MA3521: INTRODUCTORY MATHEMATICAL FINANCE

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
Introductory Mathematical Finance

Subject Code
MA - Mathematics
Course Number
3521

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
MA2506 Probability and Statistics; or
MA2510 Probability and Statistics

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course introduces students to the financial instruments used in modern financial practice, particularly forward contracts and options. The emphasis is on developing the concept of risk-neutrality and the financial and mathematical theory underlying the behaviour of these financial instruments and preparing students with knowledge to solve related problems. Students should have a basic understanding of probability concepts to be properly prepared for this course.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain the concept of a forward contract, a call option and a put option, and recognize the mathematical and logical relationships among them.		x		
2	apply the concept of no-arbitrage to the pricing of forward contracts.		x	x	
3	describe the various basic option strategies (basic instrument of portfolio for trading strategies) and their objectives.		x	x	x
4	explain the concept of risk-neutrality and risk-free rate of interest.		x	x	
5	construct a binomial tree for stock prices and apply it to evaluate the no-arbitrage price of an option and the assumptions needed for the price to be valid.		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	Lecture	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	39 hours in total

2	Take-home assignments	Learning through take-home assignments helps students implement fundamental concepts and theory of financial instruments as well as model their applications in financial markets.	1, 2, 3, 4, 5	after-class
3	Math Help Centre	Learning through project helps students apply principles of quantitative finance and financial economics to analyze financial instruments in contemporary financial markets. It also helps students to communicate and collaborate effectively in the team.	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 mathematical concepts of forward contracts and options, as well as techniques of derivatives pricing.
2	Hand-in assignments	1, 2, 3, 4, 5	10	These are skills-based assessment to help students implement basic concepts of quantitative finance, mathematical theory and pricing strategies of financial instruments.

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 to APPLY the fundamental concepts and methodology of financial derivatives, option pricing and risk hedging

Excellent (A+, A, A-)

High
Demonstrate an excellent understanding of Pricing model and can always apply this understanding to different financial derivatives.

Good (B+, B, B-)

Significant
Demonstrate an understanding of Pricing model and can usually apply this understanding to different financial derivatives.

Fair (C+, C, C-)

Moderate
Demonstrate a partial understanding of Pricing model and can sometimes apply this understanding to different financial derivatives.

Marginal (D)

Basic
Demonstrate little understanding of Pricing model and can rarely apply this understanding to different financial derivatives.

Failure (F)

Not even reaching marginal levels

Assessment Task

2. Hand-in assignments

Criterion

CAPACITY for LEARNING to understand and apply the principles and different methods of mathematic finance

Excellent (A+, A, A-)

High
Well organized with correct answers.

Good (B+, B, B-)

Significant
Organized and most answers are correct.

Fair (C+, C, C-)

Moderate
Organization needs to improve, some correct answers.

Marginal (D)

Basic
Very weak evidence of organization, a few correct answers.

Failure (F)
Not even reaching marginal levels

Assessment Task
4. Examination

Criterion
ABILITY to APPLY the fundamental concepts and methodology for the comprehensive problem solving of mathematic finance

Excellent (A+, A, A-)
High
Well organized. with correct answers. Mathematical terms and symbols are often elaborated upon.

Good (B+, B, B-)
Significant
Organized and most answers are correct. Mathematical terms and symbols are used appropriately.

Fair (C+, C, C-)
Moderate
Organization needs to improve, some correct answers. Some mathematical terms and symbols are used correctly.

Marginal (D)
Basic
Very weak evidence of organization, a few correct answers.
Mathematical terms and symbols are weak, not even refers to mathematical terms are used.

Failure (F)
Not even reaching marginal levels

Part III Other Information

Keyword Syllabus
- Forward contracts, options, payoff, and no-arbitrage profit;
- Option strategies and combinations;
- Interest rate and Risk-neutrality;
- Call and Put options, put-call parity on options;
- Binomial tree for stock option pricing model: Random Walk, Brownian Motion, Martingale;
- Binomial tree for pricing exotic options such as barrier option and Asian option.

Reading List

Compulsory Readings

	Title
1	John C. Hull, Options, Futures, and other Derivatives, Prentice Hall.

Additional Readings

	Title
1	Robert L. McDonald, Derivatives Markets. Addison-Wesley.