# Stochastic Calculus and Applications to Finance (L26)

**M. Tehranchi**

This course is an introduction to the theory of continuous-time stochastic processes, including its application to financial theory. It complements the material in Advanced Probability.

- *Stochastic integration.* Finite variation processes. Martingales, local martingales and semi-martingales. Quadratic variation and co-variation. Itô's isometry and definition of stochastic integral. Kunita–Watanabe's theorem. Itô's formula.
- *Applications to Brownian motion.* Lévy's characterization of Brownian motion. Dambis–Dubins–Schwartz theorem. Girsanov's theorem. Martingale representation theorems.
- *Stochastic differential equations.* Notions of existence and uniqueness of solutions. Yamada–Watanabe theorem. Kolmogorov, Fokker–Planck and Feynmann–Kac partial differential equations.
- *Financial applications.* Arbitrage. Pricing and hedging contingent claims. Optimal investment.

### Pre-requisites

Knowledge of measure theoretic probability at the level of Part III Advanced Probability will be assumed, especially familiarity with discrete-time martingales and basic properties of Brownian motion.

### Literature

1. M. Musiela and M. Rutkowski. *Martingale Methods in Financial Modelling.* Springer. 2005
2. D. Revuz and M. Yor. *Continuous Martingales and Brownian Motion.* Springer. 2001
3. L.C. Rogers and D. Williams.*Diffusions, Markov Processes and Martingales. Vol.1 and 2.* Cambridge University Press. 2002

### Additional support

Four sheets will be provided and four associated examples classes will be given. There will be a one-hour revision class in the Easter Term.