

Queens College
Department of Computer Science
COMPUTATIONAL FINANCE
CSCI 765
—SAMPLE SYLLABUS—
instructor: Bojana Obrenić

Course Description:

Valuation of financial derivatives is presented as a family of algorithmic computations, centering on understanding and implementation of about fifty selected algorithms. Concepts include time value of money; market risk and credit risk; arbitrage; forwards and futures on stock, currencies, interest-rates, indices, commodities; collateral, marking-to-market, margining, netting; fundamentals of capital asset pricing; yield curves, bond prices, forward rates; swaps; options, claim synthesis; binomial trees; Weiner processes, Itô's Lemma, Black-Scholes-Merton model for options; Greeks; implied volatility and term structure; credit risk, estimates of credit default probabilities, credit default spreads and default intensities; introduction to some path dependent and exotic derivatives.

Required textbooks:

- (1) J. C. Hull:
Options, Futures and Other Derivatives,
Prentice-Hall, 2008, 7th edition
ISBN 978-0-13-601586-4.
- (2) J. C. Hull:
Options, Futures and Other Derivatives,
Student Solutions Manual,
Prentice-Hall, 2008,
ISBN 978-0-13-601589-5 or 0-13-601589-1.

Lab manual:

Computational Finance
—*synopsis, algorithm catalog, problems*—
by the instructor.

Objective:

Ability to implement independently the pricing of most popular derivative contracts, including formulation of input-output algorithm specification, efficiency analysis (time and other resources), coding practice, and analysis of assumptions and restrictions imposed by models or forced by data sources; ability to extend concepts and components of these basic algorithms to the valuation of more complex derivative contracts.

Schedule and Topics:

Week 1	Chapter 1,2	Introduction to derivative trading, arbitrage; Futures, marking to market, margining
Week 2	Chapter 3,4	Index futures, hedging; Interest rates and conversion; bonds and forward rate agreements; bootstrapping yield curve from bond prices
Week 3	Chapter 5	Forward contracts: investment assets with known dividend income or yield, indices, currencies, commodities
Week 4	Chapter 6	Conversion factors and cost-to-deliver for Treasury bonds; clean and dirty prices of bonds and bond futures
Week 5	Chapter 7	Fixed-float interest-rate swaps and fixed-fixed currency swaps; bootstrapping yield curve from swap rates
Week 6	Chapter 8,9,10	European and American options; put-call parity; Combining options and stock: call, put, bull, bear, box, butterfly, calendar, straddle, strangle, ...
Week 7	Chapter 11,16,19	Binomial tree for pricing American (and European) put and call on stock, index, currency, futures
Week 8	Chapter 12	Generalized Weiner Process
Week 9	Chapter 12,13	Analytical derivation of a stochastic process for a claim on log-normal stock via Itô's Lemma;
Week 10	Chapter 13,15,16	Black-Scholes-Merton price of European put and call on stock, index, currency, futures; American call on stock, Black's approximation
Week 11	Chapter 17,18	Greeks, implied volatility, volatility smiles and term structure
Week 12	Chapter 22	Credit risk; default probability from corporate bond prices and from equity price (Merton's model)
Week 13	Chapter 23	CDS spread from default intensity prices and recovery ratio; MTM of CDS; implied default intensity from CDS spreads; convertible bond via binomial tree
Week 14	Chapter 24	Exotic options
Week 15		Final exam

Requirements:

There are three mid-term in-class problem-solving exams, and the final exam (all “cumulative.”) Exams are solved with open books and notes; they are administered in a computer lab, and Excel or an equivalent software tool is employed to implement the required calculation and to run small instances of valuation algorithms on the exams.

Final-grade rule:

First mid-term:	10%;
Second mid-term:	20%;
Third mid-term:	30%;
Final:	40%;

Absence and make-up policies:

No alternative examination time is available to individual students for any examination, regardless of the reasons for non-attendance. Two aspects of leniency apply:

- Any normalized score is automatically substituted by the one earned on the following exam if the substitution is favorable, thereby providing an automatic make-up opportunity for all students on each midterm exam;
- Extra credit is offered on each exam, and outstanding performance on any individual exam thus directly contributes to the final sum.