The Hong Kong Polytechnic University

Subject Description Form

Subject Code	AMA3659
Subject Title	Stochastic Processes
Credit Value	3
Level	3
Pre-requisite	Calculus and Linear Algebra (AMA1007) or Basic Mathematics II – Calculus and Linear Algebra (AMA1120) or Calculus for Engineers (AMA1130) or Calculus (AMA1131) or Foundation Mathematics for Accounting and Finance (AMA1500) or Calculus (AMA1702) **and** Introduction to Statistics for Business (AMA1501) or Introduction to Statistics (AMA1502/AMA1602) or Probability and Engineering Statistics (AMA2104) or Probability and Distributions (AMA2691) or Mathematical Methods for Finance (AMA2703) or Principles of Data Science (DSAI1103)
Exclusion	Applied Probability Models for Investment (AMA358) Stochastic Processes for Investment (AMA3658)
Objectives	This subject is for students to understand basic probability theory and some advanced probability models which enable them to apply in investment and actuarial science.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. understand the concepts of random variable and probability distributions; b. understand the fundamental concepts and perform basic operations of discrete and continuous Markov chains; c. construct probability models in situations with uncertainty; d. get familiar with distributions commonly applied in finance and related fields; e. evaluate critically the statistical and physical properties of the Brownian motion and apply to pricing stock options problems; f. communicate effectively in a well-structured manner and build up an open-minded attitude
Subject Synopsis/ Indicative Syllabus	Review on probability theory Random variables, probability distributions, conditional probability.

<table>
<tr><td></td><td>Markov chains
Discrete time Markov chains, Chapman-Kolmogorov equations, classification of states, limiting probabilities, random walk, branching process, applications.

Poisson process
Counting process, Poisson process, inter-arrival and waiting time distributions, non-homogeneous Poisson process, applications.

Continuous-time Markov chains
Continuous time Markov chains, birth and death processes, transition probability function, limiting probabilities, applications.

Brownian motion
Introduction to Brownian motion, hitting times, maximum value, Brownian motion with drift, geometric Brownian motion, pricing stock options, applications.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce concepts of probability theory and probability models in the syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and assignments.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods</td><td rowspan="2">% weighting</td><td colspan="7">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td></td></tr>
<tr><td>1. Assignments</td><td>15%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>2. Tests</td><td>25%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td></td></tr>
<tr><td>3. Examination</td><td>60%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr>
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Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
The subject focuses on knowledge, skill and understanding of <u>Stochastic Processes</u>, thus, <u>Exam-based assessment</u> is the most appropriate assessment method, including 25% test and 60% examination. Moreover, 15% worth of assignments are included as a component of continuous assessment so as to keep the students in progress.
Continuous Assessment comprises of assignments and tests. A written examination is held at the end of the semester.</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>26 Hrs.</td></tr>
<tr><td>▪ Tutorial</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
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	▪ Assignment	20 Hrs.
	▪ Self-study	58 Hrs.
	Total student study effort	117 Hrs.
Reading List and References	Textbook:	
	Ross, S.M. Introduction to Probability Models 13th edition	Academic Press 2023
	References:	
	Jones, P.W. & Smith, P. Stochastic processes: an introduction 3rd edition	CRC Press 2018