



Introduction to Stochastic Processes

STAT-GB.3321/STAT-UB.0021

Thursday: 6:00-9:00 pm

Spring 2023

Basic information

Instructor:	Professor Halina Frydman
E-mail:	hfrydman@stern.nyu.edu
Office hours:	Thursday 12:00-1:00 via Zoom and by appointment
TA:	Weichi Yao
E-mail:	wy635@stern.nyu.edu
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Course outline

This is an introductory course in stochastic processes. The course covers the theory of discrete and continuous Markov chains, martingales and Brownian motion and its generalizations. The discussion of Markov chains includes statistical aspects of these processes. If time permits, the stochastic integration and the rules of stochastic calculus are developed. The objective of the course is for you to learn about basic classes of stochastic processes and their applications. The topics are covered in the following order:

1. Discrete time Markov chains
2. Continuous time Markov chains
3. Discrete time martingales
4. Brownian motion and its generalizations
5. Elements of stochastic calculus

Prerequisites

The prerequisites for the course are Calculus I and a course in probability theory

Course Materials

The course is based on my Lecture Notes

Textbook: Introduction to Probability Models (12th edition) Sheldon M. Ross, Academic Press 2019.

Topics and readings

- Discrete time Markov chains
Ross: 4.1-4.6
Lecture notes: Chapter 1
- Continuous time Markov chains
Ross: 5.3.1-5.3.5
Ross: 6.1-6.5 and 6.8
Lecture notes: Chapter 2
- Discrete time martingales
Lawler: 5.1-5.3
Lecture notes: Chapter 3
- Brownian motion and its generalizations
Ross: 10.1-10.3
Lecture notes: Chapter 4
- Elements of stochastic calculus
Lecture notes: Chapter 5
Lawler: 9.1-9.3

Additional Readings

The following additional books are useful references to topics covered in the course. The third and the fifth topics use the material from the first reference (Lawler) below. The remaining references provide a different perspective on the topics covered in the course and are sources of interesting examples of Markov processes that we study in the course.

1. **Introduction to Stochastic Processes** (2nd Edition), G.F. Lawler, Chapman and Hall, Probability Series, 2006.
2. **An Introduction to Stochastic Modeling** (3rd Edition), H.M. Taylor and S. Karlin, Academic Press.
3. **A First Course in Stochastic Processes** (2nd Edition), S. Karlin and H. M. Taylor, Academic Press, 1975.
4. **Adventures in Stochastic Processes** (2nd Edition), S. Resnick, Birkhauser, (2002).
5. **Elementary Stochastic Calculus with Finance in View**, T. Mikosch, Advanced Series on Statistical Science & Applied Probability, World Scientific, 1999.
6. **Stochastic Processes**, S. Ross, (2nd Edition) Wiley 1996.

Grading

Homework 30% Weekly

Midterm 30%

Final 40%

Participation and Class Attendance

Participation is an essential part of learning in this course and the way I get to know you. Class absences may be excused only in the cases of documented illness, family emergency, religious observances, or civic duty. If you will miss the class for religious observance or civic duty you must inform me no later than the first week of class. Students are expected to arrive to class on time and stay to the end of the class period.

Academic Integrity

Our undergraduate [Academics Pillar](#) states that we take pride in our well-rounded education and approach our academics with honesty and integrity. Indeed, integrity is critical to all that we do here at NYU Stern. As members of our community, all students agree to abide by the [NYU Academic Integrity Policies](#) as well as the NYU Stern Student Code of Conduct, which includes a commitment to:

- Exercise integrity in all aspects of one's academic work including, but not limited to, the preparation and completion of exams, papers, and all other course requirements by not engaging in any method or means that provides an unfair advantage.
- Clearly acknowledge the work and efforts of others when submitting written work as one's own. Ideas, data, direct quotations (which should be designated with quotation marks), paraphrasing, creative expression, or any other incorporation of the work of others should be fully referenced.
- Refrain from behaving in ways that knowingly support, assist, or in any way attempt to enable another person to engage in any violation of the Code of Conduct. Our support also includes reporting any observed violations of this Code of Conduct or other School and University policies that are deemed to adversely affect the NYU Stern community. The Stern Code of Conduct and Judiciary Process applies to all students enrolled in Stern courses and can be found here: <https://www.stern.nyu.edu/uc/codeofconduct>.

To help ensure the integrity of our learning community, prose assignments you submit to NYU Brightspace will be submitted to Turnitin. Turnitin will compare your submission to a database of prior submissions to Turnitin, current and archived Web pages, periodicals, journals, and publications. Additionally, your document will become part of the Turnitin database.

GENERAL CONDUCT & BEHAVIOR

Students are also expected to maintain and abide by the highest standards of professional conduct and behavior. Please familiarize yourself with Stern's Policy in Regard to In-Class

Behavior & Expectations

(<https://www.stern.nyu.edu/portal-partners/registrar/policies-procedures/general-policies/code-of-conduct>)

(<http://www.stern.nyu.edu/portal-partners/current-students/undergraduate/resources-policies/academic-policies/index.htm>) and the NYU Student Conduct Policy

(<https://www.nyu.edu/about/policies-guidelines-compliance/policies-and-guidelines/universitystudent-conduct-policy.html>).

GRADING GUIDELINES

To ensure fairness and clarity of grading, the Stern faculty have agreed that for elective courses the individual instructor or department is responsible for determining reasonable grading guidelines.

STUDENT ACCESSIBILITY

If you will require academic accommodation of any kind during this course, you must notify me at the beginning of the course and provide a letter from the Moses Center for Student Accessibility ([212-998-4980](tel:212-998-4980), mosescsa@nyu.edu) verifying your registration and outlining the accommodations they recommend. If you will need to take an exam at the Moses Center for Student Accessibility, you must submit a completed Exam Accommodations Form to them at least one week prior to the scheduled exam time to be guaranteed accommodation. For more information, visit the CSA website:

<https://www.nyu.edu/students/communities-and-groups/student-accessibility.html>

STUDENT WELLNESS

Our aim is for students to be as successful academically as they can, and to help them overcome any impediments to that. Bookmark the NYU Stern Well-being Resource Hub

(<https://www.stern.nyu.edu/wellbeing>) for existing services at NYU and Stern covering a wide variety of topics including financial well-being, relationship well-being, mental well-being, and more. Any student who may be struggling and believes this may affect their performance in this course is urged to contact the Moses Center for Student Accessibility (see also the Student Accessibility section of this syllabus) at 212-998-4980 to discuss academic accommodations. If mental health assistance is needed, call the NYU's 24/7 Wellness Exchange hotline 212-443-9999. Furthermore, please approach me if you feel comfortable doing so. This will enable me to provide relevant resources or referrals. There are also drop in hours and appointments. Find out more at <http://www.nyu.edu/students/health-and-wellness/counseling-services.html>

NAME PRONUNCIATION AND PRONOUNS

NYU Stern students now have the ability to include their pronouns and name pronunciation in Albert. I encourage you to share your name pronunciation and preferred pronouns this way.

Please utilize this link for additional information: [Pronouns & Name Pronunciation](#)

RELIGIOUS OBSERVANCES AND OTHER ABSENCES

NYU's [Calendar Policy on Religious Holidays](#) states that members of any religious group may, without penalty, absent themselves from classes when required in compliance with their religious obligations. You must notify me in advance of religious holidays or observances that might coincide with exams, assignments, or class times to schedule mutually acceptable alternatives. Students may also contact religiousaccommodations@nyu.edu for assistance.

NYU Stern is committed to ensuring an equitable educational experience for all students regardless of identity or circumstances and strives to recognize the obligations its students have outside of Stern. Please review all class dates at the start of the semester and review all course requirements to identify any foreseeable conflicts with exams, course assignments, projects, or other items required for participation and attendance. If you are aware of a potential conflict, please contact me as soon as possible to discuss any potential conflicts to determine whether/how they can be accommodated.

LAPTOPS, CELL PHONES & OTHER ELECTRONIC DEVICES (3 OPTIONS)

The use of electronic devices (e.g., tablets or laptops), for the purpose of note-taking only, is permitted.

Students with disabilities

Students whose class performance may be affected due to a disability should notify the professor immediately so that arrangements can be made in consultation with the Henry and Lucy Moses Center for Students with Disabilities <http://www.nyu.edu/csd/> to accommodate their needs.