Probability

PhD in Economics and Management

Syllabus 2020-2021

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Course load: 30 hours

Objectives of the course

The course is intended for 1st year students on PhD Program in Economics and Management. The purposes of this course are: (i) to explain, at an intermediate level, the basis of probability theory and some of its more relevant theoretical features; (ii) to explore those aspects of the theory most used in advanced analytical models in economics and finance. The topics will be illustrated and explained through many examples.

Pre-requisites

Basic Calculus and basic knowledge of probability theory, as in: P. Newbold, W. Carlson, B. Thorne (2012), *Statistics for Business and Economics*, Pearson Higher Education, Chapters 3-5 (previous editions would be fine as well). Attendance to more advanced courses such as real analysis, probability, distribution theory and statistical inference would be desirable.

Contents

1. Algebras and sigma-algebras, axiomatic definition of probability, probability spaces, properties of probability, conditional probability, Bayes theorem, stochastic independence for events.
2. Random variables, measurability, cumulative distribution functions and density functions.
3. Transformations of random variables, probability integral transform.
4. Lebesgue integral, expectation and variance of random variables, Markov inequality, Tchebycheff inequality, Jensen inequality, moments and moment generating function.
5. Multidimensional random variables, joint distributions, marginal and conditional distributions, stochastic independence for random variables, covariance and correlation, Cauchy-Schwartz inequality.
6. Bivariate normal distribution, moments, marginal and conditional densities.
7. Transformations of multidimensional random variables.
8. Convergence of sequences of random variables, weak law of large numbers and central limit theorem.

Textbook

- S. Ross (2010). *A First Course in Probability*, 8th Edition. Pearson Prentice Hall.

Further readings

- G. Casella, R. L. Berger (2002). *Statistical Inference*, Second edition. Duxbury Thompson Learning.
- R. Durrett (2009). *Elementary Probability for Applications*. Cambridge University Press.
- M. J. Evans, J. S. Rosenthal (2003). *Probability and Statistics - The Science of Uncertainty*. W. H. Freeman and Co.
- G. Grimmett, D. Stirzaker (2001). *Probability and Random Processes*. Oxford University Press.
- A. M. Mood, F. A. Graybill, D. C. Boes (1974). *Introduction to the Theory of Statistics*. McGraw-Hill.
- P. Newbold, W. Carlson, B. Thorne (2012). *Statistics for Business and Economics*. Pearson Higher Education.
- D. Stirzaker (2003). *Elementary Probability*. Cambridge University Press.
- L. Wasserman (2004). *All of Statistics*. Springer.

Advanced readings

- R. B. Ash and C. A. Doléans-Dade (2000). *Probability and Measure Theory*. Harcourt/Academic Press
- M. J. Schervish (1995). *Theory of Statistics*. Springer.

Assessment

A two-hour written paper at the end of the course. No material is permitted during the examination.