POST-DOCTORAL POSITION (9 month) IN STATISTICS

- FEDER FUNDING -

Application deadline: September 10, 2020

Starting date: Octobor, 15, 2020

TITLE: Robust sequential methods for the identification of stochastic dynamic systems

PROJECT: MASyComB - Modeling and Analysis of Complex Systems in Biology (In French: Modélisation et Analyse des Systèmes Complexes en Biologie)

LABORATORY: Laboratory of Mathematics Raphaël Salem (LMRS) UMR 6085, University of Rouen Normandy, Avenue de l'Université, BP.12, 76801 Saint Étienne du Rouvray,France

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ABSTRACT: This postdoctoral topic concerns the study of sequential parameter estimation problems in non asymptotic setting for the stochastic differential equations applied in biology such that CIR or more generally CBI models. The techniques we want to develop are based on the sequential analysis approach which provides the parameter estimation for the statistical models with dependent observations in the case when the observations number is finite or bounded. This postdoctoral topic is carried out within the framework of a multidisciplinary project that involves researchers from different of theory of stochastic processes: sequential analysis, stochastic differential equations ergodic theory.

KEYWORDS: sequential analysis, stochastic differential equations, CBI models, CIR models, parameter estimation, robust estimation, truncated sequential estimation, minimax estimation, ergodic theorems

PROFILE OF THE CANDIDATE: The candidate will have a PhD in Statistics or equivalent, with knowledge in stochastic analysis. More specifically, he/she needs to have strong skills in stochastic processes, associated statistical techniques, stochastic differential equations, asymptotic statistical methods, parametric statistics.

The research program that we propose within the project "Modeling and Analysis of Complex Systems in Biology" is a part of the research and innovation strategy of the French region Normandy. This is a research project in applied mathematics within a multidisciplinary project that involves researchers from different fields: sequential analysis, stochastic differential equations, numerical analysis.

RESEARCH DIRECTIONS

The aim of this internship is to develop sequential statistics techniques for the identification of unknown parameters in Continuous state Branching processes with Immigration (CBI). Using the analysis and synthesis methods developed by Konev and Pergamenchikov (1985, 2003) for dynamic systems described by stochastic differential equations, and results obtained by Ben Alaya and Kebaier (2012, 2013) for the Cox-Ingersoll-Ross (CIR) model, we will produce new sequential procedures for estimating the parameters of these CBI processes. The estimators obtained by these methods are robust and have a non-asymptotic mean squared precision fixed in advance. Moreover, using the truncated sequential estimation methods proposed by Konev and Pergamenchikov (1993), we will also build truncated versions of these sequential procedures for the CBI processes. We will study their non asymptotic properties provided that the observation time is bounded. In this internship we also foresee a numerical component which consists, on the basis of the new techniques proposed, to develop sequential statistical algorithmsand to analyze their properties by numerical simulations to confirm the results obtained.

References.

Ben Alaya, M & Kebaier, A: Asymptotic Behavior of the Maximum Likelihood Estimator for Ergodic and Nonergodic Square-Root Diffusions. Stochastic Analysis and Applications. 31(4), 552-573, (2013).

Ben Alaya, M & Kebaier, A: Parameter estimation for the square root diffusions: ergodic and nonergodic cases. Stochastic Models. 28(4), 609-634, (2012).

Konev, V. V. and Pergamenshchikov, S. M. (1985) Sequential Estimation of the Pa- rameters of Diffusion Processes. - Problems of Information Transmission, 21 (1), 36 – 46.

Konev, V. V. and Pergamenshchikov, S. M. On Truncated Sequential Estimation of the Parameters of Diffusion Processes. - *Methods of Economical Analysis*, Central Economical and Mathematical Institute of Russian Academy of Science, Moscow, 1992, p. 3-31.

Konev, V. V. and Pergamenshchikov, S. M. (2003) Guaranteed estimation of a trigonometric polynomial by observations with an additive gaussian noise having a rational density with unknown parameter. - Statistical Inference for Stochastic Process, 6, 3, p. 215- 235.

PLANNING

- Understanding specific problems in sequential estimation and truncated sequential estimation (1 month);

- Study the main properties of the CBI and CRI models (1 month);

- Developing a sequential estimation methods for the parameter estimation problems based on existing techniques (1 months);

- Development of new statistical procedures for the parameter estimation problem for CBI and CRI models. (6 months)