Advanced Stochastic Processes

Instructor: **ST.VAKEROUDIS**

Course Code: 61212

Course Type: Elective of Course Group 3
Course Level: Graduate (MSc)
Year of Study: A'
Semester: 2nd
ECTS: 3
Language: English

Course Description

Reminder on basic knowledge of probability and Stochastic Processes. Conditional Expectation. Discrete Time Martingales (Filtrations, Martingales, Random Games, Stopping Times, Optional Stopping Theorem). Martingale Inequalities and Convergence (Doob's Martingale Inequalities, Doob's Martingale Convergence Theorem, Uniform Integrability and L1 Convergence of Martingales). Poisson Process, Compound Poisson Process, Queueing Theory. Brownian motion (Definition and basic properties, sample paths, Doob's L2 Maximal Inequality for Brownian motion). Itô's Stochastic Calculus (Itô's Stochastic Integral, Properties of Stochastic Integral, Itô's Formula, Stochastic Differential Equations).

Prerequisites

Probability Theory (probability measures, random variables, independence, expectation, conditional probability, Moment Generating function, Characteristic function, Law of Large Numbers, Central Limit Theorem), Basic Stochastic Processes, Calculus (limits, series, continuity, derivative, Riemannian integral), Basic knowledge of Lebesgue Integral.

Target Learning Outcomes

- The students, after following (and successful examination of) this course will understand the notion of Martingales which plays a crucial role in Financial and Actuarial applications.
- Moreover, they will learn applications of the Optional Stopping Theorem.
- They will study the Poisson Process and the Brownian motion, and they will get familiarised with Stochastic Calculus and Stochastic Differential Equations (with applications in Finance and in other fields).

Recommended Bibliography

- P. Billingsley, Probability and measure, Wiley, 1979.
- Z. Brzezniak, T. Zastawniak, Basic Stochastic Processes, Springer,1998.
- S. Karlin, A. M. Taylor, A Second Course in Stochastic Processes, Academic Press, 1981.
- D. Revuz, M. Yor, Continuous Martingales and Brownian motion, Springer Science & Business Media, 2013.

Teaching and Learning Activities

In class (In person) lectures, Exercises, Assignments, Presentations.

Assessment and Grading Methods

Final exam, Assignments.