

**City University of Hong Kong  
Course Syllabus**

offered by Department of Mathematics  
with effect from Semester A 20 22 / 23

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**Part I Course Overview**

**Course Title:** Statistical Methods and Calibration in Finance and Actuarial Science

**Course Code:** MA6622

**Course Duration:** 1 semester

**Credit Units:** 3 CUs

**Level:** P6

**Medium of Instruction:** English

**Medium of Assessment:** English

**Prerequisites:**  
(Course Code and Title) Nil

**Precursors:**  
(Course Code and Title) Nil

**Equivalent Courses:**  
(Course Code and Title) Nil

**Exclusive Courses:**  
(Course Code and Title) Nil

## Part II Course Details

### 1. 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.

### 2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	A2	A3
1.	Implement econometric techniques in estimation and analysis of financial econometric models, including the Capital Asset Pricing Model.	15	✓	✓	
2.	Apply advanced time series models to empirical analysis and forecasting of financial time series data.	25	✓	✓	✓
3.	Explain clearly the concept of value at risk with normal/lognormal returns and computation of which via Monte Carlo approach.	15	✓	✓	
4	Perform calibration methods in Black-Scholes model, binomial trees and one factor diffusion models.	15	✓	✓	✓
5	Describe quantitative properties of option pricing and interest rate models, as well as other factor models in modelling fixed income securities.	15	✓	✓	
6	Apply calibration and computational techniques pertinent to the analysis of economic data in contemporary financial markets.	15	✓	✓	✓
		100%			

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 self-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.*

### 3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5	6	
Teaching	Learning through teaching is primarily based on lectures.	✓	✓	✓	✓	✓	✓	39 hours in total
Take-home assignments	Learning through <b>take-home assignments</b> 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.	✓	✓	✓	✓	✓	✓	After class
Project(s)	Learning through <b>project(s)</b> helps students apply more advanced statistical and calibration methods of quantitative finance to analyze real world financial data and derivatives products computationally.						✓	After class

#### 4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

30% Coursework

70% Examination (Duration: 3 hours, at the end of the semester)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4	5	6		
Continuous Assessment: <u>30</u> %								
Test	✓	✓	✓				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.
Hand-in assignments	✓	✓	✓	✓	✓	✓	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.
Examination: <u>70</u> % (duration: 3 hrs)	✓	✓	✓	✓	✓	✓	70%	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.
							100%	

## 5. Assessment Rubrics

*(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)*

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Test	Problem solving ability	High	Significant	Basic	Not even reaching marginal levels
2. Hand-in assignments	Comprehensive understanding	High	Significant	Basic	Not even reaching marginal levels
3. Examination	Creativity and problem solving ability based on comprehensive understanding	High	Significant	Basic	Not even reaching marginal levels

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Test	Problem solving ability	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Hand-in assignments	Comprehensive understanding	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	Creativity and problem solving ability based on comprehensive understanding	High	Significant	Moderate	Basic	Not even reaching marginal levels

**Part III Other Information** (more details can be provided separately in the teaching plan)

**1. Keyword Syllabus**

*(An indication of the key topics of the course.)*

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

**2. Reading List**

**2.1 Compulsory Readings**

*(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)*

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

**2.2 Additional Readings**

*(Additional references for students to learn to expand their knowledge about the subject.)*

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