Computational Methods in Statistical Data Science (62107)

Instructors: P.BESBEAS

Core Course, 3rd semester, 5 ECTS units
Course level: Graduate (MSc)
Language: Greek

Course Description

The course aims to develop a broad and thorough knowledge of modern statistical computing techniques, to enable use of advanced statistical modelling and inference methods in practice.

In more complex situations this will mean using numerical optimisation routines to obtain maximum likelihood estimates for the model parameters, and modern computational power to simulate distributional properties of estimators and test statistics. The course also considers how to evaluate such stochastic models. Outline syllabus includes: Numerical function optimisation. Numerical maximum likelihood and likelihood tools for inference.

Simulation techniques. Inferences using Monte-Carlo and resampling methods. The methods are implemented in the statistical programming language R, and illustrated using detailed real examples.

Prerequisites

- Applied Probability – Estimation.
- Hypothesis Testing – Linear Models.
- Statistical Applications using R.

Target Learning Outcomes

On successfully completing the module students will be able to:
- demonstrate systematic understanding of computational statistics
- demonstrate the capability to deploy established approaches accurately to analyze and solve problems in the following areas: function optimization, numerical aspects of maximum likelihood estimation, simulation methods and Monte Carlo, resampling
- apply a range of computational statistics methods, showing good judgment in the selection and application of tools and techniques
- write R programs for complex applications, making effective and well-considered use of R

Recommended Bibliography

- Rizzo, Maria. 2014. Statistical Computing with R. Chapman and Hall.
- Voss, Jochen. 2013. An introduction to statistical computing: A simulation-based approach. Wiley.
- Eubank, R. and A. Kupresanin. 2011. Statistical Computing in C++ and R. Chapman and Hall.
- Givens, Geof and Hoeting, Jennifer. 2012. Computational Statistics. Wiley.
- Gentle, James. 2009. Computational Statistics. Springer.
- Martinez, Wendy and Martinez, Angel. 2015. Computational Statistics Handbook with Matlab. Chapman and Hall.
- Gentle, James. 2013. Elements of Computational Statistics. Springer.

Teaching and Learning Activities

24 hours of lectures and terminal classes. 75 hours independent study.

Assessment and Grading Methods

Assessment: The unit is assessed by a combination of examination and continuous assessment.

Continuous Assessment: Open book written assessment completed in independent study hours.

Examination: A final written examination in the examination period