City University of Hong Kong
Course Syllabus

offered by College/School/Department of <u>Mathematics</u>
with effect from Semester <u>A 2024 / 2025</u>

Part I   **Course Overview**

Course Title: **Advanced Stochastic Analysis in Finance**

Course Code: **MA6629**

Course Duration: **1 semester**

Credit Units: **3**

Level: **P6**

**Medium of
Instruction:**   **English**

**Medium of
Assessment:**   **English**

Prerequisites:
(Course Code and Title)   **Nil**

Precursors:
(Course Code and Title)   **Nil**

Equivalent Courses:
(Course Code and Title)   **Nil**

Exclusive Courses:
(Course Code and Title)   **Nil**

Part II   Course Details

1.   **Abstract**

This course aims to introduce concepts and techniques in advanced probability theory and continuous time stochastic processes, as well as their applications to the real-world financial models in depth. It introduces measure-theoretic based stochastic calculus and builds up the connections with partial differential equations of Black-Scholes type.

2.   **Course Intended Learning Outcomes (CILOs)**
(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Formulate measure-theoretic framework for probability theory required for a treatment of continuous time models.	20	✓		
2.	Introduce the Brownian motion and stochastic calculus using Ito's integral and the development of Ito's formula.	30	✓	✓	
3.	Explain Girsanov's theorem and risk-neutral pricing, and introduce a systematic treatment of risk-neutral pricing and the Fundamental Theorems of Asset Pricing	25	✓	✓	✓
4.	Develop the connection between partial differential equation and stochastic calculus, and apply it to derivative pricing and risk hedging.	25	✓	✓	✓
		100%			

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.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.						Hours/week
		1	2	3	4	5	6	(if applicable)
teaching	Learning through teaching is primarily based on lectures.	✓	✓	✓	✓			3 hours/week
take-home assignments	Learning through take-home assignments helps students implement advanced theory for better understanding	✓	✓	✓	✓			After-class

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

30% Coursework

70% Examination (Duration: 3 hours, at the end of the semester)

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4	5	6		
Continuous Assessment: _30_%								
Test	✓	✓					20	
Hand-in assignments	✓	✓	✓	✓			10	
Examination	✓	✓	✓	✓			70	
Examination: 70% (duration: 3 hrs, if applicable)								
							100%	

5. **Assessment Rubrics**

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Test	Problem solving ability	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Hand-in assignments	Comprehensive understanding	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examinations	Creativity and problem solving ability based on comprehensive understanding	High	Significant	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Test	Problem solving ability	High	Significant	Basic	Not even reaching marginal levels
2. Hand-in assignments	Comprehensive understanding	High	Significant	Basic	Not even reaching marginal levels
3. Examinations	Creativity and problem solving ability based on comprehensive understanding	High	Significant	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. **Keyword Syllabus**
    (An indication of the key topics of the course.)

    Brownian motion, Ito's formula, Stochastic differential equation, Girsanov theorem, Greeks

2. **Reading List**
2.1 **Compulsory Readings**
    (Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Course materials provided
2.	
3.	
…	

2.2 **Additional Readings**
    (Additional references for students to learn to expand their knowledge about the subject.)

1.	Stochastic Calculus for Finance II, by Steven Shreve, Springer, 2010
2.	Arbitrage theory in continuous time, by Tomas Björk, Oxford University Press, 3rd edition
3.	
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