Derivatives and Financial Engineering

FIB, Module 4, 2019-2020

Vyacheslav Gorovoy, PhD

vgorovoy[at]nes.ru

Course information

Course Website: https://my.nes.ru

Instructor's Office Hours: by assignment

TAs: Marharyta Batashava

Course description

The course is an introduction to the theory and practice of financial engineering. It will cover the pricing of forward and futures contracts, binomial and Black–Scholes– Merton model for option pricing, hedging and replication of derivatives and other important topics. The course will use Python programming language for HWs and exam. 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. Calculus
2. Probability, statistics
3. An introductory finance course

Grading:

3 homework problem sets	**30% (each 10%)**
Game	**10%**
Exam	**60%**

Software and tools: Jupyter notebook

Course contents

- Introduction to Financial Engineering
- Forward and Futures contracts: Pricing by arbitrage. Investing, trading, hedging, and arbitrage applications. Foreign exchange, equity, and commodity markets.
- Introduction to Options: Option basics. Model–free properties of option prices. Arbitrage relationship. The binomial model of asset price dynamics.
- The Black–Scholes Model: Modeling stock price behavior. Geometric Brownian motion. Lognormal distribution. Risk–neutral valuation. The Black–Scholes– Merton option pricing formula.
- Hedging: Option hedging. Greeks . Synthetic replication and hedging of options. Option hedging. Delta hedging. Greeks.
- Volatility: Implied volatility. Implied distribution. FX and equity smiles. The volatility surface and term structure. Historical versus implied volatility.
- Structured Products: Capital protected and Yield enhancement products.
- Credit risk adjustment: CVA. Wrong/Right way risk.

Description of course methodology

- Lectures
- Homeworks
- In-class simulation: derivative game

Sample tasks for course evaluation

Exotic call:
This option has the standard call payoff pays max(S_T – K ,0) at expiration T. However, the holder pays a fixed cash amount Q to the option writer at expiration only if S_T>K . Derive a closed-form formula for this cash amount Q to be paid at expiration.

Course materials

Textbooks and materials

- Lecture notes
- John Hull, “Options, Futures, and Other Derivatives”

Academic integrity policy

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