

Syllabus

FIN 5380 – Stochastic Foundations for Finance (1.5 Units)

Sections 01 / 02 / 03 – Fall 2025

Instructor:	Lorenzo Naranjo
Office:	Simon Hall 281
Office Hours:	Monday / Wednesday (4:00pm – 5:20pm)
Email:	naranjo@wustl.edu
Classroom:	Section 01 in Bauer Hall 160 / Sections 02 and 03 in Simon Hall 112
Meeting Times:	Section 01: Monday / Wednesday 10:00am – 11:20am Section 02: Monday / Wednesday 1:00pm – 2:20pm Section 03: Monday / Wednesday 2:30pm – 3:50pm
Class Modality:	In-person

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

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 utilized in finance, including random walks, martingales, and Ito diffusions.

2. Comprehension

- Explain the conceptual foundation of the stochastic integral.
- Explain how Brownian motion is constructed.

3. Application

- Use Ito's lemma for both single-variable and multi-variable diffusions.
- Use Girsanov's theorem to perform measure changes for continuous-time diffusions.
- Calculate instantaneous variances, covariances, and correlations.

4. Analysis

- Determine the conditions under which stochastic integrals with respect to Brownian motion are martingales.

5. Synthesis

- Obtain the pricing formulas for European call and put options.

Class Materials

All course materials can be accessed at <https://lorenzonaranjo.com/fin5380/>. 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. (2010). *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

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.

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 grading scale of the class will approximately follow the table below.

Percent	Grade
90-100	A
80-89	B
70-79	C
60-69	D
59-Below	F

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 CST on the dates indicated below. 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.

Assignment	Due Date
PS #1	10/31
PS #2	11/7
PS #3	11/17
PS #4	11/24
PS #5	12/5

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 11 from 9:00AM - 12:00PM CST**. 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.

Honor Code and Code of Conduct

This course will follow the standards specified in the Code of Conduct and Code of Academic Integrity, which were presented to faculty and students of the Olin Business School. Students are expected to be familiar with the codes.

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
1	10/22	Random Walk and Ruin Probabilities

Session	Date	Topic
2	10/27	The Normal and Lognormal Distribution
3	10/29	Characteristic Functions
4	11/3	Martingales in Discrete Time
5	11/5	Brownian Motion and Quadratic Variation
6	11/10	Stochastic Integrals and Ito Processes
7	11/12	Ito's Formula
8	11/17	Applications of Ito's Formula
9	11/19	Multidimensional Ito Processes
10	11/24	Girsanov's Theorem
–	11/26	Thanksgiving Break (no classes)
11	12/1	Deriving The Black-Scholes Formula
12	12/3	Review for Final Exam
–	11/12	Final Exam (9:00AM to 12:00PM)

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](#).