Engineering and Structured products

MAF, Module 3, 2019-2020

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Course description

The course is an introduction to the theory and practice of financial engineering.
It will cover the pricing of full range of financial instruments(forwards, swaps, options, structured products), binomial and Black−Scholes model for option pricing, hedging and replication of derivatives and other important topics. For options it will cover local volatility models for options and main numerical methods to pricing (solving PDE, calibration, and prepare full pipeline of model steps to obtain price).
The course will use Python programming language for Homeworks.
The material will be particularly relevant to students interested in financial markets, securities trading and structured products development involving derivatives.

Course requirements, grading, and attendance policies

Prerequisites:
1. Derivatives
2. Probability theory
3. Programming skills

Grading:
Homework Project 50%
Lecture Tests 50%

Software and tools: Jupyter notebook, Python

Course contents

- Review of Static Arbitrage
    - Interest rates
    - Forwards
        - Forward ZCB,
        - LIBOR
        - Forward Rate Agreement (FRA). Forward LIBOR rate
    - Swaps
        - Interest rate swap (IRS).
        - Forward swap rate.
        - Spot-starting swaps.
    - Options
        - Call-Put parity
        - Call and put spreads
        - Options on forward contracts
        - Black Scholes model

    - Greeks
- Numerical analysis
    - Solving non-linear equations
    - Finite different methods
    - Optimisation and calibration methods
- Volatility modelling
    - Dupire formula
    - Local Volatility
    - Andreessen and Huge model
    - Greeks
- Binomial tree
    - European and American options pricing
    - American Monte-Carlo method
- Structured products pricing
    - Autocollable notes
    - The SVI implied volatility model and its calibration
    - FtD Contract under Copula Approach

Description of course methodology
- Lectures
- Test every lecture
- Seminars
- Final homework project

Course materials

Required textbooks and materials
- Lecture Notes
- Shreve S. E. Stochastic calculus for finance II: Continuous-time models. – Springer Science & Business Media, 2004. – Т. 11.
- Shreve S. Stochastic calculus for finance I: the binomial asset pricing model. – Springer Science & Business Media, 2005.
- Lyuu Y. D. et al. Financial Engineering and Computation //Principles, Ma. – 2002

Additional materials

Academic integrity policy

Cheating, plagiarism, and any other violations of academic ethics at NES are not tolerated.