# MA4529: MATHEMATICAL FINANCE

**Effective Term**
Semester A 2022/23

## Part I Course Overview

**Course Title**
Mathematical Finance

**Subject Code**
MA - Mathematics
**Course Number**
4529

**Academic Unit**
Mathematics (MA)

**College/School**
College of Science (SI)

**Course Duration**
One Semester

**Credit Units**
3

**Level**
B1, B2, B3, B4 - Bachelor's Degree

**Medium of Instruction**
English

**Medium of Assessment**
English

**Prerequisites**
MA3521 Introductory Mathematical Finance

**Precursors**
Nil

**Equivalent Courses**
Nil

**Exclusive Courses**
Nil

# Part II Course Details

**Abstract**

This course provides fundamental concepts of probability theory, stochastic processes and option pricing. It helps students understand the mathematical concepts of stochastic processes and apply the knowledge to a range of problems in finance.

**Course Intended Learning Outcomes (CILOs)**

|   | CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|---|-------|---------------------|--------|--------|--------|
| 1 | explain clearly concepts from advanced probability and stochastic processes. | 15 | x | | |
| 2 | formulate financial phenomena in terms of Brownian motions and stochastic processes. | 15 | x | x | |
| 3 | describe basic principles of quantitative finance, including no arbitrage and risk hedging. | 20 | | x | x |
| 4 | apply the Black-Scholes formula in pricing options. | 15 | | x | |
| 5 | apply mathematical methods in deriving analytic relations among financial variables. | 15 | | x | x |
| 6 | the combination of CILOs 1-5 | 20 | 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.

**Teaching and Learning Activities (TLAs)**

|   | TLAs | Brief Description | CILO No. | Hours/week (if applicable) |
|---|------|------------------|----------|----------------------------|
| 1 | Lectures | Learning through teaching is primarily based on lectures. | 1, 2, 3, 4, 5, 6 | 39 hours in total |
| 2 | Take-home assignments | Learning through take-home assignments helps students understand advanced probability theory, stochastic processes, principles of quantitative finance and simple applications in modeling financial markets. | 1, 2, 3, 4, 5 | after-class |

**Assessment Tasks / Activities (ATs)**

|  | ATs | CILO No. | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|---|---|---|---|---|
| 1 | Test | 1, 2, 3 | 20 | Questions are designed for the first part of the course to see how well the students have learned concepts of advanced probability, stochastic processes and mathematical principles of financial economics. |
| 2 | Hand-in assignments | 1, 2, 3, 4, 5 | 10 | These are skills based assessment to help students understand advanced concepts of probability, stochastic processes and some applications in quantitative finance and option pricing. |
| 3 | Formative take-home assignments | 1, 2, 3, 4, 5 | 0 | The assignments provide students chances to demonstrate their achievements in applying concepts of mathematical finance learned from this course. |

**Continuous Assessment (%)**

30

**Examination (%)**

70

**Examination Duration (Hours)**

3

**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

**Criterion**

Ability in problem solving

**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

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**Assessment Task**
2. Hand-in assignments

**Criterion**
Understanding of concepts and applications

**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

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**Assessment Task**
3. Formative take-home assignments

**Criterion**
Study attitude

**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

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**Assessment Task**

4. Examination

**Criterion**

Comprehensive ability in independent problem solving

**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

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# Part III Other Information

**Keyword Syllabus**

Contracts, Vanilla options, American type options, exotic options, put-call parity, no arbitrage, game theory, replicating portfolio, risk-free portfolio, binomial trees, martingale methods, Black-Scholes formulas, Itô's lemma, stochastic derivatives, hedging portfolio.

**Reading List**

**Compulsory Readings**

|   | Title |
|---|-------|
| 1 | John C. Hull, Options, Futures, and other Derivatives, Prentice Hall. |
| 2 | Paul Wilmott, Sam Howison, and Jeff Dewynne, The Mathematics of Financial Derivatives, Cambridge University Press. |

**Additional Readings**

|   | Title |
|---|-------|
| 1 | Rüdiger U. Seydel, Tools for Computational Finance, Springer. |