ESTIMATION THEORY AND NUMERICAL METHODS

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Prof. D. Paindaveine holds a Ph.D. in Statistics from ULB, 2002. He is full professor of Statistics at the Solvay Brussels School of Economics and Management, ULB. He sits in the editorial board of six international journals, among which the Annals of Statistics, Statistica Sinica, the Journal of Statistical Planning and Inference, and Statistics and Probability Letters. Since 2005, he is an elected member of the International Statistical Institute (ISI) and is a visiting professor at Université Pierre-et-Marie-Curie (Paris 6). In 2007, the American Statistical Association gave him the Gottfried E. Noether Young Scholar Award, for contributions to nonparametric statistics. He was co-director of ECARES from 2006 to 2012.

Prof. T. Verdebout holds a Ph.D in Statistics form the ULB, 2008. He spent 5 years (2009-2014) at the University of Lille 3 as an assistant professor (maître de conférence). He is currently professor (chargé de cours) at the Mathematics Department of the ULB. He has been a visiting researcher at the Princeton University and is currently in the editorial board of Statistics and Probability Letters. Since 2013, he is an elected member of the International Statistical Institute (ISI). He received in 2011 an annual price in applied mathematics of the Académie des Sciences de Belgique and got a bonus for scientific excellence in 2012, France.

Course Outline

The main objective of this course is to describe the methods that allow to estimate the unknown parameters of statistical models. The various estimation techniques will be applied on some examples and will be compared in terms of efficiency, robustness, ease of application, etc. These theoretical notions will be complemented by numerical methods such as random number generation, numerical equation solving and optimization. In addition to the understanding of the theoretical and numerical techniques, the students will be expected to be able to select the appropriate technique to be used when facing a new problem, and to solve concrete problems on the computer.

At the end of the course, Participants will be able to:

- use a variety of estimation techniques such as generalized methods of moments and maximum likelihood.
- perform regression analysis
- Pseudo and quasi random number generation

Course Structure

I. Introduction
   a. probability distributions
   b. roles of diverse parameters
   c. parameter estimation
II. Finite-sample properties of estimators
   a. unbiasedness
   b. efficiency
III. Asymptotic properties of estimators
   a. types of convergence, asymptotic normality
   b. consistency
   c. asymptotic efficiency
IV. Point estimation methods
   a. Method of moments
   b. Generalized method of moments
V. Interval estimation / hypothesis testing
VI. Random number generation
   a. Monte-Carlo simulation

b. Transformation approach
c. Acceptance / rejection approach

VII. Numerical (non-linear) equation solving
a. Numerical (non-linear) equation solving

VIII. Numerical optimization
a. Maximum likelihood programming