MA 540-A - Intro to Probability Theory

School of Engineering and Science
Fall 2023

Course Schedule:	Mondays 6:30 – 9:00 PM`
Classroom Location:	Gateway South 122
Canvas Course Address:	https://sit.instructure.com/courses/69189
Instructor:	Dr. Benjamin Leinwand
Contact Info:	bleinwan@stevens.edu, North Building Office 327
Office Hours:	Mondays and Thursdays, 3:30 – 4:30 PM
Prerequisite(s):	Advanced Calculus
Corequisite(s):	None
Cross-listed with:	None

COURSE DESCRIPTION

This course serves as an introduction to the theory of probability without the use of measure theory. Topics include frameworks of probability (sample space, events), classical motivating examples of probability (basic counting techniques and combinatorial probability); random variables (discrete and continuous; probability mass functions and probability density functions, cumulative distribution functions, expectation and moments); introducing common distributions (Normal, Binomial, Uniform, Poisson, Exponential, etc.); relationships between random variables (jointly distributed random variables, conditional distributions and independence, bivariate normal, and transformations of variables); and the Central Limit Theorem. While there is no real-world data component, this course aims to lay a theoretical foundation for tools used in modern data analysis through both derivations and examples.

STUDENT LEARNING OUTCOMES

- Gain comfort with uncertainty, and learn to reason in these terms.
- Recognize and understand properties of different distributions, and when they are appropriate for modeling data with different generating mechanisms.

After successful completion of this course, students will be able to:

- Determine the expectation and (co)variance of random variables and random vectors.
- Manipulate features of random variables to reveal additional properties
- Compare and relate the different modes of convergence.
- Apply results from probability theory to study the properties of sample statistics such as estimators.

COURSE FORMAT AND STRUCTURE

Weekly lectures, 10 homework assignments, one midterm exam, one final exam. 3 credits.

Course Logistics

- When assignments are due, they are due by 11:59 PM EST on the due date listed in the course schedule.
- Deadlines are an unavoidable part of being a professional, and this course is no exception. Course requirements must be completed and posted or submitted on or before the specified due date and delivery time deadline. Due dates and delivery time deadlines are in Eastern Time (as used in Hoboken, NJ). Avoid any inclination to procrastinate. Due dates have been established for each assignment to encourage you to stay on schedule.
- Assignments received 1-2 days late will have 20% of the total points deducted.
- Assignments received more than 2 days late will receive 0 points.

Instructor's Online Hours

I will be available via email and respond as soon as I am available (generally within 24-48 hours). When emailing me, please place in the subject line the course number/section and the topic of the email (i.e., MA 540 – Assignment 2 Question). This will help me tremendously in locating your emails. However, email is not recommended for conceptual or technical questions, as those are better dealt with during office hours.

TENTATIVE COURSE SCHEDULE

Homework assignments are due by 11:59 PM EST on the due date listed in the course schedule, to be uploaded via Canvas. Schedule is subject to change. Any changes to this schedule will be announced in class and online.

Date	Class	Topics	Assignment
September 11	Lecture 1	Course overview, combinatorics	Poll Due 9/14 HW #1 Due 9/20
September 18	Lecture 2	Axioms of probability	HW #2 due 9/27
September 25	Lecture 3	Conditioning, Bayes rule, independence	HW #3 due 10/4
October 2	Lecture 4	Discrete random variables	HW #4 due 10/11
October 10	Lecture 5	Continuous random variables	Poll Due 10/13 HW #5 Due 10/18
October 16	Lecture 6	Random variables continued, midterm review Q&A	
October 23	Midterm Exam	_____	

October 30	Lecture 7	Joint distributions	HW #6 due 11/8
November 6	Lecture 8	Expectation, variance, moments	Poll Due 11/9 HW #7 due 11/15
November 13	Lecture 9	Convergence and limit theorems	HW #8 due 11/22
November 20	Lecture 10	Statistics (concentration inequalities)	HW #9 due 11/29
November 27	Lecture 11	Statistics (estimation)	HW #10 due 12/6
December 4	Lecture 12	Markov Chains	HW #11 Due 12/13
December 11	Lecture 13	Graphs, final review Q&A	

COURSE MATERIALS

Textbook(s): Ross, S. M. (2012). *A First Course in Probability*. 9th Edition. Pearson Education, Inc.

COURSE REQUIREMENTS

Homework: To be submitted as a single pdf file on Canvas by 11:59 PM on the due date. Please include your name and homework number. “Math is not a spectator sport,” so homework is meant to help clarify concepts and solidify your understanding of the material. Homework can be written by hand and then scanned and uploaded as a pdf (make sure it is legible). Answers can also be written within your preferred typesetting software (e.g. MS Word, Latex) and then uploaded as a pdf.

Students may work in groups for completing assignments, but each student must upload a personal answer sheet written on their own.

The assignment portion of the course grade is the average of the nine best assignment scores.

Exams: There will be one midterm exam and one final exam. Both will be in class and cumulative. Students are entitled to one sheet of handwritten notes to bring to the exam. The content will be similar to that of the homeworks, but may cover additional material discussed in class. We will hold Q&A sessions for part of the class immediately preceding each exam.

GRADING PROCEDURES

Grades will be based on:

Homework	40%
Midterm	25%
Exam 2	35%
Polls	3%

Late Policy

Late homework will be accepted until the Friday evening following the homework deadline. However, assignments received 1 - 2 days late will have 20% of the total points deducted

Academic Integrity

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More

information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics.

Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/office-disability-services. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone 201-216-3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are can be made by phone (201-216-5177).

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text "Home" to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.