

**City University of Hong Kong**  
**Course Syllabus**

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

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**Part I Course Overview**

**Course Title:** Stochastic Interest Rate Models

**Course Code:** MA6627

**Course Duration:** One Semester

**Credit Units:** 3 CUs

**Level:** P6

**Medium of Instruction:** English

**Medium of Assessment:** English

**Prerequisites:**  
(Course Code and Title) MA5616 Financial Mathematics in Derivative Markets

**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

- examine quantitative aspects of interest rate models and pricing of associated derivatives, such as caps and swaps;
- present calibration methods to stochastic interest rate models, including short rate and forward rate models; and
- introduce modeling of stochastic term structure models and hedging from an infinite-dimensional viewpoint.

### 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.	describe short rate models by Itô stochastic processes and derive governing equations of bond prices with no-arbitrage argument.	40%	✓	✓	
2.	model stochastic movement of forward rates with HJM model.	20%	✓	✓	
3.	formulate LIBOR market model (BGM model) of interest rate derivatives under the Gaussian HJM framework.	20%	✓	✓	
4.	apply the technique of forward measure to price interest rate derivatives and to examine expectation of the short rate and the LIBOR process.	10%	✓	✓	✓
5.	present an infinite-dimensional analysis to interest rate term structure and hedging derivatives.	10%	✓	✓	✓
		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	
Lectures	Learning through <b>teaching</b> is primarily based on lectures.	✓	✓	✓	✓	✓		39 hours in total
Assignments	Learning through <b>take-home assignments</b> helps students characterize and analyze various interest rate models with stochastic techniques, as well as apply these models in pricing traded interest rate derivatives.	✓	✓	✓	✓	✓		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: 30 %								
Test	✓	✓	✓				15--30%	Questions are designed for the first part of the course to see how well students have learned stochastic analysis of interest rate models, such as HJM and LIBOR models.
Hand-in assignments	✓	✓	✓	✓	✓		0--15%	These are skills-based assessment which enables students to model interest rate and forward rate with stochastic methods, as well as to formulate HJM framework and LIBOR processes.
Examination: 70% (duration: 3 hrs, if applicable)								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 mathematical methods underlying stochastic interest rate models and associated derivatives pricing.
							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	Independent problem solving skills on progressive learning based on lecture	High	Significant	Basic	Not even reaching marginal levels
2. Hand-in assignments	Understanding based on both lecture and outsource reference	High	Significant	Basic	Not even reaching marginal levels
3. Examination	Comprehensive problem solving skills on learning materials throughout the semester	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	Independent problem solving skills on progressive learning based on lecture	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Hand-in assignments	Understanding based on both lecture and outsource reference	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	Comprehensive problem solving skills on learning materials throughout the semester	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.)*

Short term interest rate models. Zero-coupon bonds. Forward rates. Term structure dynamics-HJM model. Arbitrage and change of numeraire. LIBOR market-BGM model. Interest rate derivatives. Pricing of caps and swaps. Infinite dimensional approach to hedging. Calibration issues.

#### 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.	Steven E. Shreve, Stochastic Calculus for Finance I: The Binomial Asset Pricing Model, Springer; 2004th edition
2.	Steven E. Shreve, Stochastic Calculus for Finance II: Continuous-Time Models, Springer, 2010
3.	
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##### 2.2 Additional Readings

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

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