

Monte Carlo and Finite Differences Methods with Applications to Finance

**ECTS** : 6

**Volume horaire** : 30

**Description du contenu de l'enseignement :**

Chapter 1. Foundations of Monte-Carlo

- Principle of Monte Carlo Methods
- Random Number Generation
- Inverse Transform Method
- Acceptance-Rejection Method
- Gaussian Distribution

Chapter 2. Variance Reduction Techniques

- Antithetic variable
- Control Variates
- Importance Sampling

Chapter 3. Simulation of Diffusion Processes

- Exact Simulation( Brownian Motion and Black–Scholes Model)
- Euler Scheme (Construction, Strong and weak error)

Chapter 4. Brownian Bridge Approach

- Brownian Bridge
- Exit Times and Barrier Options (Naive approach and Brownian Bridge Approach)

Chapter 5. Computation of Sensitivities (Greeks in finance)

- Finite Differences
- Black–Scholes Model
- Pathwise Differentiation
- Malliavin Differentiation

Chapter 6. American Options

- Discretization
- Naive Approach
- Regression Methods

Chapter 7. Finite Difference Method for Linear PDE

- Construction ( Space Discretization, Time Discretization)
- Convergence ( Consistency, Stability, Convergence )

Chapter 8. Finite Difference Method for Non-Linear PDE

- Non–Linear PDE
- The Linear Case Revisited
- Variational Inequality
- Hamilton–Jacobi–Bellman Equation

**Compétence à acquérir :**

This course provides an in-depth presentation of the main techniques for the evaluating of options using Monte Carlo techniques.

