City University of Hong Kong
Course Syllabus

offered by Department of Management Sciences
with effect from Semester A 2024/2025

Part I Course Overview

Course Title:	Probability and Markov Chain Models
Course Code:	MS8944
Course Duration:	One Semester
Credit Units:	3
Level:	R8
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 advanced course aims to equip PhD students with a deep understanding of the theoretical foundations and practical applications of stochastic modeling and analysis. The curriculum will focus on the core topics of Markov chains and queuing systems, providing a solid grounding in the mathematical and statistical principles underpinning these stochastic processes. Through the use of two seminal textbooks, students will explore the formulation and solution of probability models, with an emphasis on their relevance to operations management and other real-world contexts. The course will delve into the properties and behavior of Markov chains, including stationary distributions, transient analysis, and the application of these concepts to various problem domains. Additionally, students will learn about queuing theory and its analytical techniques for modeling and optimizing service systems. By the end of the program, students will possess the knowledge and skills necessary to conduct advanced research, develop innovative stochastic models, and tackle challenging problems in their respective fields of study.

2. Course Intended Learning Outcomes (CILOs)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Demonstrate familiarity with the fundamental definitions, concepts, and principles in the field of stochastic modeling and processes		✓		
2.	Analyze and apply key theoretical results and properties of stochastic processes, particularly Markov chains, to solve problems			✓	
3.	Evaluate the behavior and performance of basic stochastic systems, such as queuing models, and interpret the analytical findings			✓	
4	Synthesize the course concepts and techniques to develop probability models that address operations management-related applications and challenges				✓
		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. Learning and Teaching Activities (LTAs)

LTA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Interactive lecture	Students will actively participate in interactive lectures and small-group discussions to develop a comprehensive understanding of the fundamental concepts, analytical techniques, and practical applications in the field of stochastic modeling and processes, with a focus on Markov chains and queuing systems.	✓	✓	✓	✓			3 hours/week
Homework and case study	Students will complete assigned homework, problem sets, and case study analyses to reinforce the theoretical knowledge, apply the course concepts to real-world operations management challenges, and engage in independent research and collaborative problem-solving with peers.	✓	✓	✓	✓			3 hour/week

4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4				
Continuous Assessment: 60 %								
Homework assignments	✓	✓	✓				30%	
Mid-term test	✓	✓	✓				30%	
Examination: __40__% (duration: 2 hours, if applicable)								
Examination	✓	✓	✓				40%	
							100%	

5. Assessment Rubrics

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1.Homework assignments	ABILITY to APPLY the methodology and knowledge to solve problems	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Mid-term test	EVIDENCE of knowledge of subject matter and capability to formulate, analyze the fundamental probability models and their applications	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	EVIDENCE of knowledge of subject matter and capability to formulate, analyze the fundamental probability models and their applications	High	Significant	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Homework assignments	ABILITY to APPLY the methodology and knowledge to solve problems	High	Significant	Moderate	Not even reaching marginal levels
2. Mid-term test	EVIDENCE of knowledge of subject matter and capability to formulate, analyze the fundamental probability models and their applications	High	Significant	Moderate	Not even reaching marginal levels
3. Examination	EVIDENCE of knowledge of subject matter and capability to formulate, analyze the fundamental probability models and their applications	High	Significant	Moderate	Not even reaching marginal levels
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Part III Other Information

1. Keyword Syllabus

- Random variables, expectation, moment generating functions, limit theorem, conditional probability, conditional expectation
- Markov chains, Poisson process, birth-death process, uniformization
- Renewal reward processes,
- Queuing theory: networks of queues, M/M/1, M/G/1, M/M/k queues
- Simulation
- Other applications in operations management

2. Reading List

2.1 Compulsory Readings

1.	Introduction to Probability Models, Academic Press, Tenth Edition Author: Sheldon M. Ross ISBN-10: 0123756863 ISBN-13: 978-0123756862
2.	Modeling and Analysis of Stochastic Systems. Chapman & Hall, 2020. 3rd Edition (Author: Vidyadhar G. Kulkarni). ISBN 9780367736798

2.2 Additional Readings

Nil.