Monte Carlo and Finite Differences Methods with Applications to Finance

ECTS : 6

Volume horaire : 30

Description du contenu de l'enseignement :

Generalities on Monte-Carlo methods
1. Generalities on the convergence of moment estimators
2. Generators of uniform law
3. Simulation of other laws (rejection method, transformation, …)
4. Low discrepancy sequences

Variance reduction
1. Antithetical control
2. Payoff regularization
3. Control Variable
4. Importance sampling

Process simulation and payoff discretization
1. Black-Scholes model
2. Discretisation of SDEs
3. Diffusion's bridges and applications to Asian, barrier and lookback options.

Calculation of sensitivities (greeks)
1. Finite differences
2. Greeks in the Black-Scholes model
3. Tangent process and Greeks
4. Malliavin calculus, Greeks, conditional expectations and pricing of American options

Calculation of conditional expectations and valuation of American options.
1. Nested Monte Carlo approach
2. Regression Methods (Tsitsiklis Van Roy, Longstaff Schwartz)
3. Rogers' Duality

Finite difference methods: the linear case
1. Construction of classical schemes (explicit, implicit, theta-scheme)
2. Conditions for stability and convergence

Finite difference methods: the non-linear case
1. Monotonous schemes: General conditions of stability and convergence
2. Examples of numerical schemes: variational problems, Hamilton-Jacobi-Bellman equations.

Compétence à acquérir :

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