UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Statistica Computazionale

2627-1-F8206B003-F8206B003-2

Learning objectives

In line with the educational objectives of the Degree Programme, this course is part of the Statistical-Mathematical learning area. The course contributes to developing advanced methodological, algorithmic, and programming skills, which are essential to defining the quantitative profile of the Master's graduate and ensuring the coherence of individual study plans.

The course aims to provide the skills necessary to develop computational techniques for inference in statistical models.

In terms of knowledge and understanding, the course introduces the essential elements of programming in R, with particular focus on their application in implementing computational techniques for statistical inference.

Regarding the ability to apply knowledge and understanding, students will acquire practical skills in programming and computational methodologies, enabling them to effectively implement and interpret statistical inference methods using R.

With reference to making judgements, by the end of the course, students will be able to critically evaluate and select the most suitable computational techniques for statistical inference, assessing their appropriateness and effectiveness in different statistical contexts.

Regarding communication skills, students will learn to present the results of statistical analyses and computational implementations clearly and accurately, effectively communicating complex concepts to both specialist and non-specialist audiences.

Finally, in terms of learning skills, the course aims to strengthen students' ability to learn and independently stay updated on advanced methods of statistical inference, preparing them for a path of continuous professional and academic development in the disciplinary field of "Statistics" within the Master's Degree Programme in Statistical and Economic Sciences.

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 delivered in person through 2- or 3-hour lectures, during which theoretical concepts will be applied and tested through concrete examples involving simulations and the use of algorithms using the R programming language.

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 Informatizzat.

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