an error, I will gladly correct it. But I will adjust grades only if I have made an error. I cannot and will not adjust grades based on consequences, such as hurt pride, lost scholarships, lost tuition reimbursement, lost job opportunities, or dismissals. Do not ask me to do so. It is dishonest to attempt to influence faculty in an effort to obtain a grade that you did not earn, and it will not work.

COURSE SCHEDULE

| <u>Date</u> | <u>Topic</u> |
|----------------------|---|
| Sep 5 th | Introduction |
| Sep 12 th | (Ross, Chapter 1): Principles of combinatorial analysis. Examples of combinatorial problems. Permutations and combinations. Stirling's formula. |
| Sep 19 th | (Ross, Chapter 2): The concept of probability: classical, frequentist and axiomatic definitions. Inclusion-exclusion formula. |
| Sep 26 th | (Ross, Chapter 3): Conditional probability and independence. Law of Total Probability. Bayes's Theorem. |
| Oct 3 rd | (Ross, Chapter 4): Discrete random variables. Examples: Bernoulli, Binomial. Expectation and variance. |
| Oct 10 th | (Ross, Chapter 4): More examples of discrete random variables: Poisson and others. Sums of random variables. Properties of random variables. |
| Oct 17 th | Midterm exam |
| Oct 24 th | (Ross, Chapter 5): Continuous random variables. Expectation and variance. Examples: Uniform, Normal, Exponential. Functions of random variables. |
| Oct 31 st | (Ross, Chapter 6): Jointly distributed random variables. Independent random variables. Conditional distributions. Buffon's needle. |
| Nov 7 th | (Ross, Chapter 7): Properties of Expectation. Expectation of sums of random variables. Conditional expectation. Moments. |
| Nov 15 th | (Ross, Chapter 8): Convergence and limit theorems. The Markov, Chebyshev and Jensen Inequalities. The Weak and Strong Laws of Large Numbers, the Central Limit Theorem. |
| Nov 21 st | No class |
| Nov 28 th | (Weber, Chapter 12) Probability generating functions |
| Dec 5 th | (Weber, Chapters 14 and 15) Branching processes. Random walks. Gambler's ruin. |
| Dec 12 th | Final exam |

SUPPORT SERVICES

If you need accommodation for a *disability*, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey, provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law Against Discrimination. <https://ods.rutgers.edu>

If you are a military *veteran* or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. <http://veterans.rutgers.edu/>

If you are in need of *mental health* services, please use our readily available services. Rutgers University-Newark Counseling Center: <http://counseling.newark.rutgers.edu/>

If you are in need of *physical health* services, please use our readily available services. Rutgers Health Services – Newark: <http://health.newark.rutgers.edu/>

If you are in need of *legal* services, please use our readily available services: <http://rusls.rutgers.edu/>

If you are in need of additional *academic assistance*, please use our readily available services. Rutgers University-Newark Learning Center: <http://www.ncas.rutgers.edu/rlc>
Rutgers University-Newark Writing Center: <http://www.ncas.rutgers.edu/writingcenter>