

# MATH-SH U233: Honors Theory of Probability

## NYU Shanghai, Spring 2024

Lectures: Mondays and Wednesdays 11:15-12:30 in N207  
Problem sessions / Recitation: Fridays 11:15-12:30 in E402

**Instructor:** Wei Wu (w910, wei.wu@nyu.edu)

**Office Hours:** Mondays 4:30-5:30pm and Wednesdays 3:30-4:30pm

**Textbook:** We will follow “Probability and Random Processes” (4th edition) by G. Grimmett and D. Stirzaker. Some suggested references:

- Probability and Measures by P. Billingsley
- Essentials of Stochastic Processes by R. Durrett, Springer-Verlag New York
- Introduction to Stochastic Processes, Second Edition, by G. Lawler

The following references are more suitable for a higher level course in probability, but I also encourage you to look up relevant sections there

- Probability : Theory and Examples by R. Durrett, Cambridge Univ. Press
- Probability with martingales, by D. Williams, Cambridge Univ. Press
- A course in probability theory, Third Edition, by Kai-Lai Chung

**Overview of the course:** This course is an introduction for mathematics majors to the mathematical treatment of random phenomena occurring in the natural, physical, and social sciences. Topics covered include axioms of mathematical probability, combinatorial analysis, the binomial distribution, Poisson and normal approximations, random variables, probability distributions, random walks, generating functions, branching processes, and Markov chains and their applications.

The plan is to cover most of the Chapters 1-7 of the book during the semester with some supplementary topics.

**Homework:** Homework will be assigned every Friday and will be posted on Brightspace after the class. The assignments are due the following Friday at 1:15pm before the start of class. Late work will be not accepted.

**Exams:** There will be Midterm and Final exams. Students **must attend** both exams—it cannot be rescheduled except for emergencies and make-ups will not be given!

**Grade calculation:** Participation 5%, Homework 15%, Midterm 40% and Final 40%.

**Topics** We will cover the following topics (not necessarily all of them in the same depth):

- Probability space,  $\sigma$ -algebra, measure, conditional probability and independence
- Measurable functions, random variables and their distributions

- Integration/ Expectation, conditional distributions and expectation, functions of random variables, Radon-Nikodym derivatives
- Random walks
- Generating functions and characteristic functions
- Branching process
- Convergence of random variables, laws of large numbers, Monte-Carlo methods
- Central limit theorem, large deviations
- Markov Chains (time permitting)

**Academic integrity** Students are expected to read and understand the university's policy on academic integrity as laid out in the Undergraduate Bulletin. In particular, this policy also applies to the homework and the online quizzes. Plagiarism and cheating will be penalized.