Course Syllabus

STAT 559:
Measure Theory

Spring 2024

Instructor: Fang Han
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Course Website: Canvas!

Class Schedule: There will be two lectures a week:

- (Lecture) WF, 11:30-12:50 PM in MGH 254.

Course Overview: This is a 10-week lecture-based course focused on introducing the very foundation of probability, the celebrated measure theory, which ends a hundreds-of-years debate of Bayesian v.s. Frequentist. This course covers measure spaces, measurable functions over measure spaces, Lebesgue integration of measurable functions, product spaces and measure-theoretical Fubini's theorem, measure-theoretical random variables, and lastly, modes of convergence and their implications in probability theory (particularly, the law of large numbers and central limit theorem).

Prerequisites: This course requires either MATH 424 and MATH 425, or MATH 574 and MATH 575, and is appropriate for a graduate student of a mathematics/probability/statistics background, and requires a certain level of mathematical maturity. Please do not hesitate to approach the instructor if you have any concerns.

Grades: There will be nine HWs (35%), one midterm (30%), and one final exam (35%). The final grade will be curved.

Format of HWs: There will be 9 homework assignments (each worth 5%); the lowest two will be dropped. It will be out each Friday night and be due at the end of the next Friday (23:59:59). Late HWs will be penalized 20% per day (for instance, a homework turned in two days late will receive only 60% credit). Exceptions to these rules will of course be made for serious illness or other emergency circumstances; in these cases, please contact me as soon as you are aware of the problem. You need to upload your answers to the Canvas. Teamwork is allowed, but it is encouraged to think by yourself first; plagiarism is strictly forbidden. Technical correctness, clarity, and completeness are equally important.

Format of the exam: There will be a midterm and a final exam, both in-class, on May 03 and May 31. The exams are closed-book; however, each student is permitted to bring a single-sided cheat sheet (US letter size, no Möbius Strip please).

Course Textbook: This course is built on the first 8 chapters of the following lecture notes provided by Professor Sourav Chatterjee (a special thank to Sourav!)

- Sourav Chatterjee, Graduate Probability (Stats 310 series)
  `https://canvas.uw.edu/files/117905173/`

Professor Galen Shorack's book shall also be referenced from time to time

- Galen R. Shorack (2017), Probability for Statisticians (2nd Edition)

The following four books may also be referenced

1. Patrick Billingsley (1995),Probability and Measure (3rd Edition)
2. Kai-Lai Chung (2001), A Course in Probability Theory (3rd Edition)
3. Rick Durrett (2005), Probability: Theory and Examples (3rd Edition)

4. Jeffrey Rosenthal (2006), A First Look at Rigorous Probability Theory (2nd Edition)

Illness protocols and safety: If you feel ill or exhibit respiratory or other symptoms, you should not come to class. Seek medical attention if necessary and notify your instructor(s) as soon as possible by email.

Please check your email daily BEFORE coming to class. If we need to conduct class remotely because the instructor or a guest speaker is unable to attend in person, we will send all registered students an email with a Zoom link for remote instruction or a plan for making up the class.

Religious accommodations: "Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/)."

Academic integrity: The University takes academic integrity very seriously. Behaving with integrity is part of our responsibility to our shared learning community. If you're uncertain about if something is academic misconduct, ask me. I am willing to discuss questions you might have.

Acts of academic misconduct may include but are not limited to:

- Cheating (working collaboratively on quizzes/exams and discussion submissions, sharing answers and previewing quizzes/exams)
- Plagiarism (representing the work of others as your own without giving appropriate credit to the original author(s))

Concerns about these or other behaviors prohibited by the Student Conduct Code will be referred for investigation and adjudication by (include information for specific campus office).

Students found to have engaged in academic misconduct may receive a zero on the assignment (or other possible outcome).

Course Schedule:

Date	Content	Date	Content	Date	Content
		3/27	Introduction	3/29	measure spaces, Dynkin's theorem
4/01 (M)	outer measures, starting Caratheodory	4/03	Caratheodory extension theorem	4/05	measurable function
		4/10	No class	4/12	No class
4/15 (M)	Lebesgue integration	4/17	MCT, Fatou, and DCT	4/19	MCT, Fatou, and DCT (cont.)
		4/24	product spaces	4/26	Fubini theorem
		5/01	L_p spaces	5/03	Midterm exam
		5/08	L_p spaces (cont.)	5/10	CDF and pdf, expectation, independence
		5/15	four notions of convergence	5/17	four notions of convergence (cont.)
		5/22	WLLN and SLLN	5/24	CLT
		5/29	CLT (cont.)	5/31	Final exam

MCT: monotone convergence theorem
DCT: dominated convergence theorem
WLLN: weak law of large numbers
SLLN: strong law of large numbers
CLT: central limit theorem

Figure 1: Course schedule (tentative).