Centro de Investigación en Ingeniería Matemática

Seminario de Análisis Numérico y Modelamiento Matemático de Estudiantes

Error analysis in the learning of fractional stochastic differential equations

This talk focuses on the study of stochastic processes with memory applied to the modeling and forecasting of time series, particularly in finance and mathematical physics [1, 2]. We consider stochastic differential equations driven by fractional Brownian motion, which constitute a broad and flexible class of models [3]. We will present an analysis framework for the approximation error in the non-parametric estimation of these equations, incorporating recent results on approximation schemes for equations driven by fractional Brownian motion [4]. We will identify the main sources of error—temporal discretization, coefficient approximation, and model fitting—and establish convergence rates that depend on the regularity of the trajectories. Finally, we will show how to estimate the coefficients of the equations using machine learning methods based on recurrent neural networks [5]. This is a collaborative work with Lauri Viitasaari (Aalto University School of Business, Finland) and Mahdi Dehshiri (Aalto University School of Business, Finland).

References

[1] C. Bayer, P. Friz and J. Gatheral. Pricing under rough volatility. Quantitative Finance, 16(6):887–904, 2016.

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[4] L. Viitasaari and C. Zeng. Stationary Wong–Zakai Approximation of Fractional Brownian Motion and Stochastic Differential Equations with Noise Perturbations. Fractal and Fractional, 6(6), 2022.

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