

MA6623: ADVANCED MATHEMATICAL METHODS FOR FINANCE AND ACTUARIAL SCIENCE

Effective Term

Semester A 2025/26

Part I Course Overview

Course Title

Advanced Mathematical Methods for Finance and Actuarial Science

Subject Code

MA - Mathematics

Course Number

6623

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

MA5621 Mathematical Methods for Finance and Actuarial Science; fundamentals of statistics and probability theory

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

This course aims to present the collective risk model that allows for modeling the accumulated claim process of an insurance company; introduce the usual reinsurance treaties and their quantitative properties; and examine the premium principles and risk measures in risk management

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Construct probability models for assessing risks in dynamic situations of actuarial practice.	20	x	x	
2	Implement methods of one-period collective risk model to evaluate distribution of accumulated claim.	20	x	x	x
3	Evaluate numerically insurance and reinsurance premium by deterministic or stochastic (Monte Carlo) methods.	20	x	x	x
4	Explain clearly properties of premium principles and risk measures, and apply them to quantify risks of insurance industries.	20	x	x	x
5	Apply more advanced mathematical and computational techniques to practical problems involving insurance and risk management.	20	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)
1	Teaching	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	3 hours/week
2	Take-home assignments	Learning through take-home assignments helps students implement more advanced mathematical and modelling techniques to approach problems of insurance and risk management.	1, 2, 3, 4, 5	After-class

3	Project(s)	Learning through project(s) enables students to apply numerical and computational techniques in practical situations involving risk assessment and premium calculation.	5	After-class
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Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("- " for nil entry)	Allow Use of GenAI?
1	Test	1, 2, 3	20	Questions are designed for the first part of the course to see how well students have learned the methods of collective risk model and insurance/reinsurance premium computation.	No
2	Hand-in assignments	1, 2, 3, 4, 5	10	These are skills based assessment which enables students to implement mathematical and numerical methods of collective risk model and practical risk management.	Yes
3	Project	5	20	Students are assessed on their ability in applying quantitative and computational methods of risk management and premium evaluation to real life scenarios, as well as on the presentation of results with analysis.	Yes

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

3

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

50% Coursework

50% 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.

Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be skills and understanding based to assess the student's versatility in advanced methods of premium calculation and risk measures.

Assessment Rubrics (AR)

Assessment Task

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

Criterion

Ability to apply basic concepts of the advanced mathematical models and statistical methods to solve problems

Excellent

(A+, A, A-) Consistently demonstrates a thorough understanding of the advanced mathematical models and statistical methods and can always apply them to solve financial problems

Good

(B+, B, B-) Adequately demonstrates an understanding of the advanced mathematical models and statistical methods and can usually apply them to solve financial problems

Fair

(C+, C, C-) Demonstrates some understanding of the advanced mathematical models and statistical methods and can sometimes apply them to solve financial problems

Marginal

(D) Demonstrates limited understanding of the advanced mathematical models and statistical methods and can seldom apply them to solve financial problems

Failure

(F) Demonstrates little understanding of the advanced mathematical models and statistical methods and cannot apply them 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 advanced mathematical and computational techniques

Excellent

(A+, A, A-) Consistently demonstrates a thorough understanding of the mathematical and computational techniques and can always apply the techniques to solve complex problems

Good

(B+, B, B-) Adequately demonstrates an understanding of the mathematical and computational techniques and can usually apply the techniques to solve problems

Fair

(C+, C, C-) Demonstrates some understanding of the mathematical and computational techniques and can sometimes apply the techniques to solve simple problems

Marginal

(D) Demonstrates limited understanding of the mathematical and computational techniques and can seldom apply the techniques to solve simple problems

Failure

(F) Demonstrates little understanding of the mathematical and computational techniques and cannot apply the techniques to solve simple problems

Assessment Task

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

Criterion

Real data analytic ability and software usage to solve practical problems involving insurance and risk management.

Excellent

(A+, A, A-) Demonstrates a comprehensive understanding of the advanced mathematical models and statistical methods and strong ability in programming to solve relevant problems in finance

Good

(B+, B, B-) Demonstrates an understanding of the advanced mathematical models and statistical methods and ability in programming to solve relevant problems in finance

Fair

(C+, C, C-) Demonstrates some understanding of the advanced mathematical models and statistical methods and ability in programming to solve simple problems in finance

Marginal

(D) Demonstrates limited understanding of the advanced mathematical models and statistical methods and limited ability in programming to solve simple problems in finance

Failure

(F) Demonstrates little understanding of the advanced mathematical models and statistical methods and is unable to solve simple problems in finance

Assessment Task

4. Examination (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-) Consistently demonstrates a thorough understanding of the advanced mathematical models and statistical methods and can always apply them to solve complex problems

Good

(B+, B, B-) Adequately demonstrates an understanding of the advanced mathematical models and statistical methods and can usually apply them to solve problems

Fair

(C+, C, C-) Demonstrates some understanding of the advanced mathematical models and statistical methods and can sometimes apply them to solve simple problems

Marginal

(D) Demonstrates limited understanding of the advanced mathematical models and statistical methods and can seldom apply them to solve simple problems

Failure

(F) Demonstrates little understanding of the advanced mathematical models and statistical methods and cannot apply them to solve simple problems

Assessment Task

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

Criterion

Ability to apply basic concepts of the advanced mathematical models and statistical methods to solve problems

Excellent

(A+, A, A-) Consistently demonstrates a thorough understanding of the advanced mathematical models and statistical methods and can always apply them to solve financial problems

Good

(B+, B) Adequately demonstrates an understanding of the advanced mathematical models and statistical methods and can usually apply them to solve financial problems

Marginal

(B-, C+, C) Demonstrates some understanding of the advanced mathematical models and statistical methods and can sometimes apply them to solve financial problems

Failure

(F) Demonstrates little understanding of the advanced mathematical models and statistical methods and cannot apply them to solve financial problems

Assessment Task

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

Criterion

Comprehensive understanding of advanced mathematical and computational techniques

Excellent

(A+, A, A-) Consistently demonstrates a thorough understanding of the mathematical and computational techniques and can always apply the techniques to solve complex problems

Good

(B+, B) Adequately demonstrates an understanding of the mathematical and computational techniques and can usually apply the techniques to solve problems

Marginal

(B-, C+, C) Demonstrates some understanding of the mathematical and computational techniques and can sometimes apply the techniques to solve simple problems

Failure

(F) Demonstrates little understanding of the mathematical and computational techniques and cannot apply the techniques to solve simple problems

Assessment Task

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

Criterion

Real data analytic ability and software usage to solve practical problems involving insurance and risk management.

Excellent

(A+, A, A-) Demonstrates a comprehensive understanding of the advanced mathematical models and statistical methods and strong ability in programming to solve relevant problems in finance

Good

(B+, B) Demonstrates an understanding of the advanced mathematical models and statistical methods and ability in programming to solve relevant problems in finance

Marginal

(B-, C+, C) Demonstrates some understanding of the advanced mathematical models and statistical methods and ability in programming to solve simple problems in finance

Failure

(F) Demonstrates little understanding of the advanced mathematical models and statistical methods and is unable to solve simple problems in finance

Assessment Task

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

Criterion

Creativity and problem solving ability based on comprehensive understanding

Excellent

(A+, A, A-) Consistently demonstrates a thorough understanding of the advanced mathematical models and statistical methods and can always apply them to solve complex problems

Good

(B+, B) Adequately demonstrates an understanding of the advanced mathematical models and statistical methods and can usually apply them to solve problems

Marginal

(B-, C+, C) Demonstrates some understanding of the advanced mathematical models and statistical methods and can sometimes apply them to solve simple problems

Failure

(F) Demonstrates little understanding of the advanced mathematical models and statistical methods and cannot apply them to solve simple problems

Part III Other Information

Keyword Syllabus

The accumulated claim process. Reinsurance. Risk management: premium principles and risk measures.

Reading List

Compulsory Readings

Title	
1	Mathematical Models of Financial Derivatives by Y. K. Kwok, Springer, 1998.

Additional Readings

Title	
1	Derivatives Markets, by R. L. McDonald