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Editorial

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Fractional calculus, fractional operators and fractional processes are a very rapidly developing trend today. In order to discuss these topics, the Lucia Workshop on Fractional Processes and Calculus was initiated at Linnaeus University in Växjö, Sweden, in December 2024, with a second edition held in 2025. Both international meetings were devoted to recent developments in fractional calculus, nonlocal operators, anomalous diffusion, and stochastic processes with memory and long-range dependence. Bringing together researchers from diverse mathematical traditions – including stochastic analysis, functional analysis, partial differential equations, numerical analysis, and applications in physics and life sciences – the workshop created a stimulating environment for in-depth scientific exchange.

The continuity of the series reflects both the vitality of the research area and the strong scientific community that has formed around it.

This special issue of *Modern Stochastics: Theory and Applications* collects the papers devoted to "fractional issues" and, in particular, contains selected contributions inspired by presentations and discussions during the Lucia Workshop (but not only). The papers included here illustrate the breadth of contemporary research in fractional processes and calculus, ranging from foundational theoretical advances to methodological developments and applications.

We thank all authors for their high-quality contributions and the referees for their careful and constructive reports. We hope that the present issue will serve not only as

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a record of the workshop's scientific achievements but also as a catalyst for further advances in the theory and applications of fractional and nonlocal stochastic models.

The special issue comprises five invited papers devoted to various aspects of fractional calculus and fractional processes.

The paper *"First-return time in fractional kinetics"* by M. Dahlenburg and G. Pagnini studies first-return times for random walks governed by fractional kinetics within the framework of continuous-time random walks with Mittag-Leffler waiting times. It is shown that the first-return-time density is independent of the jump-size distribution when the latter is symmetric. Exact results are obtained in both Markovian and non-Markovian settings and for general symmetric jump distributions.

The paper *"The Ornstein–Uhlenbeck process driven by the Hermite–Ornstein–Uhlenbeck process"* by C.-P. Diez and C. A. Tudor introduces a non-Gaussian Ornstein–Uhlenbeck-type model driven by Hermite–Ornstein–Uhlenbeck noise. Estimators for the drift and Hurst parameters are constructed using quadratic variations, and their asymptotic properties are established.

The paper *"Simulation of supOU processes with specified marginal distribution and correlation function"* by N. N. Leonenko and A. Pepelyshev is devoted to the simulation of a special class of processes driven by Lévy noise with flexible dependence structures, including long-range dependence, and self-decomposable marginal distributions. Fractional calculus provides a natural limiting description of supOU processes, producing power-law kernels that form a basis for fractional processes and fractional derivatives used in models of fractional-order stochastic dynamics.

The paper *"Drift parameter estimation for tempered fractional Ornstein–Uhlenbeck processes based on discrete observations"* by O. Prykhodko and K. Ralchenko studies statistical inference for Ornstein–Uhlenbeck-type models driven by tempered fractional Brownian motion and its variant of the second kind. Least-squares estimators of the drift parameter based on discrete observations are constructed and shown to be strongly consistent.

Finally, the paper *"On long-range dependent time series driven by pseudo-Poisson type processes"* by E. Azzo introduces a class of stationary time series obtained from increments of family-wise scaling processes defined via pseudo-Poisson type processes. The resulting models exhibit long-range dependence with an autocovariance function that decays according to a power law with a slowly varying component, and a spectral density that displays a power-law divergence at low frequencies. The approach extends classical results on fractional Gaussian noise as well as on series driven by Poisson-type or Lévy-type noise.