



FE 610 Stochastic Calculus for Finance

School of Business
Stevens Institute of Technology
Fall 2024

Instructor: Thomas Lonon

Course Web Address: <https://sit.instructure.com/courses/74032>

Course Schedule: Virtual office hours by appointment

Contact Info: tlonon@stevens.edu or 201-216-3705

Office: Babbio 544

Virtual Office Hours: by appointment

Virtual session URL: Zoom, accessed through Canvas

Prerequisite(s): *Knowledge of Calculus and Probability*

COURSE DESCRIPTION / Overview

This course is designed for advanced undergraduate students and masters students in Financial Engineering. The goal is to learn the foundation on which Finance is built upon. The students are supposed to have a strong background in applied mathematics (analysis and calculus) and probability at an undergraduate level. Any student who does not already have this previous knowledge will have much greater difficulty learning the material.

Relationship of Course to Rest of Curriculum

This course is the basis for the rest of your masters program here in Financial Engineering. The concepts and approaches we discuss here will be seen through-out your studies in this program.

STUDENT LEARNING OUTCOMES / Course Outcomes

At the end of this course, students will be able to:

1. classify stochastic processes as martingales, Markov, or both/neither
2. simplify stochastic (Ito) integrals
3. determine the differentials of functions of stochastic processes
4. change probability measures to facilitate pricing of derivatives
5. solve stochastic differential equations through transformations to partial differential equations.

COURSE FORMAT AND STRUCTURE / Pedagogy

This course's materials are fully online. To access the course, please visit stevens.edu/canvas. For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

Course Logistics

Late Policy

This course will have you submit your homework (and possibly exams) virtually, so the computer will know exactly when your submitted work was received. You should consider all due dates/times as “due by” instead of “due at”. This is because immediately after the due time, the assignment is late. As a result, if an assignment/quiz/anything is due by 11:30 am, then at 11:30:00 am it's late. The late penalty will depend on what type of assignment it is and will be explicitly stated in advance. Don't wait until the minute before to try and submit your work because internet lag is not an excusable reason for why your submission is late. **Also if you are in a section of the world that is not in the same time zone as Hoboken, please be aware that all due dates and times are with respect to Hoboken local time.**

Homework

There will be around 5 homework assignments throughout the semester. Collaboration is encouraged as it can be helpful to understand some of these concepts. Do not confuse collaboration for academic misconduct. Attempt each problem on your own before seeking help from another person. Make sure that you understand the entire assignment that you turn in and could reproduce the work or solve a similar problem. Do not think that you can simply copy another person's assignment and expect to understand the material. Late homeworks will be accepted under the following policy: for every day that the homework is late, it will lose 10 points off its score.

Homework assignments can be considered to consist of two separate components. The required component which will be graded, and the recommended component which will just be scanned to confirm it was attempted. Both parts need to be your own work and should not be copied in any way. For the recommended part, if all of the problems are attempted, you can earn up to 5 bonus points per assignment.

These homework assignments should be where you feel comfortable making your mistakes, with little consequences. Also uploaded to Canvas, there is a document showing the difference between exam grading and homework grading. The homework is graded much more leniently to allow you to learn how to accomplish the tasks. Please do your own work so that you can get your individual feedback to help you learn.

Homeworks should be pledged (see details below). Any homework that is not pledged will receive no credit until it is pledged.

Exams

There will be one midterm and one final exam given in the class. If you miss an exam, you must provide a written explanation signed by proper authorities in order to be allowed the chance to take a replacement exam. Any exam taken through Canvas will be timed and you will be expected to upload your final answers, much like the format of the homeworks. These exams will be made available for a duration (on Saturdays EST) in which you will have a 3 hour and fifteen minute window in which to submit your exam. This window is 3 hours to take the exam, and fifteen minutes to submit it. **You should stop working on your exam after the three hour mark and immediately begin submitting.** I don't expect it to take the full fifteen minutes to submit your file, that amount of time is to cover possible issues in either compiling or uploading. Once you begin the exam, your answers MUST be submitted before the 3.25 hour window expires (the only exception to this being if you start the exam with less than the 3.25 hours remaining in the duration, you will end up with less time available so start before then to get the full 3.25 hours).

If you don't manage to submit your exam within 3.25 hours, you can still submit it through email or other sources, but **you will lose 10 points every minute that the exam is late** (including for the first second, just like with the homeworks). The time that will be observed for applying this late penalty will be the time that my email shows it arriving, not what time your computer shows it being sent (so avoid this by submitting your assignment as early as possible). Again, this is with respect to Hoboken local time.

Classes

The in-class section meets on Thursday afternoons from 3:30 to 6PM. You must comply with the Stevens Health Honor Code when attending class. These sessions are open to anyone from either section who wants to attend, but priority of seating goes to those registered for the in-class section (I don't think this would be a problem, but just in case I'm putting this in writing here).

Instructor's Online Hours

I will be available via email and will respond as soon as I am available (generally within 48 hours during the week. If its been longer than that, its very possible I missed it so feel free to check back in). When emailing me, please place in the subject line the course number/section and the topic of the email (i.e. FE 610A – Assignment 2 Question).

Virtual Office Hours

If you would like to meet with me online to get some answers for questions, you can email me and we can try and set up a time to meet (virtually).

Online Etiquette Guidelines

Your instructor and fellow students wish to foster a safe online learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea but you are not to attack an individual. Our differences, some of which are outlined in the University's inclusion statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambience. Please read the Netiquette rules for this course:

- Do not dominate any discussion. Give other students the opportunity to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language. This could possibly lead to misinterpretation.
- Keep an "open-mind" and be willing to express even your minority opinion.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.

TENTATIVE COURSE SCHEDULE

	Topic(s)	Reading(s)
Week 1	Probability review: Random variables and vectors. Stochastic processes.	Ch. 1 and 2
Week 2	Random walk. Brownian motion.	Ch. 3
Week 3	Markov Property, Reflection Principle and Passage Times	Ch. 3
Week 4	Stochastic Calculus(Integrands)	Ch. 4
Week 5	Ito lemma and applications	Ch. 4
Week 6	Black-Scholes- Merton Model	Ch. 4
Week 7	Multivariable Stochastic Calculus	Ch. 4
Week 8	Midterm	

Week 9	Risk-Neutral Measure and Girsanov	Ch. 5
Week 10	Multidimensional Stock Model	Ch. 5
Week 11	PDE's and SDE's	Ch. 6
Week 12	Poisson Processes and Jump Diffusion	Ch. 11
Week 13	Exotic Options	Ch. 7
Week 14	Review & Catch-up	

COURSE MATERIALS

Textbook(s): *Stochastic Calculus for Finance vol II*, by Steven E. Shreve, Springer Finance, 2004, ISBN-13: 978-0387401010.

Readings: Chapters 1-7, and 11

Additional Readings

These textbooks are completely optional. Some students have found them useful and some haven't.

- *Introduction to Probability Models*, 10th edition, by Sheldon M. Ross, Academic Press, 2009, ISBN-10: 0123756863, ISBN-13: 978-0123756862.
- *Stochastic Calculus for Finance vol I*, by Steven E. Shreve, Springer Finance, 2004, ISBN-13: 978-0387249681 (vol I).
- *Probability and Random Processes*, by Geoffrey Grimmett and David Stirzaker, Oxford University Press 2001.
- *Stochastic Differential Equation*, by Bernt Oksendal, 6th edition, 2010, ISBN-10: 3540047581, ISBN-13: 978-3540047582
- *Introduction to the Mathematics of Financial Derivatives*, by Salih N Neftci, 2nd ed, Associated Press, 2000, ISBN 0125153929.

TECHNOLOGY REQUIREMENTS

Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Canvas

Technology skills necessary for this specific course

- Live web conferencing using Zoom
- Compiling pdfs

Required Equipment

- Computer with internet to access the course
- Preferred use for accessing the Q and A sessions is a headset with headphones and a microphone

Required Software

- None, other than what is necessary to create pdfs

GRADING PROCEDURES

Grades will be based on:

Homeworks	25%
Midterm	30%
Final Exam	45%

Note that your grade in this class will be based solely on your performance in this class. No outside influences will be taken into consideration when determining if you pass this course.

Extensions and Re-submits

It is my policy to never give a student an extension after a deadline is missed. You know before you actually miss a deadline that you will miss the deadline. If you reach out to me before an assignment is due and let me know why you will miss the deadline, if its a valid reason (and this does not have to include medical issues, I realize that sometimes life just gets in the way) I have no problem providing an extension if necessary.

I will under very rare circumstances allow a student to re-submit an assignment that has already been submitted, but it is my policy to not allow a re-submit of an assignment once it has been graded. Once the assignment has been graded, you now possess much better information than the average student and it is therefore unfair to the others in the class to allow this.

Extra Credit

Possibly on an assignment, there will be the occasional extra credit problem. These are the only source of extra credit for the course. There are no "extra assignments" that students can do to raise their average outside of the ones assigned. There are no exceptions, don't even bother coming to me and asking about extra work and the end of the semester, as I will only direct your attention to this part of the syllabus.

Academic Integrity

Generative AI Technologies

You may not submit any work generated by an AI program as your own. If you include material generated by an AI program, it should be cited like any other reference material (with due consideration for the quality of the reference, which may be poor).

Any plagiarism or other form of cheating will be dealt with under relevant Stevens policies.

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at <http://web.stevens.edu/honor/>

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student

to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics.

The following statement is printed in the Stevens Graduate Catalog and applies to all students taking Stevens courses, on and off campus.

“Cheating during in-class tests or take-home examinations or homework is, of course, illegal and immoral. A Graduate Academic Evaluation Board exists to investigate academic improprieties, conduct hearings, and determine any necessary actions. The term ‘academic impropriety’ is meant to include, but is not limited to, cheating on homework, during in-class or take home examinations and plagiarism.”

Consequences of academic impropriety are severe, ranging from receiving an “F” in a course, to a warning from the Dean of the Graduate School, which becomes a part of the permanent student record, to expulsion.

Reference: The Graduate Student Handbook, Academic Year 2003-2004 Stevens Institute of Technology, page 10.

Consistent with the above statements, all homework exercises, tests and exams that are designated as individual assignments MUST contain the following signed statement before they can be accepted for grading.

I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination. I further pledge that I have not copied any material from a book, article, the Internet or any other source except where I have expressly cited the source.

Signature _____

Date: _____

Please note that assignments in this class may be submitted to www.turnitin.com, a web-based anti-plagiarism system, for an evaluation of their originality.

More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics.

Assignments that are not pledged will receive 0 credit until they are pledged.

Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

EXAM/QUIZ CONDITIONS

The following procedures apply to quizzes and exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Conditions on the quiz or exam.

1. Students may use the following materials during quizzes and/or exams. Any materials that are not mentioned in the list below are not permitted.

Material	Permitted?	
	Yes	No
Handwritten Notes Conditions: i.e. size of note sheet	x	
Typed Notes Conditions: i.e. size of note sheet	x	
Textbooks Conditions: i.e. specific books	x	
Readings Conditions: i.e. specific documents	x	
Other (specify)		X, no surfing the net

2. Students are/are not allowed to work with or talk to other students during quizzes and/or exams.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and

coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit <https://www.stevens.edu/office-disability-services>. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone 201-216-3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression) and who can visit the office in person. CAPS is open from 9:00 am – 5:00 pm Mondays, Wednesdays, Thursdays and Fridays and from 9:00 am – 7:00 pm on

Tuesdays during the Fall and Spring semesters; appointments are highly encouraged. For those students who cannot visit the Stevens campus for an in-person appointment, you can contact a local mental health care provider for an in-person appointment, or if you are enrolled in the Stevens Student Health Insurance, you may call Care Connect for 24/7 mental health support at 1-888-857-5462.

For further information please visit the CAPS webpage on [Seeking Help Off-Campus](#).

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.