FIN 519
Stochastic Finance
Module 3, 2025-2026

Course Information

Instructor: Yu SUN (孙羽)
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Office Hour: Wednesday 2:00 PM–4:00 PM; Tuesday & Friday 4:00 PM–5:00 PM

Teaching Assistant: TBD
Phone:
Email:
Office Hour:

Classes:
Lectures: Tuesday & Friday 10:30 AM – 12:20 PM
Venue: PHBS Building, Room

Course Website:
TBD

1. Course Description

1.1 Context

Course overview:
This course provides an introduction to stochastic calculus, a fundamental tool in continuous-time finance, and explores the risk-neutral pricing theory in financial engineering. Practical examples will illustrate applications in option pricing and financial modelling. The course is structured as follows:

- A review of general probability theory.
- Brownian motion and its properties.
- Ito's formula and Black-Scholes option pricing theory.
- Risk-neutral pricing and the fundamental theorems of asset pricing.
- Stochastic differential equations and the Feynman-Kac formula.
- Financial derivatives with various payoff structures (European-style, American-style and Exotic options).
- Stochastic optimal control theory with applications in finance.

Prerequisites:

Calculus, Linear Algebra and Probability.

1.2 Textbooks and Reading Materials

Textbook:
S. E. Shreve, Stochastic Calculus for Finance II: Continuous-Time Models. Springer.

Reading Materials:
Lecture Notes and Slides.

S. E. Shreve, Stochastic Calculus for Finance I: The Binomial Asset Pricing Model. Springer.

T. Bjork, Arbitrage Theory in Continuous Time. 3rd Edition. Oxford University Press.

2. Learning Outcomes

2.1 Intended Learning Outcomes

Learning Goals	**Objectives**	**Assessment (YES with details or NO)**
1. Our graduates will be effective communicators.	1.1. Our students will produce quality business and research-oriented documents.	YES
	1.2. Students are able to professionally present their ideas and also logically explain and defend their argument.	YES
2. Our graduates will be skilled in team work and leadership.	2.1. Students will be able to lead and participate in group for projects, discussion, and presentation.	YES
	2.2. Students will be able to apply leadership theories and related skills.	NO
3. Our graduates will be trained in ethics.	3.1. In a case setting, students will use appropriate techniques to analyze business problems and identify the ethical aspects, provide a solution and defend it.	NO
	3.2. Our students will practice ethics in the duration of the program.	NO
4. Our graduates will have a global perspective.	4.1. Students will have an international exposure.	YES
5. Our graduates will be skilled in problem-solving and critical thinking.	5.1. Our students will have a good understanding of fundamental theories in their fields.	YES
	5.2. Our students will be prepared to face problems in various business settings and find solutions.	YES
	5.3. Our students will demonstrate competency in critical thinking.	YES

2.2 Course specific objectives

By the end of this course, students will:

1. Understand the fundamental concepts of stochastic calculus and risk-neutral pricing to derive the prices of financial derivatives with various payoff structures.
2. Apply appropriate stochastic differential equation (SDE) models to characterize the dynamics of financial market variables.
3. Utilize stochastic optimal control theory to model problems in quantitative finance and solve them using Hamilton-Jacobi-Bellman equations.

2.3 Assessment/Grading Details

Tentative weights are as below:
Assignments 35%, Mid-term Exam 30%, Final Exam 35%.

2.4 Academic Honesty and Plagiarism

It is important for a student's effort and credit to be recognized through class assessment. Credits earned for a student work due to efforts done by others are clearly unfair. Deliberate dishonesty is considered academic misconducts, which include plagiarism; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work;

taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; or altering, forging, or misusing a University academic record; or fabricating or falsifying of data, research procedures, or data analysis.

All assessments are subject to academic misconduct check. Misconduct check may include reproducing the assessment, providing a copy to another member of faculty, and/or communicate a copy of this assignment to the PHBS Discipline Committee. A suspected plagiarized document/assignment submitted to a plagiarism checking service may be kept in its database for future reference purpose.

Where violation is suspected, penalties will be implemented. The penalties for academic misconduct may include: deduction of honour points, a mark of zero on the assessment, a fail grade for the whole course, and reference of the matter to the Peking University Registrar.

AI tools requirements:
Assignments should be completed independently with original thought. AI tools may be used to aid in understanding related mathematical concepts but must not be used to generate answers directly. Any violation of this rule will result in a score of zero for the assignment.

For more information of plagiarism, please refer to PHBS Student Handbook.

3. Topics, Teaching and Assessment Schedule

Week	Date	Topics (Subject to changes)
Week 1	Mar 3 and 6	Review of Probability Theory; One-Period Financial Market Model
Week 2	Mar 10 and 13	Information and Conditioning; Random Walk; Brownian Motions
Week 3	Mar 17 and 20	Ito Integral and Ito Processes; Ito Formula
Week 4	Mar 24 and 27	Black-Scholes Option Pricing Theory; Change-of-Measure and Girsanov Theorem; Risk-Neutral Pricing
Week 5	May 31 and Apr 3	Fundamental Theorems of Asset Pricing; **Midterm Exam during class time on Apr 3**
Week 6	Apr 7 and 10	Stochastic Differential Equations; Feynman-Kac Theorem
Week 7	Apr 14 and 17	First Passage Times of Brownian Motion; Exotic Option Pricing (Barrier, Lookback, and Asian Options)
Week 8	Apr 21 and 22	American Derivative Securities
Week 8 & 9	Apr 24 and 28	Stochastic Optimal Control Theory with Applications in Finance
	Apr 30	**Final Exam (4:00pm-6:00pm)**

4. Miscellaneous

- Both the midterm and final examinations are closed-book; however, an A4-sized two-sided cheat sheet is allowed.
- Grade in letters (e.g., A+, A, A-, ..., D+, D, F). A- or above < 30% and B- or below > 10%.