CEU Political Science Department
PhD Program
2010/20011 Fall

Mathematical Statistics

Instructor: Tamas Rudas

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Office hours: by appointment
Class meets: Tuesdays 11:00-12:40

Course description

This is an advanced class for those students who are already familiar with some of the methods of statistical analysis. The main focus of the class is not how, rather why. That is, we will review some of the fundamental assumptions behind and optimality properties of the main statistical methods. Such knowledge is necessary for the good selection of the statistical methods to be applied and for the precise interpretation of their results. The main topics will include structure and stochastics in statistics, exploratory and confirmatory analyses, the linear model, additive and multiplicative interaction, distance measures, maximum likelihood, asymptotic and finite sample considerations, Bayesian statistics

Learning goals and outcomes

Ability to select the appropriate statistical methods for the research problem at hand, ability to realize limitations of statistical methods, ability to understand the optimality properties of statistical methods and the assumptions under which such optimality holds.

Topics to be covered (timing subject to change):

Week 1: Statistics
- Descriptive and inferential statistics
- Exploratory and confirmatory analyses

Week 2: Structure and stochastics
- Statistical models
- The role of simplicity
- Sources of randomness

Week 3: Simple statistical hypotheses

Power of a test
Neyman-Pearson theory

Week 4: Estimation
Properties of estimates
Principles of estimates

Week 5: The likelihood principle
Maximum likelihood

Week 6: Asymptotic considerations
The role of normal approximation
The central limit theorem

Week 7: The law of large numbers
The fundamental theorem of mathematical statistics

Week 8: Asymptotic behaviour of maximum likelihood estimates
Fisher information
Cramer – Rao inequality

Week 9: The linear model
The generalized linear model

Week 10: The concept of interaction
Linear interaction
Multiplicative interactions

Week 11: Bayesian statistics
Choice of prior disrtribution

Week 12: Review

Texts:

There is no text for the students of this course. Most of our topics are well represented on Wikipedia

The instructor will occasionally consult
Cox & Hinkley: Theoretical Statistics, Chapman & Hall

Grading:

Based on final take-home assignment