

# MA6622: STATISTICAL METHODS AND CALIBRATION IN FINANCE AND ACTUARIAL SCIENCE

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**Effective Term**

Semester A 2025/26

## Part I Course Overview

**Course Title**

Statistical Methods and Calibration in Finance and Actuarial Science

**Subject Code**

MA - Mathematics

**Course Number**

6622

**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 econometric theory and calibration methods applied to finance and insurance engineering, e.g. in implementation of interest rate models;
- provide up-to-date knowledge of econometrics and calibrations for financial and economic time series, with emphasis on theories, case studies and use of software;
- develop theory of relative-value and hedging progressively with a “financial engineering approach” ; and
- focus on specific aspects of pricing and hedging and with problems that a technical analyst or trader has to consider in practice.

### Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Implement econometric techniques in estimation and analysis of financial econometric models, including the Capital Asset Pricing Model.	15	x	x	
2	Apply advanced time series models to empirical analysis and forecasting of financial time series data.	25	x	x	x
3	Explain clearly the concept of value at risk with normal/lognormal returns and computation of which via Monte Carlo approach.	15	x	x	
4	Perform calibration methods in Black-Scholes model, binomial trees and one factor diffusion models.	15	x	x	x
5	Describe quantitative properties of option pricing and interest rate models, as well as other factor models in modelling fixed income securities.	15	x	x	
6	Apply calibration and computational techniques pertinent to the analysis of economic data in contemporary financial markets.	15	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)
1	Teaching	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 implement mathematical and statistical techniques to analyze financial data as well as to calibrate models of computing interest rates and pricing derivative securities.	1, 2, 3, 4, 5, 6	After class
3	Project(s)	Learning through project(s) helps students apply more advanced statistical and calibration methods of quantitative finance to analyze real world financial data and derivatives products computationally.	6	After class

**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 methods of econometrics in analyzing pricing models and time series data, as well as analytical and computational approaches to value of risk.	No

2	Hand-in assignments	1, 2, 3, 4, 5, 6	10	These are skills based assessment which enables students to implement statistical and calibration methods in studying financial market models and financial time series data.	Yes
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**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.

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 statistical and calibration methods of finance and actuarial science.

**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 financial and actuarial problems based on the statistical and calibration methods

**Excellent**

(A+, A, A-) Consistently demonstrates a thorough understanding of the statistical and calibration methods and can always apply the techniques to solve financial and actuarial problems

**Good**

(B+, B, B-) Adequately demonstrates an understanding of the statistical and calibration methods and can usually apply the techniques to solve financial and actuarial problems

**Fair**

(C+, C, C-) Demonstrates some understanding of the statistical and calibration methods and can sometimes apply the techniques to solve financial and actuarial problems

**Marginal**

(D) Demonstrates limited understanding of the statistical and calibration methods and can seldom apply the techniques to solve financial and actuarial problems

**Failure**

(F) Demonstrates little understanding of the statistical and calibration methods and can rarely or never apply the techniques to solve financial and actuarial problems

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**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 statistic methods and calibration and computational techniques for financial problem

**Excellent**

(A+, A, A-) Consistently demonstrates a thorough understanding of the statistical and calibration methods and can always apply the techniques to solve financial and actuarial problems

**Good**

(B+, B, B-) Adequately demonstrates an understanding of the statistical and calibration methods and can usually apply the techniques to solve financial and actuarial problems

**Fair**

(C+, C, C-) Demonstrates some understanding of the statistical and calibration methods and can sometimes apply the techniques to solve financial and actuarial problems

**Marginal**

(D) Demonstrates limited understanding of the statistical and calibration methods and can seldom apply the techniques to solve financial and actuarial problems

**Failure**

(F) Demonstrates little understanding of the statistical and calibration methods and can rarely or never apply the techniques to solve financial and actuarial problems

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**Assessment Task**

3. 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 statistical and calibration methods and can always apply the techniques to solve financial and actuarial problems

**Good**

(B+, B, B-) Adequately demonstrates an understanding of the statistical and calibration methods and can usually apply the techniques to solve financial and actuarial problems

**Fair**

(C+, C, C-) Demonstrates some understanding of the statistical and calibration methods and can sometimes apply the techniques to solve financial and actuarial problems

**Marginal**

(D) Demonstrates limited understanding of the statistical and calibration methods and can seldom apply the techniques to solve financial and actuarial problems

**Failure**

(F) Demonstrates little understanding of the statistical and calibration methods and can rarely or never apply the techniques to solve financial and actuarial 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 financial and actuarial problems based on the statistical and calibration methods

**Excellent**

(A+, A, A-) Consistently demonstrates a thorough understanding of the statistical and calibration methods and can always apply the techniques to solve financial and actuarial problems

**Good**

(B+, B) Adequately demonstrates an understanding of the statistical and calibration methods and can usually apply the techniques to solve financial and actuarial problems

**Marginal**

(B-, C+, C) Demonstrates some understanding of the statistical and calibration methods and can sometimes apply the techniques to solve financial and actuarial problems

**Failure**

(F) Demonstrates little understanding of the statistical and calibration methods and can rarely or never apply the techniques to solve financial and actuarial 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 statistic methods and calibration and computational techniques for financial problem

**Excellent**

(A+, A, A-) Consistently demonstrates a thorough understanding of the statistical and calibration methods and can always apply the techniques to solve financial and actuarial problems

**Good**

(B+, B) Adequately demonstrates an understanding of the statistical and calibration methods and can usually apply the techniques to solve financial and actuarial problems

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**Failure**

(F) Demonstrates little understanding of the statistical and calibration methods and can rarely or never apply the techniques to solve financial and actuarial problems

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**Assessment Task**

3. Examination dents 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 statistical and calibration methods and can always apply the techniques to solve financial and actuarial problems

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

Econometrics theory. The Capital Asset Pricing Model: the econometrics of financial markets, calibration of market models.

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

Title	
1	Analysis of Financial Time Series, by Ruey S. Tsay, Wiley; 3rd edition
2	Monte Carlo Methods in Financial Engineering, by Paul Glasserman, Springer; 2003rd edition
3	The Volatility Surface, by Jim Gatheral, Wiley; 1st edition
4	Options, Futures, and other derivatives, by John C. Hull, Pearson; 9th edition
5	Interest Rate Modelling, by Leif Andersen and Vladimir Piterbarg, Atlantic Financial Press, 2010
6	Numerical Recipes, by William H. Press et al., Cambridge University Press; 3rd edition

**Additional Readings**

Title	
1	Nil