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Research field: Theoretical statistics and probability theory
Key words: Asymptotic statistical theory, statistical inference for stochastic differential equations and stochastic partial differential equations, high-frequency data analysis

Present research

Our laboratory focuses on the statistical analysis of stochastic processes, high-frequency data analysis, and spatio-temporal data analysis. Stochastic differential equations (SDEs) and stochastic partial differential equations (SPDEs) are an important family of continuous-time stochastic processes used for modeling random phenomena. When the coefficient parameters are unknown, parameter estimation based on discrete observations, such as high-frequency or spatio-temporal data, is essential. However, in parametric inference based on such discrete observations, the likelihood function is rarely available in an explicit form, which makes it impracticable to directly apply standard likelihood-based methods. To address this issue, we construct contrast functions and quasi-likelihood functions as alternatives to the likelihood function. We develop estimation and testing methods based on these functions and provide their mathematical justification. Furthermore, we work on the development and theoretical validation of statistical modeling techniques, including information criteria for model selection and structural equation modeling.

In addition, we verify the asymptotic properties of the proposed methods through large-scale numerical simulations and strive to apply these theoretical results to real data analysis.

Notice for the students

To conduct statistical data analysis using stochastic process models such as SDEs and SPDEs, students are expected to have fundamental knowledge of measure theory, probability theory, and mathematical statistics, or to be willing to acquire this knowledge after enrollment. Research on theoretical statistics based on high-frequency or spatio-temporal data also requires knowledge of stochastic analysis and statistical inference for continuous-time processes. Proficiency in statistical computing tools such as R or Python is also required for numerical simulations.

After enrollment, students will study some textbooks and research papers following consultation with the supervisor. They will then select a stochastic process model which attracts their interests, learn its statistical inference theory, develop and evaluate methods through simulations and real data analysis, aiming to produce original research results.