EF5250: STOCHASTIC CALCULUS FOR FINANCE

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Stochastic Calculus for Finance

Subject Code
EF - Economics and Finance

Course Number
5250

Academic Unit
Economics and Finance (EF)

College/School
College of Business (CB)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
This course is designed to enhance students' mathematical ability, and equip them with the basic knowledge and skills of stochastic calculus for financial applications. Students will be introduced to stochastic processes, Brownian motion, and Ito

calculus. Student will learn how to use quantitative analysis to derive the Black-Scholes formula for various types of options (European options, etc). At the end of this course students will be able to price various types of options and construct hedging strategies. The course also aims to develop students' creative and innovative abilities through various assessment tasks that involve the discovery and innovative process. Classes will encourage students to develop their discovery abilities through problem solving and class discussions. Stress will also be placed on common pricing and hedging problems in global financial markets to help students to discover the basic knowledge in the finance industry. Assignments will require students to discover and innovate through the use of mathematical concepts. Students will get to know how to use these theories to come up with their own analyses on different financial products. The final exam which covers topics discussed in the lectures and tutorials will reveal the students' accomplishments in discovery and innovation.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the theory and modelling of stochastic processes. Discovering the rationale behind the quantitative analysis.	25	x	x	x
2	Design and discover discrete time models and Brownian motion equations to address financial problems and construct innovative solutions.	20	x	x	x
3	Justify and apply Ito’s calculus. Demonstrate the ability to derive Ito’s formula to solve stochastic differential equations with innovative insights.	20	x	x	
4	Derscribe the Black-Scholes Formula by using partial differential equations (PDEs). Discovering the logic behind the Black-Scholes Formula a widely used formula.	25	x		
5	Design delta and gamma hedging strategies. Demonstrate the ability to generate innovative solutions towards risk management problems.	10	x		

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Students will engage in formal lecture which will introduce basic concepts and structure. Students are expected to discover the theory on stochastic calculus and understand the modelling on asset valuation, followed by the hedging functions of various financial products.	1, 2, 3, 4, 5	2 hours per week
2	Tutorial and in-class discussion	Students will be encouraged to think critically and logically by responding to questions and solving the problems by themselves to apply knowledge and theory. Even though the suggested solutions may be given, this process motivates students to be innovative. Through active in-class discussion, the communication skills of students will also be enhanced.	1, 2, 3, 4, 5	1 hour per week

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignments: Students will perform analyses on various modelling problems. They will be required to apply mathematical theories to generate innovative solutions for certain problems facing the finance industry.	1, 2, 3, 4, 5	50	For assignments, students can use Generative Artificial Intelligence Tools to help them understand the concepts/ questions/ problems, or analyze data. But the final version must be their own work, e.g., students cannot copy and paste the AI answers as their own answers.	Yes

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

3

Additional Information for ATs

The final examination which covers topics discussed in lectures and tutorials, will also reveal the students' accomplishments of discovery and innovation.
Students are not allowed to use Generative Artificial Intelligence Tools in the final examination.

Assessment Rubrics (AR)

Assessment Task

Final Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Ability to apply the theory of stochastic calculus and explain its concepts

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Capacity for discovering/ deriving results complementing the theory of stochastic calculus covered by the lectures and for applying the theory

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task
Final Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Ability to apply the theory of stochastic calculus and explain its concepts

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Capacity for discovering/ deriving results complementing the theory of stochastic calculus covered by the lectures and for applying the theory

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

a. Partial Differential Equations
b. Two-instants model
c. N-instants model
d. Self-financing portfolio
e. Risk neutral measure
f. Arbitrage opportunity
g. Market completeness

h. Filtration
i. Brownian motion
j. Stochastic processes
k. Itô formula
l. Black-Scholes Formula
m. Delta hedging
n. Gamma hedging

Reading List

Compulsory Readings

	Title
1	Stochastic Calculus for Finance II: Continuous-Time Models by Steven E. Shreve, Springer Finance.

Additional Readings

	Title
1	Stochastic Calculus and Financial Applications by J. Michael Steele.
2	An Introduction to Measure Theory by T. Tao, American Mathematical Society.