

# MA5618: STOCHASTIC ANALYSIS IN FINANCE

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## Effective Term

Semester B 2024/25

## Part I Course Overview

### Course Title

Stochastic Analysis in Finance

### Subject Code

MA - Mathematics

### Course Number

5618

### 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 discrete time stochastic processes, as well as their applications to the real-world financial models and risk analysis. It introduces some fundamental

concepts in Markov process, Martingales, Change of measure, and provides a needed preparation for its subsequent course “Advanced Stochastic Analysis in Finance” .

### Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understanding the notions of martingales and Markov chains in discrete time, based on the rigorous framework of probability theory, with a view to analyzing real-world processes.	25	x		
2	Knowing how to use the no-arbitrage method of option pricing in a binomial model for various derivatives.	25	x	x	
3	Being able to express the risk-neutral pricing in terms of martingales and Markov processes, and understanding the change of measure associated with pricing of derivatives of European type.	25	x	x	x
4	Understanding the concept of stopping times, in connection with pricing of derivatives of American type, and other exotic options.	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 (e.g. Parameter for GenAI use)
1	Test	1, 2	20
2	Hand-in assignments	1, 2, 3, 4	10

**Continuous Assessment (%)**

30

**Examination (%)**

70

**Examination Duration (Hours)**

3

**Additional Information for ATs**

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 & thereafter)

**Criterion**

Problem solving ability on stochastic analysis, including martingales and Markov process

**Excellent**

(A+, A, A-) Demonstrates a thorough understanding of the concepts and techniques in the stochastic analysis and can always apply the techniques to solve financial problems

**Good**

(B+, B, B-) Demonstrates a substantial understanding of the concepts and techniques in the stochastic analysis and can usually apply the techniques to solve financial problems

**Fair**

(C+, C, C-) Demonstrates a general understanding of the concepts and techniques in the stochastic analysis and can sometimes apply the techniques to solve financial problems

**Marginal**

(D) Demonstrates a partial understanding of the concepts and techniques in the stochastic analysis and can seldom apply the techniques to solve financial problems

**Failure**

(F) Demonstrates little understanding of the concepts and techniques in the stochastic analysis and can rarely or never apply the techniques to solve financial problems

**Assessment Task**

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

**Criterion**

Comprehensive understanding of financial problem in terms of stochastic analysis

**Excellent**

(A+, A, A-) Demonstrates a thorough understanding of the concepts and techniques in the stochastic analysis and can always apply the techniques to solve financial problems

**Good**

(B+, B, B-) Demonstrates a substantial understanding of the concepts and techniques in the stochastic analysis and can usually apply the techniques 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 thorough understanding of the concepts and techniques in the stochastic analysis and can always apply the techniques to solve financial problems

**Good**

(B+, B, B-) Demonstrates a substantial understanding of the concepts and techniques in the stochastic analysis and can usually apply the techniques 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 stochastic analysis, including martingales and Markov process

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**Part III Other Information****Keyword Syllabus**

Risk-neutral pricing, Martingale, Binomial model, Arbitrage, Delta Hedging

**Reading List****Compulsory Readings**

Title	
1	Course materials provided

**Additional Readings**

Title	
1	Stochastic Calculus for Finance I, by Steven Shreve, Springer; 2004th edition