Numerical Finance

ECTS : 3

Description du contenu de l'enseignement :

The course bears on the modeling and numerical analysis of financial derivatives. The objectives are:

- Understanding the financial meaning of the related mathematics: model parameters, implied volatility, Greeks.
- Learning how to derive a pricing equation based on the probabilistic formulation of a model, possibly with stochastic volatility and/or jumps,
- Learning how to implement a theta-scheme of finite differences or a tree pricing method,
- Learning simulation Monte Carlo pricing and Greeking methods: basic principles and variance reduction techniques, first in a set-up of random variables or vectors, then in a dynamic set-up of stochastic processes.

Course outline:
1) Motivating examples: Black-Scholes and Dupire model, Realized volatility vs Implied volatility vs Local volatility,
2) Derivation of the Pricing Equations in various models,
3) Deterministic Pricing Schemes: Finite Differences methods and Tree Methods
4) Simulation Pricing Schemes: simulation of random variables and stochastic processes, Pseudo Monte Carlo versus Quasi Monte Carlo, variance reduction techniques

Compétence à acquérir :

Master the modelling and numerical analysis of financial derivatives

Mode de contrôle des connaissances :

Project (in teams of two to three students)

Bibliographie, lectures recommandées :

Crépey S., Computational Finance Lecture Notes, 2009 edition, 188 pages, available on http://www.maths.univ-evry.fr/crepey
Lamberton D. and Lapeyre P., Introduction to Stochastic Calculus Applied to Finance. Chapman & Hall, 2nd revised edition, 2007.
Shreve S., Stochastic Calculus for Finance II, Springer Finance, 2008.
Hull J., Options, Futures, and Other Derivative Securities, Prentice-Hall, 7th edition, 2009.