Computational Statistics

A course for PhD students, Alma Mater Studiorum Università di Bologna
Instructor: Silvia Bianconcini (Department of Statistical Sciences, University of Bologna)

About the course
Computational statistics is a branch of mathematical sciences concerned with efficient methods for obtaining numerical solutions to statistically formulated problems. This course will introduce students to a variety of computationally intensive statistical techniques and the role of computation as a tool of discovery. Topics include numerical optimization in statistical inference [expectation-maximization (EM) algorithm, Fisher scoring, etc.], random number generation, Monte Carlo (integration) methods, and bootstrap.

Prerequisites

Multivariate calculus, familiarity with basic matrix algebra, basic concepts of probability and statistics.

Course Goal

Provide a background in computationally intensive tools and methodologies relevant to statistical analysis.

Course Objectives

- Introduce and understand modern computational methods used in statistics. Included are methods for simulation and estimation.
- Understand the role of computation as a tool of discovery in data analysis.
- Be able to appropriately apply computational methodologies to real world statistical problems.

Syllabus

- Fisher Scoring
- EM Algorithm
- Random Number Generation
- Monte Carlo Methods (integration)
- Bootstrap Methods

Learning and assessment modalities
The course will be organized in five of three hours each, divided into class lectures and practical activities (exercises, software experiments and data analysis). It will be taught in English. The final assessment requires the students to prepare a short paper on one of the discussed topics, agreed with the instructor, and possibly revised according to the instructor's remarks; the final acceptation of the paper means that the exam is passed.

Teaching materials
Lecture notes and slides will be provided by the instructor, along with papers and a list of bibliographical references and additional material. All the course material is in English.

Lecture schedule
- Mon, June 3 2019, 10-13 – Room II*
- Wed, June 5 2019, 10-13 – Room II
- Thu, June 6 2019, 10-13 – Room II
- Mon, June 10 2019, 10-13 – Room II
- Wed, June 12 2019, 10-13 – Room II

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