

# MA6629: ADVANCED STOCHASTIC ANALYSIS IN FINANCE

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## Effective Term

Semester A 2025/26

## Part I Course Overview

### Course Title

Advanced Stochastic Analysis in Finance

### Subject Code

MA - Mathematics

### Course Number

6629

### Academic Unit

Mathematics (MA)

### College/School

College of Science (SI)

### 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 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.

### Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if DEC-A1 DEC-A2 DEC-A3 app.)			
1	Formulate measure-theoretic framework for probability theory required for a treatment of continuous time models.	20	x		
2	Introduce the Brownian motion and stochastic calculus using Ito' s integral and the development of Ito' s formula.	30	x	x	
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	x	x	x
4	Develop the connection between partial differential equation and stochastic calculus, and apply it to derivative pricing and risk hedging.	25	x	x	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)
teaching	Learning through teaching is primarily based on lectures.	1, 2, 3, 4	3 hours/week
take-home assignments	Learning through take-home assignments helps students implement advanced theory for better understanding	1, 2, 3, 4	After-class

### Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("- " for nil entry)	Allow Use of GenAI?
1	Test	1, 2	20	-	No
2	Hand-in assignments	1, 2, 3, 4	10	-	Yes

**Continuous Assessment (%)**

30

**Examination (%)**

70

**Examination Duration (Hours)**

3

**Minimum Examination Passing Requirement (%)**

30

**Additional Information for ATs**

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 Rubrics (AR)****Assessment Task**

1. Test (for students admitted before Semester A 2022/23 and in Semester A 2024/25 &amp; thereafter)

**Criterion**

Problem solving ability on probability theory and stochastic analysis

**Excellent**

(A+, A, A-) Demonstrates a comprehensive understanding of the probability theory and stochastic analysis and applies them to complex financial problems

**Good**

(B+, B, B-) Adequately demonstrates an understanding of the probability theory and stochastic analysis and applies them to moderately complex financial problems

**Fair**

(C+, C, C-) Demonstrates some understanding of the probability theory and stochastic analysis and applies them to simple financial problems

**Marginal**

(D) Demonstrates limited understanding of the probability theory and stochastic analysis and has limited ability to apply them to simple financial problems

**Failure**

(F) Inappropriately or unable to apply modern statistical method for analysing time series data to solve financial problems

**Assessment Task**

2. Hand-in assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 &amp; thereafter)

**Criterion**

Comprehensive understanding of statistical methods to solve financial problem

**Excellent**

(A+, A, A-) Demonstrates a comprehensive understanding of the probability theory and stochastic analysis and applies them to complex financial problems

**Good**

(B+, B, B-) Adequately demonstrates an understanding of the probability theory and stochastic analysis and applies them to moderately complex financial problems

**Fair**

(C+, C, C-) Demonstrates some understanding of the probability theory and stochastic analysis and applies them to simple financial problems

**Marginal**

(D) Demonstrates limited understanding of the probability theory and stochastic analysis and has limited ability to apply them to simple financial problems

**Failure**

(F) Inappropriately or unable to apply modern statistical method for analysing time series data to solve financial problems

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**Assessment Task**

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

**Criterion**

Creativity and problem solving ability based on comprehensive understanding

**Excellent**

(A+, A, A-) Demonstrates a comprehensive understanding of the probability theory and stochastic analysis and applies them to complex financial problems

**Good**

(B+, B, B-) Adequately demonstrates an understanding of the probability theory and stochastic analysis and applies them to moderately complex financial problems

**Fair**

(C+, C, C-) Demonstrates some understanding of the probability theory and stochastic analysis and applies them to simple financial problems

**Marginal**

(D) Demonstrates limited understanding of the probability theory and stochastic analysis and has limited ability to apply them to simple financial problems

**Failure**

(F) Inappropriately or unable to apply modern statistical method for analysing time series data to solve financial problems

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**Assessment Task**

1. Test (for students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

Problem solving ability on probability theory and stochastic analysis

**Excellent**

(A+, A, A-) Demonstrates a comprehensive understanding of the probability theory and stochastic analysis and applies them to complex financial problems

**Good**

(B+, B) Adequately demonstrates an understanding of the probability theory and stochastic analysis and applies them to moderately complex financial problems

**Marginal**

(B-, C+, C) Demonstrates some understanding of the probability theory and stochastic analysis and applies them to simple financial problems

**Failure**

(F) Inappropriately or unable to apply modern statistical method for analysing time series data to solve financial problems

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**Assessment Task**

2. Hand-in assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

Comprehensive understanding of statistical methods to solve financial problem

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(A+, A, A-) Demonstrates a comprehensive understanding of the probability theory and stochastic analysis and applies them to complex financial problems

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**Failure**

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**Assessment Task**

3. Examinations (for students admitted from Semester A 2022/23 to Summer Term 2024)

**Criterion**

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#### Failure

(F) Inappropriately or unable to apply modern statistical method for analysing time series data to solve financial problems

## Part III Other Information

#### Keyword Syllabus

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

#### Reading List

##### Compulsory Readings

Title	
1	Course materials provided

##### Additional Readings

Title	
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