The Hong Kong University of Science and Technology
UG Course Syllabus
Fall, 2025

[Course Title] Stochastic Models
[Course Code] IEDA 3250
[No. of Credits] 3

Prerequisites: Students are expected to have the necessary prerequisites in probability theory and have taken (I) IEDA 2520 (Probability for Engineers) and IEDA 2540 (Statistics for Engineers), or (II) MATH 2411 and MATH 2421.

This course is also a prerequisite for IEDA 4331 (Quantitative Methods in Financial Engineering), IEDA 4420 (Dynamic Pricing and Revenue Optimization), IEDA 4510 (Systems Risk Management) and IEDA 4520 (Numerical Methods for Financial Engineering).

Instructor: Professor Rachel Zhang, Rm 5539, rzhang@ust.hk, 2358-7113
Class Schedule: 4:30 – 5:50pm, Wednesday and Friday, Rm 2502
TAs: Zhihao Li zlifx@connect.ust.hk (Rm 5569)
Wenxi Qiu wqiuae@connect.ust.hk (Rm 5569)
Tutorial hours: Tuesday 6:00 – 6:50 pm (T1: Rm 1527)
Wednesday 2:00 – 2:50 pm (T2: Rm 4579)
Office hours: Wednesday 3:00 – 4:00pm; Friday 3:00-4:00pm (??) or by appointment

Course Objectives: A Markov process is a particular type of stochastic process where, given the current state, the future is independent of the past (this is the Markov property). If something is "stochastic", then it involves chance or uncertainty. In the second half of Operations Research/Management Science, *Stochastic Models*, we will learn the mathematical language used to study real-world processes that involve uncertainty and have the Markov property. Because this is an introductory course, we will focus predominantly on tools rather than applications. Applications will be given whenever possible but, just as scales must be learnt when studying piano, there will be situations where no applications are obvious at our level of knowledge.

Topics to be discussed include four parts: probability review, Markov chains, Poisson processes and continuous time Markov chains, and queuing theory. We devote an equal amount of time to each of the four parts.

Text: *Introduction to Probability Models*, by Sheldon Ross, Academic Press.

Intended Learning Outcomes (ILOS):

1. To reinforce knowledge of basic probability and mathematics.
2. Explain basic Markov processes and their applications (reliability, inventory management, and queueing).
3. Demonstrate the abilities in analytical thinking.

Assessment and Grading: 4 quizzes, 25% each on

1. Sept 19 (F) for basic probability and mathematics (ILOS 1 & 3)
2. Oct 15 (W) for discreate time Markov chains (ILOS 2 & 3)
3. Nov 7 (F) for continuous time Markov chains (ILOS 2 & 3)
4. Nov 28 (F) for queueing applications (ILOS 2 & 3)

Quizzes are designed to assess students' foundational understanding of stochastic processes and their applications and their ability to apply them to service systems, aligning with the thinking skills of remembering and understanding.

The quizzes are closed book, but you are allowed to bring in a cheat sheet (both sides) and a calculator. You are responsible for following the course materials and completing homework assignments, not to be turned in, on time whose solutions will be provided. Lecture notes, Homework and solutions as well as tutorial materials will be available on Canvas under Files.

Final Grade Description

A (Excellent Performance): Demonstrating a deep understanding of fundamental concepts of stochastic processes and their applications in queueing and reliability. Exhibits exceptional critical thinking skills in analyzing service systems using relevant theoretical frameworks. Effectively communicates ideas and apply the concepts to enhancing leaning and problem-solving.

B (Good Performance): Show a solid grasp of basic concepts and their applications. Demonstrate good critical thinking skills in analyzing service systems using relevant theoretical frameworks. Effectively communicates complex ideas and apply the concepts to enhancing leaning and problem-solving.

C (Satisfactory Performance): Has adequate knowledge of concepts and their applications. Demonstrate satisfactory critical thinking skills in analyzing service systems using relevant theoretical frameworks. Communicates complex ideas and apply the concepts to enhancing leaning and problem-solving, but may lack depth in analysis and application.

D (Marginal Pass): Has basic knowledge of concepts and their applications. Demonstrate limited critical thinking skills in analyzing service systems using relevant theoretical frameworks. Communicates ideas at a basic level and apply the concepts to enhancing leaning and problem-solving, but with minimal effectiveness.

F (Fail): Demonstrates insufficient knowledge of concepts and their applications. Lack critical thinking skills and unable to analyze service systems using relevant theoretical frameworks. Struggles to communicates ideas and unable to apply the concepts to enhancing leaning and problem-solving.

Policy on the use of Generative AI

There is no restriction, except that no electronic device is allowed during the quizzes.

Tutorial schedule: T1 on Tuesday and T2 on Wednesday

- Probabilities: T1: Sept 9, 16
  T2: Sept 10, 17
- DTMC: T1: Oct 7, 14
  T2: Oct 8, 15
- CTMC: T1: Oct 28 (will be recorded for T2), Nov 4
  T2: Nov 5 (Oct 29 is a holiday, Zoom recording)
- Queueing: T1: Nov 18, 25
  T1: Nov 19, 26