Probability theory - Syllabus

Objectives of the course

The course is intended for the 1st year students of the PhD programme in Economics. 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; (iii) to give an introduction to some concepts of statistical inference. The topics will be illustrated and explained through many examples.

Pre-requisites

Introduction to Mathematics. Elementary set theory (textbook, pp. 1-13)

Contents

1. Axiomatic definition of probability. Properties of probability measure. Conditional probability, stochastic independence.
2. Random variables, distribution functions and density functions. Expectation and moments of random variables.
3. Some parametric families of random variables.
4. Multivariate random variables. Joint and conditional distributions. Stochastic independence. Expectation. Covariance and correlation. Independence and expectation. Cauchy-Schwartz inequality.
5. Bivariate normal distribution. Density function, moments, marginal and conditional densities.
6. Distributions of transformations of random variables.
7. Convergence of sequences of random variables. Laws of large numbers. Central limit theorems.
8. Sampling and sampling distributions. Sample mean. Order statistics. Sample cumulative distribution function.

9. Statistical theory. The basics of point estimation and hypotheses testing from the frequentist viewpoint.
10. A different view of probability and statistics: the Bayesian paradigm.

Textbook

- A. M. Mood, F. A. Graybill, D. C. Boes (1974). Introduction to the Theory of Statistics. McGraw-Hill

Further readings

- G. Casella and R.L. Berger (2002). Statistical Inference, second edition. Duxbury Thompson Learning.
- M.J. Evans and J.S. Rosenthal (2003). Probability and Statistics - The Science of Uncertainty. W. H. Freeman.
- 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

Written examination.