



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Computational Statistics

2425-1-F8204B004-F8204B007M

Learning objectives

This course 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

Definition of random and pseudo-random numbers. Algorithms for generating pseudo-random numbers, randomness tests. Introduction to the Monte Carlo method and the plug-in principle. Jackknife and bootstrap resampling methods.

Detailed program

- 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

Prerequisites

There are no formal prerequisites for this course; however, a knowledge of statistical inference, probability theory, and the R language is highly desirable.

Teaching methods

The entire course will be conducted in lecture mode, through lecturing sessions where theoretical concepts will be applied and verified through concrete examples of simulation and algorithm using R.

- 30 hours of in-person lecturing sessions.
- 12 hours of remote synchronous lecturing sessions.

Assessment methods

Attending students: written exam and computational part with R.

Non-attending students: written exam and computational part with R.

During the exam, the correctness and clarity of the answers will be evaluated. The exam aims to assess the skills described in the learning objectives.

The written exam consists of 3 open-ended questions, including theoretical questions and exercises to be performed using R/RStudio through the [Piattaforma degli Esami Informatizzati](#).

Students and the instructor may request an optional oral exam covering the entire program.

The use of texts or any other materials is not permitted during the exam, except for the codes provided by the instructor at the beginning of the exam.

The use of mobile phones or any digital support is not allowed during the exam.

Textbooks and Reading Materials

- 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

First semester (I period).

Teaching language

Italian.

Sustainable Development Goals

QUALITY EDUCATION
