THE CHINESE UNIVERSITY OF HONG KONG
Department of Systems Engineering & Engineering Management
2024/2025, Term 1

Course Code & Title: SEEM5580 Advanced Stochastic Models

Instructor

Instructor	
Name	Prof. Gao Xuefeng
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Office hour	By Appointment

Lecture and Teaching Mode

Time	Venue
Wednesday 2:30pm – 5:15pm	Lee Shau Kee Building LT1
Note	No classes on public holidays

Course Description & Content

The course introduces basic stochastic models. We will discuss Poisson Process, Discrete and Continuous time Markov Chains, Martingales and Brownian motions. Applications including queueing models and inventory models will also be discussed.

Learning Resources

Textbook:
Sheldon Ross, *Stochastic Processes*, 2nd Edition, Wiley, New York, 1996

References:
1. Sidney I. Resnick, *Adventures in Stochastic Processes*, Springer, 1992.
2. Richard Serfozo, *Basics of Applied Stochastic Processes*, Springer, 2009.
3. Olav Kallenberg, *Foundations of Modern Probability*, Springer, New York, 1997.

Course-website:
https://blackboard.cuhk.edu.hk

Learning Outcome

1) Understand various stochastic models in depth, including their definitions and properties 2) Provide logical and rigorous proofs of important theoretical results 3) Identify appropriate stochastic process model(s) for a given research or applied problem 4) Apply the theory to model real phenomena in various applications

Assessment Scheme

Task nature	**Weight**
Assignments Mid-Term Exam (tentative date: Oct 23) Final Exam (tentative date: Dec 4)	15% 35% 50%
	100%
Exams: closed book/notes format (one cheat sheet is allowed).	

Prerequisite:
Calculus, Linear Algebra, Probability

Course Schedule (Subject to Changes)

Chapter 1. Preliminaries (1~2 weeks)
- Probability, random variables and expectation
- Stochastic processes

Chapter 2. Poisson Processes (2 weeks)
- Definition
- Interarrival and waiting time distributions
- Nonhomogeneous Poisson processes
- Compound Poisson processes

Chapter 3. Discrete-Time Markov Chains (2 weeks)
- Definition
- Chapman-Kolmogorov's equation
- Classification of states
- Limit theorems

Chapter 4. Continuous-Time Markov Chains (2 weeks)
- Definition
- Birth-and-death processes
- Kolmogorov's differential equation
- Limiting probabilities

Chapter 5. Discrete-Time Martingales (2 weeks)

- Definition
- Stopping times
- Optional sampling theorem
- Martingale convergence theorem

Chapter 6. Brownian Motions (2 weeks)
- Introduction
- Hitting times
- Variations on Brownian motions

Rules for Examinations:

- NO make-up mid-term examination will be provided under any circumstances. If the situation seems inevitable (e.g., illness with a doctor's sick leave certificate), then students who are absent for the midterm exam could submit supporting documents to the instructor within 3 working days after the midterm exam. Upon the approval of the instructor, the weight for the mid-term examination will be transferred to the final examination.

- Final examination will not be optional. If you could not sit for the final examination, you must apply in writing to the instructor for permission of absence. In case of illness/injury, the application must be accompanied by a doctor's letter certifying that you are unfit to take the examination, following the guideline of the university. The format of the make-up final exam will be determined by the course instructor. A student who is absent from any makeup examination will be given a failure grade in that examination. Absent application for makeup examination will not be considered.

Academic Honesty

Students are strongly advised to read the University's guideline on academic honesty (http://www.cuhk.edu.hk/policy/academichonesty/). In particular, no form of plagiarism will be tolerated. A student caught plagiarizing will be reported to the Faculty's Committee for disciplinary actions.

AI Policy: Approach 1 (by default) - Prohibit all use of AI tools

- In completing assignments and exams, students are expected to produce their own work independently without any collaboration or the use of AI tools.

Feedback for Evaluation

- At the completion of the course, you will be requested to fill out a course evaluation.