UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Complex Data Analysis

2021-3-E4102B083

Learning objectives

The course aims to introduce the Bayesian approach, both from a theoretical and applied point of view, and to problems of inference related to longitudinal data, for repeated measures over time of same statistical units. The freeware statistical software R Project will be used for the applied part of the course.

Contents

Introduction to Bayesian Statistics and to longitudinal data analysis

Detailed program

- Bayesian Statistics:

1. Introduction: framework and priors
2. Decision-theoretic foundations: evaluation of estimators and loss functions
3. Priors: models, subjectivity, conjugacy and noninformativeness
4. Bayesian point estimation: inference, normal model, dynamic models
5. Bayesian calculations: approximation methods, Markov chain Monte Carlo
6. Other topics: tests and model choice, hierarchical models, empirical Bayes

- Longitudinal data:

1. Linear mixed models: mixed-effects models, fitting, parameter variability
2. Multiple random-effect terms: crossed effects, nested effects, partially crossed effects
3. Longitudinal models: models with correlated and uncorrelated effects, precision assessment, prediction
4. Computational methods: framework, penalized least squares, residual maximum likelihood

Prerequisites

There are no formal prerequisites, but basic knwoledge of the following topics is needed: Mathematical Analysis, Linear Algebra, Probability Calculus, Statistical Inference, R programming.

Teaching methods

Theoretical and applied (with R statistical software) frontal lectures.

Assessment methods

The exam will be consist of a written test with exercises and open questions, to assess knowledge and autonomous reproduction of the study material proposed during the course.

In the exercises we will assess theoretical and applied aspects of the course, on how to correctly build, estimate and implement statistical models and inferential methodologies being studied.

In the open questions we will assess the capacity of the student in the interpretation of complex problems and in the communication of elaborated answers requiring formal reasoning, logic discretion, and coherente language.

No different exams will be provided between attending and no attending students.

Textbooks and Reading Materials

There is no specific textbook.

Class notes will be provided during the course.

For the first part of the course, a good reference book is P.D. Hoff (2009) A First Course in Bayesian Statistical Methods, Springer https://www.stat.washington.edu/~pdhoff/book.php.

For the applied part of the course students are referred to the online material available available at http://www.r-project.org.

Semester

First semester

Teaching language

English