DERIVATIVES
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TA: TBD

Course description

The course is designed to provide an overview of the derivatives instruments, a framework for understanding basic valuation concepts as well as real world applications of derivatives. Getting lost in math equations is not purpose of this course, although familiarity with basic math and probability concepts (expected value, correlation, probability distribution, basic calculus etc.) is expected and will be helpful. Instead we will try to strike the right balance between technicalities and ideas so that you could get grasp of the main financial engineering concepts and its applications to make use of derivatives in your future careers either as a hedging tool or an investment. We will also discuss the risks of the derivative instruments extensively and cover many famous derivatives' losses in financial history.

Grading

Your course grade will be determined by results of your quizzes, homeworks, class participation & final exam.

- (15%) Quizzes. You'll have a 10-min quiz at the beginning of a class. Don't be shy, don't panic, it is just a simple check of the lecture materials we discussed the class before. You'll get a score for each quiz. There will be 3-4 of them.
- (35%) Homeworks. There will be 4-5 of them.
- (50%) Final exam covers core topics from the course.

Course intended schedule and contents

Class	Topic	Reading

1	● Introduction to Financial Engineering
	   o What is a derivative?
	   o Why do we discuss derivatives separately from the rest of financial instruments?
	
	● Forward and Futures contracts
	   o Introduction to forward/futures contracts.
	   o Constructing a replicating portfolio. Arbitrage arguments.
	   o Investing, trading, hedging, and arbitrage applications
	   o Foreign exchange, equity, and commodity markets
	   o Mark-to-market of forward contracts
		[1] Ch. 1-6

2	● Swaps
	   o FX swaps
	   o Interest rate curve. Forward rates. FRA. FRN
	   o Interest rate swaps. Mark-to-Market
	   o FX and Cross-currency interest rates swaps revisited
	   o Applications
		[1] Ch. 7

3	● Introduction to Options
	   o Options basics
	   o Arbitrage relationship
	   o Strategies based on relative value: Long/Short, Market neutral
	   o The binomial model of asset price dynamics
	
	● The Black–Scholes Model
	   o Modeling stock price behavior.
	   o Basics of Ito's calculus
	   o Geometric Brownian motion. Lognormal distribution
		[1] Ch. 8-11

4	● The Black–Scholes Model (continued)
	   o The Black–Scholes option pricing formula
	● Option hedging and trading. Greeks
	   o Dynamic delta-hedging.
	   o Gamma. Properties of gamma positive position.
	   o Gamma-delta-neutral position
	   o Options – trading volatility
	   o Option trading strategies
	   o FX and equity smiles. The volatility surface and term structure
		[1] Ch. 12-13

Class	Topic	Reading
5	● Risk neutral valuation o Option prices and risk-neutrality o Repricing option is risk-neutral measure o Numeric methods of pricing: Monte Carlo method ● Exotic options o Asian options o Barrier options o Quanto options ● Application: Multi-currency deposits	[1] Ch. 17-19, 27
6	● Credit derivatives o Implied probabilities of defaults from bonds and CDS o Collateral debt obligation (CDO) o Fundamental problem with pricing credit derivatives o Exposure. CVA of options and forward contracts o Wrong way risk. Right way risk ● Applications o Problems with CDO pricing (and credit pricing in general!) o First-to-default basket	[1] Ch. 22-23
7	● Derivatives as a source of disaster o What can go wrong: where practice differs from theory and math finds its limitations o World's largest derivatives' losses: what went wrong	[1] Ch. 24

Description of course methodology

Students are expected to effectively prepare to each class. There will be 3 seminars with the TA to focus on more technical areas of the course.

Course materials

Recommended textbooks and materials

1. Hull, Options, Futures, and Other Derivatives, Prentice-Hall

   While the Hull's book is a standard go-to textbook for the introductory course on derivatives the other two books though less known are written with passion for the subject. The first one (Neftci) being a bit more practical and the other a bit more conceptual (Joshi):

2. Neftci, Principles of Financial Engineering, Elsevier
3. Joshi, The concepts and practice of Mathematical Finance, Cambridge

Academic integrity policy

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