SYLLABUS DEL CORSO

Probabilità e Statistica Computazionale M

2122-1-F8204B004

Learning objectives

The course consists of two parts:

1) Applied probability

2) Computational statistics

Part 1 aims at introducing and illustrating the concepts and tools of probability theory and applied mathematics needed for statistical inference and economics.

Part 2 provides an introduction to the most important computational statistical methods. Students will be introduced to the use of R for the implementation of the computational methods shown during the course.

Contents

Part 1.

Random events and probability measures.

Discrete and continuous random vectors.

Convergence of random variables and limit theorems.

Convexity and optimization with equality and inequality constraints.

Part 2.

Basic principles of the Monte Carlo method,.

Theoretical basis of the random numbers generators.

Fundamental concepts of resampling techniques (bootstrap and jackknife).

Detailed program

Part 1.

Random events and probability measures.

Discrete and continuous random vectors.

Special multidimensional distribution functions.

Moments and generating functions.

Convergence of random variables.

Law of large numbers and central limit theorem.

Functions of random vectors. Convex functions.

Optimization with equality constraints. Optimization with inequality constraints. Kuhn-Tucker conditions.

Part 2

Random numbers generation for uniform, non-uniform, discrete and continuous distributions.

Introduction to Monte Carlo simulation and Monte Carlo Integration.

Variance reduction techniques.

Resampling Techniques: bootstrap and jackknife.

Bootstrap confidence intervals.

Bootstrap Hypothesis Testing.

Numerical and graphical aspects for likelihood inference.

Prerequisites

Part 1.

Knowledge of the topics covered by basic courses in Probability and Calculus.

Part 2.

At least BSc courses on probability calculus, statistical inference; basic programming skills.

Teaching methods

Part 1.

Class lectures.

Part 2.

Lectures and tutorial sessions in computer laboratory.

Assessment methods

Part 1.

Written and oral exams.

The written exam aims at testing the problem-solving ability while the oral exam aims at evaluating the theoretical skills.

The overall mark is the average of the marks obtained in the two exams.

Examples of questions for the exams are available on the e-learning platform.

Part 2.

Oral and a computer-based exam.

The final mark is the average of the marks obtained in the two parts.

Textbooks and Reading Materials

Part 1.

A. Gut, "An Intermediate Course in Probability", Springer, 2009.

K. Lange, "Optimization", Springer, 2013.

E.L. Lehmann, "Elements of Large-Sample Theory", Springer, 1999.

Lecture notes available on the e-learning platform.

Part 2.

Lecture notes provided by the instructor.

Robert, C.P. e Casella, G. (2009), Introducing Monte Carlo Methods with R, New York: Springer-Verlag.

Davison and Hinkley (1997). Bootstrap Methods and their Applications, Chapman and Hall.

Semester

The course is scheduled in the first semester.

Teaching language

Italian.