



## MATH733: PROBABILITY THEORY

Fall 2022

### COURSE INFORMATION

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<b>Instructor</b>	Hanbaek Lyu	(Email: <a href="mailto:hlyu@math.wisc.edu">hlyu@math.wisc.edu</a> , Office: Van Vleck 303)
<b>Lectures</b>	TTh 1:00PM - 2:15PM at Van Vleck B236	
<b>Office hours</b>	(tentative) M 2-3pm and 4-5pm	
<b>Textbook</b>	<a href="#">Richard Durrett: Probability: Theory and Examples, 5th edition, 2019</a> (Additional Lecture notes will be provided)	
<b>Canvas</b>	<a href="https://canvas.wisc.edu/courses/313430">https://canvas.wisc.edu/courses/313430</a>	
<b>Piazza</b>	<a href="https://piazza.com/wisc/fall2022/fa22math733001">https://piazza.com/wisc/fall2022/fa22math733001</a>	
<b>Grader</b>	Chenyun Zhou (Email: <a href="mailto:czhou265@wisc.edu">czhou265@wisc.edu</a> )	

### GENERAL INFORMATION

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<b>Instructional Modality</b>	In-person
<b>Credits</b>	3.0. The three credit hours are met by two 75-minute class periods and a for about 2-3 hours outside of class student work for every class period.
<b>Regular and Substantive Student-Instructor Interaction</b>	Participation in regularly scheduled learning sessions (where there is an opportunity for direct interaction between the student and the qualified instructor), office hours.

### COURSE DESCRIPTION

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This is the first semester of a two-semester graduate-level introduction to probability theory and it also serves as a stand-alone introduction to the subject. The course will focus on the basics of probability and cover at least the following topics: foundations (probability spaces and existence of processes), independence, zero-one laws, laws of large numbers, weak convergence and the central limit theorem, conditional expectations and their properties, and random walks, and martingales (convergence theorem and basic properties). Optional topics include expected and empirical loss minimization.

We are expecting to cover Sections 1 (Measure Theory), 2 (Laws of Large Numbers), 3 (Central Limit Theorems) and (about half of) 4 (Conditional Expectations and Martingales) in Durrett.

### PROBABILITY BEYOND CLASSROOM

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Check out the [Probability Seminar](#), the [Graduate Probability Seminar](#) and the [Statistics Seminar](#) for talks that might interest you. Have a look at the [wiki page](#) of our probability group to learn more about the probabilists at UW-Madison.

## REQUISITES

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Familiarity with basic measure theory (e.g. MATH 629 or 721) or concurrent registration in MATH 721 is recommended, but not required. We will cover basic measure theory at the beginning of the semester following Ch. 1 of Durrett. Prior exposure to elementary probability theory (undergraduate level) could be useful, but it is not required.

## LEARNING OUTCOME

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1. State, explain, and apply the axioms, principal results, denitions, and theorems of modern measure theoretic probability theory.
2. Construct a probability space model for a given situation.
3. Analyze asymptotic problems in probability theory using the law of large numbers, the central limit theorem, and the Borel-Cantelli lemmas.
4. Bound tail probabilities of unwanted events using various concentration inequalities.
5. Master the mathematically rigorous denitions of conditional probabilities and conditional expectations, learn various ways for computing them, and apply them in the theory of martingales

## GRADING AND EXAMS

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<b>Grading Scheme</b>	Homework (30%) + Midterm 2 (30%) + Final (40%) (You should attend the final exam to pass the course.)
<b>Midterm</b>	Wednesday, 10/26, 5:45PM-7:15PM (VV B107)
<b>Final</b>	Wednesday, 12/21, 2:45 - 4:45PM (Location TBD)

## HOMEWORK

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- Homework problems will be posted every other Thursday under "Assignments" in Canvas and will be due the following **Wed. 10 pm**. The lowest homework score will be dropped.
- Homework will be handed in, graded, and returned using Canvas. It should be uploaded to Canvas in the format of a **single PDF file**. ([Latex typesetting is recommended](#).) Put your problems in the correct order (to simplify this, it might be useful to write each problem on a separate sheet of paper (certainly if you do not type your solutions). Please also make sure all pages are in the right orientation when you convert them. Do not hand in your rough draft or first attempt. Papers that are unreadable or disorganized cannot be graded.
- The homework is graded according to its correctness, completeness and presentation. Answers alone carry no credit. One should provide clear arguments and steps that lead to your solution/conclusion. Organize your work neatly. Use proper English. Answers should be simplified as much as possible.
- If you have mathematical questions about HW, I strongly encourage you to use Piazza (you may use anonymous option if you wish). You certainly can write me an e-mail with the questions, but Piazza is much more useful for mathematical formulas than e-mail programs.
- Observe rules of academic integrity. Handing in plagiarized work, whether copied from a fellow student or off the web, is not acceptable. Plagiarism cases will lead to sanctions. You can discuss the problems, ideas, hints with your classmates, however, you should always write down the solutions on your own.

## CAMPUS SPACES FOR VIRTUAL LEARNING & TESTING

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Dedicated on-campus spaces with high-speed internet are available for students to reserve (see [LINK](#)) for any exam/quiz taken during the semester. Computers can also be requested.

## COURSE EVALUATION

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UW-Madison now uses an online course evaluation survey tool, AEFIS. You will receive an official email two weeks prior to the end of the semester when your course evaluation is available. You will receive a link to log into the course evaluation with your NetID where you can complete the evaluation and submit it, anonymously. Your participation is an integral component of this course, and your feedback is important to me. I strongly encourage you to participate in the course evaluation. You are also very welcome to provide a feedback about the course during the semester (as a direct e-mail to me, or, if you prefer the anonymous option, you can use anonymous comments on Piazza).

## ACADEMIC INTEGRITY

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By enrolling in this course, each student assumes the responsibilities of an active participant in the UW-Madison community of scholars, in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct and Community Standards for additional review. For more information, refer to [LINK](#).

## ACADEMIC CALENDAR& RELIGIOUS OBSERVANCES

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See [LINK](#).

## ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

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The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform the instructor of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. The instructor will work either directly with you or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. For more information, refer to [LINK](#).

## DIVERSITY AND INCLUSION

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Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world. For more information, refer to [LINK](#).

## **RULES, RIGHTS & RESPONSIBILITIES**

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During the global COVID-19 pandemic, we must prioritize our collective health and safety to keep ourselves, our campus, and our community safe. As a university community, we must work together to prevent the spread of the virus and to promote the collective health and welfare of our campus and surrounding community. For more information, refer to [LINK](#).

## **UW-MADISON BADGER PLEDGE**

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See [LINK](#).

## **PRIVACY OF STUDENT INFORMATION & DIGITAL TOOLS: TEACHING & LEARNING ANALYTICS & PROCTORING STATEMENT**

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The privacy and security of faculty, staff and students personal information is a top priority for UW-Madison. The university carefully reviews and vets all campus-supported digital tools used to support teaching and learning, to help support success through learning analytic, and to enable proctoring capabilities. UW-Madison takes necessary steps to ensure that the providers of such tools prioritize proper handling of sensitive data in alignment with FERPA, industry standards and best practices. Under the Family Educational Rights and Privacy Act (FERPA which protects the privacy of student education records), student consent is not required for the university to share with school officials those student education records necessary for carrying out those university functions in which they have legitimate educational interest. 34 CFR 99.31(a)(1)(i)(B). FERPA specifically allows universities to designate vendors such as digital tool providers as school officials, and accordingly to share with them personally identifiable information from student education records if they perform appropriate services for the university and are subject to all applicable requirements governing the use, disclosure and protection of student data.

## **PRIVACY OF STUDENT RECORDS AND THE USAGE OF AUDIO RECORDED LECTURES**

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Lecture materials and recordings for this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without my permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document 4-1] Students may not copy or have lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructors express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the universitys policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

## CAMPUS GUIDANCE ON THE USE OF FACE COVERINGS

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Students of the class are expected to comply with the University's current COVID rules and policies that are maintained [here](#): (see in particular [link](#)).

Face coverings must be correctly worn on campus at all times and in all places (both outside and inside), except by students in their assigned residence hall rooms; by employees when alone in a private, unshared lab or office; when traveling alone in a private vehicle; and when exercising outside in a way that maintains 6 feet of distance from other people.

Students with disabilities or medical conditions who are unable to wear a face covering should contact the McBurney Disability Resource Center or their Access Consultant if they are already affiliated. Students requesting an accommodation unrelated to disability or medical condition, should contact the Dean of Students Office.

Students who choose not to wear a face covering may not attend in-person classes, unless they are approved for an accommodation or exemption. All other students not wearing a face covering will be asked to put one on or leave the classroom. Students who refuse to wear face coverings appropriately or adhere to other stated requirements will be reported to the Office of Student Conduct and Community Standards and will not be allowed to return to the classroom until they agree to comply with the face covering policy. An instructor may cancel or suspend a course in-person meeting if a person is in the classroom without an approved face covering in position over their nose and mouth and refuses to immediately comply.