MATH571 – Mathematical Models of Financial Derivatives (Fall 2006)

Course objective

This course is directed to those students who would like to acquire an introduction to the pricing theory of financial derivatives. The course starts with the discussion of fundamental concepts of financial economics, like the fundamental theorem of asset pricing, risk neutral valuation principle. The renowned Black-Scholes pricing theory and martingale pricing theory will be introduced. Lattice tree methods and Monte Carlo simulation for pricing European and American options will be considered.

Prerequisite and exclusion

No prior knowledge in finance is required. Knowledge in probability theory and partial differential equation will be very useful.

Instructor

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Course content

1. Single period securities model
    - 1.1 Dominant trading strategies and linear pricing measure
    - 1.2 No-arbitrage theory and risk neutral probability measure
    - 1.3 Valuation of contingent claims and complete markets
    - 1.4 Binomial option pricing model
2. Filtrations, martingales and multi-period models
    - 2.1 Information structures and filtrations
    - 2.2 Notions of martingales
    - 2.3 Multi-period securities models
    - 2.4 No-arbitrage principle and martingale measure
    - 2.5 Multi-period binomial models
3. Review of stochastic processes and Ito calculus
    - 3.1 Brownian motions
    - 3.2 Ito calculus
    - 3.3 Change of measure: Girsanov's Theorem
4. Option pricing models under the Black-Scholes framework
    - 4.1 Riskless hedging principle and dynamic replication strategy
    - 4.2 Martingale pricing approach
    - 4.3 European option pricing formulas and their greeks
    - 4.4 Exchange options and quanto-prewashing techniques
5. American style options
    - 5.1 Characterization of optimal exercise policies
    - 5.2 Formulation as optimal stopping problems
6. Numerical methods of option pricing
    - 6.1 Lattice tree algorithms
    - 6.2 Finite difference methods
    - 6.3 Monte Carlo simulation

Grading policies

Two one-hour mid-term tests	25% x 2
Two-hour final examination	50%
Six sets of homework	0%