

Stochastic Calculus

Introducing

Description

Program (detailed content):

- Continuous-time stochastic processes and martingales. Introduction to stopping times.
- Construction of Brownian motion and the stochastic integral, followed by the derivation of Itô's formula.
- Introduction to stochastic differential equations (SDEs) and derivation of the Fokker-Planck equations.
- Solving a parabolic equation using a solution of an SDE.
- Solving a Dirichlet problem using Brownian motion.
- Girsanov's theorem.
- Ergodicity of Markov processes.
- Maximum likelihood estimation of parameters in an SDE.

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):

- The Brownian motion, as well as the Wiener integral and Itô's formula.
- The relationship between a stochastic differential equation and its Fokker-Planck equation.
- The formulation of a solution to a parabolic or elliptic PDE using a suitably chosen stochastic process.
- The maximum likelihood estimation of parameters in a stochastic differential equation.

The student should be able to:

- Perform stochastic calculus by applying Itô's formula.
- Implement numerical methods for solving a parabolic or elliptic equation using a probabilistic approach based on solutions of stochastic differential equations.
- Use Girsanov's theorem combined with the ergodicity results of Markov processes to estimate parameters via maximum likelihood in stochastic differential equations.

Necessary prerequisites

Complements of Probability (3A), Advanced Probability (4A).

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

 Toulouse