Institute of Statistics, Biostatistics and Actuarial Sciences (ISBA)

Young Researchers' Day

Friday, February 17, 2017
C115, ISBA

9^{00}
Welcome

9^{05}
Hélène Morsomme
"Stochastic optimal control of public pension schemes"

9^{30}
Yue Zhao
"Inference for elliptical copula multivariate response regression models"

10^{00}
Michel Thiel
"Development of modern chemometrics methods for the spectroscopic monitoring of active pharmaceutical ingredients in chemical reactions"

10^{30} : Coffee Break

11^{00}
Michaël De Backer
"An Adapted Loss Function for Censored Quantile Regression"

11^{25}
Sébastien de Valeriola
"Minimum Protection in DC Funding Pension Plans and Margrabe Options"

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"Stochastic optimal control of public pension schemes"

Hélène Morsomme

Abstract:
Population ageing undermines the current social security pension system. In this context, new pay-as-you-go pension systems are considered in order to maintain its sustainability. Solidarity between generations can result in risk sharing between the pensioners and the contributors. In classical pension design, there are essentially two kinds of pension schemes: Defined Contribution (DC) and Defined Benefit (DB) plans. Alternative pension plans based on a mix between DC And DB are considered.

Our purpose is to determine an optimal risk sharing between DC and DB. Currently, automatic balance mechanisms are studied with discrete dynamic programming. In order to generalize this approach in continuous time, we apply the stochastic optimal control theory in Brownian environment. We present this optimization for a quadratic loss function based on the processes of the replacement rate and the contribution rate.

"Inference for elliptical copula multivariate response regression models"

Yue Zhao

Abstract:
We study multivariate response linear regression within an elliptical copula context. The naive approach that treats the individual responses separately may not be optimal for a number of reasons. For instance, the coefficient matrix may have an overall structure (e.g., rank- or row-sparse) that is not reflected by its individual columns, or the different components of the error vector may be correlated. We will take into account both of these factors in our study, and in particular we will consider a row-sparse model for the coefficient matrix. We will assume that the response, the covariate and the error vectors follow a joint elliptical distribution. However, we assume that we do not observe the response and the covariate vectors directly; instead, we observe the vectors obtained by unknown, strictly increasing transformations of the individual components of the response and the covariate vectors. In other words, we observe the copula versions of the response and the covariate. In this case, the design matrix is obtained from Kendall's tau statistics via a sine function transformation, and is thus not necessarily positive semidefinite. To deal with this problem, and also to incorporate the row-sparsity of the coefficient matrix, we will use a group Dantzig selector program. We will demonstrate that under mild conditions we achieve the same optimal recovery rate for the coefficient matrix as the traditional group LASSO program under non-copula setting.

"Development of modern chemometrics methods for the spectroscopic monitoring of active pharmaceutical ingredients in chemical reactions"
Michel Thiel

Abstract:
The Quality-by-Design (QbD) framework promotes the understanding and designing of manufacturing process to ensure predefined and constant quality products. As part of this framework, the Process Analytical Technology (PAT) initiative promoted by the Food and Drug Administration (FDA) has encouraged pharmaceutical companies to perform constant monitoring of the critical quality attributes (CQA) of raw materials with methods like near infrared spectroscopy (NIR). NIR spectroscopy has many advantages: high speed acquisition, minimization of sample preparation, non destructive nature and measurements of both physical and chemical properties but generates complex multivariate data.

The aim of this PhD thesis consists in the development of chemometrics methods for the analysis of multivariate data generated in the context of the pharmaceutical industry. Spectral data generated during several chemical reactions to produce an Active Pharmaceutical Ingredient (API) will be used as part of this project. This work will focus on three objectives:

1. -Finding which experimental conditions optimize the production
2. Understanding the impact of experimental conditions on chemical reactions
3. Validating the precision of spectral measurements

This PhD thesis will start using two methods, namely ANOVA-Simultaneous Component Analysis (ASCA) and ANOVA-PCA (APCA), and their extensions for longitudinal and mixed models will be investigated.

"Minimum Protection in DC Funding Pension Plans and Margrabe Options"
Sébastien de Valeriola

Abstract:
The regulation on the Belgian occupational pension schemes has been recently changed. The new law allows for employers to choose between two different types of guarantees to offer to their affiliates. In this paper, we address the question arising naturally: which of the two guarantees is the best one? In order to answer that question, we set up a stochastic model and use financial pricing tools to compare the methods. More specifically, we link the pension liabilities to a portfolio of financial assets and compute the price of exchange options through the Margrabe formula.

"An Adapted Loss Function for Censored Quantile Regression"

Michaël De Backer

Abstract:
Since the pioneering work of Koenker and Bassett (1978), quantile regression has become a preeminent substitute to the classical least-squares regression in both theoretical and applied statistics. While mean regression models solely grasp the central behavior of the data, quantile regression allows the analyst to investigate the complete distributional information of the dependence of the response variable on a set of one or more covariates at hand. In that sense, quantile regression provides a more complete view of relationships between the response and the covariates.

Existing literature on the estimation of a quantile regression function includes numerous methodologies for fully observed response observations. In practice however, many interesting applications are affected by possible right censoring of the responses due, for instance, to the withdrawal of patients in biomedical studies, or the end of the follow-up period of a clinical trial. When confronted to such incomplete data, the statistical methodologies are to be adapted in order to avoid underestimation of the quantiles of the true response variable. In this perspective, the main rationale of the current literature has been so far to take censoring into account through the formulation of ad hoc synthetic observations or weighting schemes.

In this talk however, we discuss a novel methodology for the estimation of quantiles starting from an alternative point of view as the idea is to tackle censoring at the very level of the loss function usually employed for the computation of quantiles, the so-called "check" function. Subsequently, when considering the inclusion of covariates for conditional quantile estimation, by defining a new general loss function the proposed methodology opens the gate to numerous parametric, semiparametric and nonparametric modelling techniques. In order to illustrate this statement, we consider the well-studied linear regression. Consistency of the resulting estimator is obtained under classical assumptions, while numerical examples and a simple application to a real dataset illustrate the adequateness and finite sample performance of the proposed estimator with respect to the literature.

This is joint work with A. El Ghouch and I. Van Keilegom