Stat 212 Probability II, Spring 2024

STAT212 Syllabus

Prof. Morgane Austern *TF:TBD*

Contact information

- **Instructor:** Morgane Austern, email: maustern@fas.harvard.edu
- **TF**: TBD

Office Hours Friday from 11am to noon in 701 science center. Send me an email if this does not work for you, and we can try to setup a separate appointment.

Objective of this class This is the second course in the graduate probability sequence, and a natural follow-up to STAT 210. Since it is a PhD-level class, the main goal is to give students the tools and background to make novel contributions in the field. We will cover advanced martingale theory, Brownian motions and general stochastic processes and high dimensional probability (concentration inequalities, stein method etc..).

Prerequisites Probability at the level of STAT 210 and real analysis at the level of MATH 112 are required.

Tentative outline of the class Advanced Martingales— L_p convergence, L_1 convergence, Backward Martingales, Uniform Integrability, Hewitt Savage 0/1 law, Exchangeability, De-Finetti's Theorem, Martingale CLT, Effron Stein inquality; Brownian Motion— construction, properties, Blumenthal's 0/1 law, Martingale property of Brownian Motion; Strong Markov Property, Reflection Principle, Distribution of the maximum and hitting times, Ito integral; General theory of stochastic processes— existence, continuous modifications, Kolmogorov continuity criterion, stationary processes, ergodic theorem; High-dimensional probability— Concentration inequality (Azuma, Bernstein, Exchangeable pair method...), application to high-dimensional vectors, Stein method for central limit theorems and univariate comparison.

Grading policy Homework assignments (25%), Midterm (25%), Final (35%), Project (10%), Class participation and scribing (5%). Homework will be assigned approximately bi-weekly on a Monday and due on the following Friday. As this class is aimed at preparing students for research there will be a final project. The aim of this final project is to introduce some of the modern areas of research in probability. I will provide with a list of modern research topics and related papers. The students will work together (by group of 3 or 4) and prepare a short presentation on the topic of their choice. No new results are expected. Finally, students are expected to show active participation in class: you will learn far more from solving the problems on your own, than by looking at other's solutions.

Important dates

- Midterm: Last week before spring break (tentative)
- Final: TBD

Homework policy Two late days are allowed over the whole semester–send an email to the course staff when using one of these days. The worst homework score will be dropped from the grade. You are welcome to discuss the homework problems with others, but you must write up your solutions yourself and in your own words. Additionally, you must list the names of the students with whom you collaborated (if any). Copying someone else's solution, or just making trivial changes for the sake of not copying verbatim, is not acceptable.

Academic integrity Members of the Harvard University community commit themselves to producing academic work of integrity – that is, work that adheres to the scholarly and intellectual standards of accurate attribution of sources, appropriate collection and use of data, and transparent acknowledgement of the contribution of others to their ideas, discoveries, interpretations, and conclusions. Cheating on exams or problem sets, plagiarizing or misrepresenting the ideas or language of someone else as one's own, or any other instance of academic dishonesty violates the standards of our community, as well as the standards of the wider world of learning and affairs.