Stochastic Calculus and Applications (L24)

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This course provides an introduction to Itô calculus.

- *Stochastic calculus for continuous processes.* Martingales, local martingales, semi-martingales, quadratic variation and cross-variation, Itô's isometry, definition of the stochastic integral, Kunita-Watanabe theorem, and Itô's formula.

- *Applications to Brownian motion and martingales.* Lévy characterization of Brownian motion, Dubins-Schwarz theorem, martingale representation, Girsanov theorem, and Dirichlet problems.

- *Stochastic differential equations.* Strong and weak solutions, notions of existence and uniqueness, strong Markov property, and relation to second order partial differential equations.

- *Applications and examples.*

Pre-requisites

Knowledge of measure theoretic probability as taught in Part III Advanced Probability will be assumed, in particular familiarity with continuous-time martingales and Brownian motion.

Literature

1. J.-F. Le Gall, *Brownian Motion, Martingales, and Stochastic Calculus.* Springer. 2016

2. D. Revuz and M. Yor, *Continuous martingales and Brownian motion.* Springer. 1999

3. I. Karatzas and S. Shreve, *Brownian Motion and Stochastic Calculus.* Springer. 1998

4. L.C. Rogers and D. Williams, *Diffusions, Markov Processes, and Martingales.* Cambridge. 2000