Probability Theory (61211)

Instructors: H.PAVLOPOULOS

Core Course, 2nd semester, 4 ECTS units
Course level: Graduate (MSc)
Language: Greek/English

Course Description

The course provides a measure theoretic approach to probability theory according to Kolmogorov's Axioms, with emphasis on construction of probability spaces by the Caratheodory-Lebesgue Extension Theorem, on properties of the Expected (Mean) Value of a random variable as Lebesgue integral in its probability space and in the Borel real-line, on modes of Stochastic Convergence (*almost surely, in probability, in law, in p-th order mean*) and related Limit Theorems (*laws of large numbers, central limit theorems, continuity properties of expectation and probability*), on Lebesgue Decomposition to discrete and continuous components of probability measures on the Borel real-line, on the Radon-Nikodym Theorem and on properties of Conditional Expectation of a random variable with respect to a given σ-algebra of events.

Prerequisites

Calculus, Introduction to Probability, Introduction to Mathematical Analysis.

Target Learning Outcomes

After completing the course, students should be able to construct Probability Spaces, to calculate Expected (Mean) Value of a random variable by Lebesgue integration with respect to the induced probability distribution on the Borel real line, to discern among different notions of Stochastic Convergence and to implement them properly via pertinent significant theorems (e.g. monotone and dominated convergence theorems, laws of large numbers, central limit theorems) applied in both probability theory as well as in mathematical statistics.

Recommended Bibliography

- **Textbook:**
  Rosenthal, J.S. (2006): *A First Look at Rigorous Probability Theory*, 2nd Edition, World Scientific.
- **Suggested Supplementary Bibliography:**

- Billingsley, P. (1995): *Probability and Measure*, 3rd Edition, John Wiley & Sons, New York.
- Chung, K.-L. (1974): *A Course in Probability Theory*, Academic Press, San Diego.
- Roussas, G.G. (2005): *An Introduction to Measure-Theoretic Probability,* Elsevier Academic Press.
- Capinski, M. and Kopp P.E. (2004): *Measure, Integral, and Probability*, 2nd Edition, Springer.
- Durrett, R. (1996): *Probability: theory and examples*, Duxbury, Belmont.
- Port, S.C. (1994): *Theoretical Probability for Applications*, John Wiley & Sons, New York.

- Leadbetter, R, S. Cambanis and V. Pipiras (2014): *A Basic Course in Measure and Probability – Theory for Applications*, Cambrige University Press.

Teaching and Learning Activities

Remote Teaching (Tuesday 12:00-15:00) by implementing a combination of tools available via AUEB e-class and Microsoft-Teams platforms.

Assessment and Grading Methods

Homework Assignments (50%) + Final Written Exam (50%).