Syllabus

FIN 5380 – Stochastic Foundations for Finance (1.5 Units)

Sections 01 / 02 – Fall 2026

Last updated: October 21, 2026

Instructor:	Lorenzo Naranjo
Office:	Simon Hall 281
Office Hours:	Tuesday / Thursday (2:30pm – 4:00pm)
Email:	naranjo@wustl.edu
Classroom:	Section 01 in Simon Hall 103 / Section 02 in Simon Hall 112
Meeting Times:	Section 01: Tuesday / Thursday 10:00am – 11:20am
	Section 02: Tuesday / Thursday 1:00pm – 2:20pm
Class Modality:	In-person
Teaching Assistants:	Charlie Li – guangchen@wustl.edu
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Class Information

Course Description

This is a foundations course, which is designed as a prerequisite to FIN 539, Mathematical Finance. It is therefore mainly designed for students in the Masters in Finance program who aim at quantitative positions in investment banks, hedge funds and consulting firms. While financial examples will be given, the primary focus will be on stochastic process and stochastic calculus theory. Students interested in applications of the theory are expected to take follow-on courses. Topics to be covered include: general probability theory; Brownian motion and diffusion processes; martingales; stochastic calculus including Ito's lemma; and jump processes.

Classroom Etiquette

Class time is valuable, and I am dedicated to making sure that every minute in class is used effectively. As such, any conduct that interferes with my ability or your classmates' ability to use class time productively is prohibited. Please try to be punctual. If I observe that students are regularly coming late, I may start recording attendance at the beginning of each session.

> ! Important
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> Laptops are not permitted in class unless the instructor has given explicit permission for a particular activity requiring a laptop. Tablets may be used solely for note-taking purposes and must be kept in horizontal orientation throughout class. The use of external keyboards, computer mice, or headphones during class is also not allowed.

Learning Goals

1. Knowledge
   - Identify the primary stochastic processes used in finance, including random walks, martingales, Poisson processes, Brownian motion, and Itô processes.
2. Comprehension
   - Explain conditional expectation given an information set, and how filtrations model information revealed over time.
   - Explain how Brownian motion arises as the limit of a scaled random walk.
   - Explain the stochastic integral as the gains from trading.
3. Application
   - Use generating functions to find the distribution and moments of sums of random variables.
   - Use Itô's formula for one and for several Itô processes.
   - Calculate instantaneous variances, covariances, and correlations.
   - Use Girsanov's theorem to change the drift of a Brownian motion by changing the probability measure.
4. Analysis
   - Use martingales and the optional stopping theorem to compute ruin probabilities and expected durations.
   - Determine whether an Itô process is a martingale by checking its drift.
   - Relate the risk-free rate and risk premia to the stochastic discount factor.
5. Synthesis

- Build the risk-neutral measure from the stochastic discount factor and derive the Black-Scholes prices of European call and put options.

Class Materials

All course materials can be accessed at https://lorenzonaranjo.com/teaching/fin5380-fall26b/. I will link all relevant materials to Canvas.

The following textbooks were consulted in developing the course materials:

- Back, K. (2010). *Asset Pricing and Portfolio Choice Theory*. Oxford University Press.
- Oksendal, B. (2010). *Stochastic Differential Equations: An Introduction with Applications*. Springer.
- Shreve, S. (2004). *Stochastic Calculus for Finance II: Continuous-Time Models*. Springer.
- Steele, J. M. (2001). *Stochastic Calculus and Financial Applications*. New York: Springer.

Although our lectures cover material in a self-contained way, consulting the textbooks will strengthen your understanding of the lecture content.

> ! Important
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> A calculator is required for this course. Any scientific calculator capable of computing exponential functions and logarithms will suffice. These calculators typically cost around $10. I advise against using a financial calculator as entering lengthy expressions can be difficult and error-prone. Mobile phones are not allowed during the final exam.

Course Schedule

The tentative course schedule is given below. The topics covered on each proposed date may change as the course progresses, but the main content and the general order should not vary.

Session	Date	Topic	Due
1	10/20	Probability Basics; Conditioning and Independence	
2	10/22	Continuous Distributions	
3	10/27	Generating Functions	
4	10/29	Ruin Probabilities	PS #1
5	11/3	Martingales in Discrete Time	
6	11/5	Poisson Processes	PS #2
7	11/10	Brownian Motion	
8	11/12	Stochastic Calculus (1)	PS #3
9	11/17	Stochastic Calculus (2)	
10	11/19	Modeling Stock Prices	PS #4
11	11/24	Discount Factors in Continuous Time	
–	11/26	Thanksgiving Break (no classes)	
12	12/1	Derivatives Pricing in Continuous Time; Pricing with Jumps	
13	12/3	Review for Final Exam	PS #5
14	12/10	Final Exam (8:30AM)	

Grading

Following is the summary of weights on the various components that I will use to evaluate your performance in this course:

Assignment	Weight
Problem Sets	30
Final Exam	60
Class Attendance	10

The precise grade cutoffs between and within letter grades will be chosen so that the average grade for the class is around 3.5 GPA. For MBA students, as per school rules no more than 20% high passes can be awarded in total.

Grades are non-negotiable. If you feel I have graded one of the course requirements incorrectly, please bring it to my attention immediately. Grade appeals (e.g., because your points were not added up correctly) must be submitted within a week after the grades are released. I certainly want all of you to receive the grades you have earned.

Problem Sets

There will be weekly problem sets so you can practice the concepts covered in class and that will help you prepare for the final exam. Each problem set is due at 11:59 pm Central Time on the date shown in the course schedule. All problem sets are individual and must be handwritten. You must submit your work via Canvas as a PDF file. If you do not have a scanner, download a scanner app such as Adobe Scan that allows you to scan on your phone and generate a PDF.

There is a 0.2% grade deduction per hour, i.e. 4.8% per day, for late submissions.

Final Exam

There will be a comprehensive final exam that will allow you to demonstrate your learning on each of the course units. The final exam will be held on **Thursday, December 10 at 8:30am Central Time**. I will announce the rooms and logistics later. The exam is closed-book and closed-notes. I will provide you with a formula sheet, and you must bring a scientific calculator. No other electronic devices, like smart watches or smart glasses are allowed during the exam.

The exam time is non-negotiable. If you have a conflict, you must inform me by the end of the second class of the course. Hence, I encourage you to check your schedule early (e.g., make sure that the exam dates do not conflict with a religious holiday, etc.). If you think you will miss the final exam, please (1) immediately e-mail me prior to the exam time and (2) send me a justifiable and reliable proof of absence. Without clear and hard evidence, you will get no credit.

Required Policies

Academic Integrity

In all academic work, the ideas and contributions of others (including generative artificial intelligence) must be appropriately acknowledged and work that is presented as original must be, in fact, original. You should familiarize yourself with the appropriate academic integrity policies of your academic program(s).

Unauthorized Recording and Distribution of Classroom Activities and Materials

The following applies to all students in my class: "Except as otherwise expressly authorized by the instructor or the university, students may not record, stream, reproduce, display, publish or further distribute any classroom activities or course materials. This includes lectures, class discussions, advising meetings, office hours, assessments, problems, answers, presentations, slides, screenshots or other materials presented as part of the course. If a student with a disability wishes to request the use of assistive technology as a reasonable accommodation, the student must first contact the Office of Disability Resources to seek approval. If recording is permitted, unauthorized use or distribution of recordings is also prohibited."

Disability Resources

WashU supports the right of all enrolled students to an equitable educational opportunity and strives to create an inclusive learning environment. In the event the physical or online environment results in barriers to your inclusion due to a disability, please contact WashU's Disability Resources (DR) as soon as possible and engage in a process for determining and communicating reasonable accommodations. As soon as possible after receiving an accommodation from DR, send me your WashU Accommodation Letter. Remember that accommodations cannot be applied retroactively. https://disability.wustl.edu/

Sexual Harassment and Assault

If you are a victim of sexual discrimination, harassment or violence, we encourage you to speak with someone as soon as possible. Understand that if you choose to speak to me as an instructor, I must report your disclosure to my department chair, dean, or the Gender Equity and Title IX Compliance Officer, which may trigger an investigation into the incident. You may also reach out to the Relationship & Sexual Violence Prevention (RSVP) Center to discuss your rights and your options with individuals who are not mandatory reporters. https://titleix.wustl.edu/students/confidentiality-resources-support/

Religious Holidays

To ensure that accommodations may be made for students who miss class, assignments, or exams to observe a religious holiday, you must inform me in writing before the end of the third week of class, or as soon as possible if the holiday occurs during the first three weeks

of the semester. For more information, please see the university's Religious Holiday Class Absence Policy.

Emergency Preparedness

Before an emergency affects our class, students can take steps to be prepared by downloading the WashU SAFE App. In addition, each classroom contains a "Quick Guide for Emergencies" near the door.

Resources for Students

WashU provides a wealth of support services that address academic, personal, and professional needs. To start exploring resources that can help you along the way, please visit: Resources for Students.