

Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): MATH3730 Topics in Probability Theory and Stochastic Processes (3,3,0)

Course Aims: This course introduces topics from conditional expectations, Markov chains, Markov processes, Brownian motion, and martingales, and their applications to stochastic calculus.

Prerequisite: MATH1112 Mathematical Analysis II, STAT1131 Statistical Methods and Theory I

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Course Intended Learning Outcomes (CILOs):

Upon successful completion of this course, students should be able to:

| No. | Course Intended Learning Outcomes (CILOs) |
|-----|--|
| 1 | Understand the probability theory and stochastic processes of financial processes and instruments. |
| 2 | Recognize stationary stochastic process and Brownian motion, and able to understand basic knowledge of Markov chains and Poisson process. |
| 3 | Judge stationary processes, Poisson processes and Markov processes, and use knowledge of stochastic processes to make financial forecasting. |
| 4 | Apply the knowledge of probability theory and stochastic processes to analyze financial related problems in practice. |

Teaching & Learning Activities (TLAs)

| CILO | TLAs will include the following: |
|------|---|
| 1-4 | Lectures with rigorous mathematical discussions and concrete examples. The lecturer will constantly ask questions in class to make sure that the majority of students are following the teaching materials. |
| 1-4 | Assignments to monitor both students' learning and mastering of the taught materials. In addition, common mistakes will also be addressed and analyzed. |

Assessment:

| No. | Assessment Methods | Weighting | CILO Addressed | Remarks |
|-----|-----------------------|-----------|----------------|--|
| 1 | Continuous Assessment | 30% | 1-4 | Assessments are designed to measure how well the students' recognizing of the theory, techniques, and applications of probability theory and stochastic processes. The test is conducted to monitor the students' recognizing of the theory, techniques and skills taught in the class. This may involve, but not limited to, in class discussions of rigorous technical problems and their solutions. |
| 2 | Final Examination | 70% | 1-4 | Final Examination questions are designed to see how far students have achieved their intended learning outcomes. Students should have a thorough recognizing of the knowledge and apply them correctly in different context to do well in the exam. |

Course Intended Learning Outcomes and Weighting:

| Content | CILO No. | Teaching (in hours) |
|--|----------|---------------------|
| 1. Review of Probability | 2 | 2 |
| 2. Conditional Expectation | 2 | 2 |
| 3. Martingales | 1-4 | 8 |
| 4. Markov Chains | 2 | 6 |
| 5. Poisson, Levy Processes | 2 | 7 |
| 6. Brownian Motion | 2 | 7 |
| 7. Stochastic calculus essentials and Ito calculus | 1-4 | 10 |

Textbook: Zdzislaw Brzezniak and Tomasz Zastawniak, *Basic Stochastic Processes*, 3rd edition, Springer, 2000.

References: Gregory Lawler, *Introduction to Stochastic Processes*, Chapman and Hall/CRC, 2000.
Richard Durrett, *Essentials of Stochastic Processes*, 2nd edition, Springer, 2012.

Course Content in Outline:

| | <u>Topic</u> | <u>Hours</u> |
|------|---|---------------------|
| I. | Review of Probability | 2 |
| II. | Conditional Expectation | 2 |
| III. | Martingales | 8 |
| IV. | Markov Chains | 6 |
| V. | Poisson, Levy Processes | 7 |
| VI. | Brownian Motion | 7 |
| VII. | Stochastic calculus essentials and Ito calculus | 10 |