Objective: The objective of this course is to introduce derivative products including forwards, futures and swaps ("linear" contracts) and options ("non-linear" contracts). Emphasis is placed on "plain-vanilla" or "first-generation" products, but some coverage of "exotic" or "second-generation" products is provided. This course stresses the valuation and application of derivative securities. To this end, we employ a combination of two texts: Hull, which offers strong coverage of valuation issues; and Mason et al, which represents a case-study approach to product application. Topics covered include the risk-neutral pricing of linear and non-linear contracts; the dynamic and static replication (and therefore hedging of price risk) of derivative securities; credit derivatives and the management of credit risk; and applications including hedging financial risk, tactical asset allocation and money management, facilitating certain corporate treasury management functions, accessing capital on a global scale, speculation, and regulatory and tax arbitrage. At the conclusion of this course the student should know what these products are, how they are traded, how they are priced, and how they are employed to achieve a variety of financial goals.


Grading: There are two take-home style exams, each worth forty percent of the final letter grade. There is one project worth twenty percent of the final grade.

Project: Phase I: Price an Asian option (arithmetic averaging and equal weighting). Use a Monte Carlo simulation with geometric Brownian motion in discrete time and a risk-neutral economy. The parameter values are $S = X = 50$, $r = .03$ p.a., and $\sigma = .20$ p.a. The option's payoff is $\text{MAX}[0,\text{Save} - X]$. The option has a thirty-day maturity and you are to use a one-day time increment and 2000 trials. Report your price and its standard error, and ten price paths. The Phase I due date is June 21.

Phase II: Extend your software to accommodate two correlated state variables. Specifically, introduce a second asset with $S = 48$ and $\sigma = .30$. The correlation among the two assets is 0.40. Now price a spread option whose payoff is $\text{MAX}[0, S_1 - S_2]$, where $S_1$ ($S_2$) is the terminal price of the first (second) asset. This option has a forty-day maturity. Again use a one-day time increment and 2000 trials. Turn-in the option price, its standard error, and ten price paths. The due date for Phase II is July 17.
Exams and projects are to be completed independently. My e-mail handle is tucker@mtaglobal.com, my home office number is 215-736-8622, and my home fax number is 215-736-8477. My cell number is 215-378-3651. The solutions manual to Hull is available at the reserve desk of the main library.

Class Schedule

Monday, May 15:  *Course Introduction:* We briefly review the syllabus and then introduce important concepts that are witnessed throughout the course. These include arbitrage and the law of one price; risk-neutral valuation; geometric Brownian motion; price and credit risk; local risk management for dealers; linear and non-linear contracts; and other concepts. The appropriate readings are Hull’s chapter 1 Mason’s chapters 1-2.

Wednesday, May 17:  *Risk-Neutral Valuation:* This important valuation tool is covered via example in a simple one-period two-state setting. The principal point is to show that derivatives (on traded assets) can be priced as if all investors are risk-neutral. We then cover geometric Brownian motion in a risk-neutral economy and describe the project assignment in detail. GBM will be employed as a descriptive model of asset price dynamics when dealing with equities, equity indices, currencies, and certain interest rate products. Finally, Phase I of the project assignment is detailed. The appropriate readings are Hull’s chapter 10 and sections 9.1, 9.2, and 16.6.

Monday, May 22:  *Black-Scholes:* We begin with options because, as non-linear contracts, they can be combined to create linear contracts. Thus, our coverage of options will readily accommodate our later coverage of forwards, futures and swaps. Here we cover the seminal model of Fisher Black and Myron Scholes for the pricing of European-style plain-vanilla calls and puts. Put-call parity is also covered. The appropriate reading is Hull’s chapter 11.

Wednesday, May 24:  *More Black-Scholes:* Here we extend the model to accommodate underlying securities that pay discrete or continuous dividends. And we cover issues related to volatility estimation including generating implied vols, vol smiles and skews, implied volatility term structures and forward vols. The appropriate readings are Hull’s chapter 12 and sections 17.1 and 17.5.
Wednesday, May 31: *American Options Pricing*: We cover the valuation of American-style options using the binomial options pricing model of Cox, Ross and Rubinstein. The BOPM is the discrete-time analog of Black-Scholes. The trinomial model is also covered. Appropriate readings are Hull chapter 9 and sections 16.1-16.5.

Monday, June 5: *Dynamic Hedging*: We cover how option dealers can hedge their books at a local level via dynamic hedging. You’ll need your Greek alphabet for this one. And you will get a good feel for what a risk management report looks like from the middle office. The appropriate reading is Hull’s chapter 13.

Wednesday, June 7: *Option Applications*: Our first case study is finally here. We will discuss how Coca-Cola used warrants to achieve a funding rate below the comparable-maturity treasury yield - a negative credit spread. The assigned reading is Mason’s “Coca-Cola Harmless Warrants”.


Wednesday, June 14: *Forward and Futures Contracts*: Institutional topics such as daily resettlement and margin requirements are quickly covered, followed by a derivation of the carrying charge model via use of put-call parity and the creation of synthetic forwards. The readings are Hull’s chapters 2, 3 and 4.

Monday, June 19: *More on Futures*: We cover the unbiased forward rate hypothesis and illustrate micro hedges with futures contracts. Other futures contract applications are discussed including index tracking and spread strategies.

Wednesday, June 21: *Swaps*: We cover the various types of plain-vanilla swap products including interest rate, currency, equity, commodity, and cross-currency interest rate swaps. Emphasis is placed on product description and applications for risk management. Read Hull’s chapter 5. Phase II of the project is assigned.

Monday, June 26: *Swap Pricing*: We cover the valuation of at-market plain-vanilla interest rate swaps, necessitating discussion of forward interest rate computation and the concepts of par rates and swap curves. Price risk and credit risk management for swap dealers are also covered.

Wednesday, June 28: *Swap Applications*: We focus on early arbitrage gains from interest rate swap trading. The reading is Mason’s case titled “The B.F. Goodrich-Rabobank Interest Rate Swap”.
Monday, July 10:  *More Swap Applications:* We focus on accessing capital on a global scale via currency swaps. The case study is Mason’s “The Walt Disney Company’s Yen Financing”.

Wednesday, July 12:  *Black’s Model and Interest Rate Options:* We cover the valuation of particular interest rate options using Black’s model, namely those whose values do not depend on the evolution of the term structure of interest rates. Specifically, we cover the pricing of European-style caps and floors, swaptions, and bond options. The appropriate reading is Hull’s chapter 20.

Monday, July 17:  *Exotic Options:* We address the various types of popular second-generation option products including certain path-dependent options, correlation options, digital options, and others. Our focus is on payoff conditions, product use, and additional hedging complexities at a local level. The reading is Hull’s chapter 18.

Wednesday, July 19:  *More Exotic Options:* We address a popular hedging technique for barrier and digital options known as static replication. We also demonstrate how structured products are engineered by embedding exotic options in otherwise plain-vanilla instruments. The second exam is assigned and is due Monday, July 31.

Monday, July 24:  *Credit Derivatives:* Credit derivatives have existed since 1991 but have only recently witnessed volume growth in secondary markets. Essentially, these products permit investors to isolate credit risk and to hedge it, speculate on it, et cetera. In short, credit derivatives can be used to engage in strategies entailing credit risk in the same manner that non-credit derivatives can be used in strategies involving price risk. Here we examine some of the more popular credit derivatives including credit spread swaps, default swaps, and total return swaps. The reading is Hull’s chapter 23.

Wednesday, July 26:  *Value-at-Risk and Credit-at-Risk:* VaR is illustrated using a simple variance-covariance model for linear securities. Modern CaR models are also discussed.
How to Find a Job in the Derivatives Industry

Step 1: Get a copy of The Tokyo-Mitsubishi Risk Directory (Risk Publications, 101-112 Marylebone Lane, London W1M 5FU, Tel 44 (0) 171 487 5326, Fax 44 (0) 171 486 0879 (ISBN 1 899332 60 X). This directory lists the names and addresses of key derivatives and risk management personnel around the world. Apply screens by geography and the like, to obtain a list of about 60. Send your resume and cover letter to all 60 indicating the desired position (sales and trading, middle office, et cetera). You will get about 6-8 interviews.

Step 2: Pick up and read a copy of Jeffrey G. Allen’s The Complete Q&A Job Interview Book, 2nd ed., 1997, John Wiley & Sons: New York, NY. This is a general book that will help you to prepare for any job interview.

Step 3: Pick up and read Timothy Falcon Crack’s Heard on the Street: Quantitative Questions from Wall Street Job Interviews, at www.angelfire.com (and follow links). This book provides an excellent review of the kinds of interview questions you are likely to encounter in the derivatives industry.


Step 5: Join the Global Association of Risk Professionals (GARP). Membership is free. See their web site at www.garp.com. Also consider joining the International Association of Financial Engineers at www.iafe.org. Student membership is inexpensive.

Step 6: Consider sitting for GARP’s exam leading to a certification in financial risk management (Certified Risk Manager) and the IAFE’s exam leading to a certification in financial engineering (Licensed Financial Engineer).

Important Dates

Wednesday, May 17: Project Phase I is assigned
Monday, June 12: Exam 1 is assigned
Wednesday, June 21: Project Phase I is due, Phase II is assigned
Monday, June 26: Exam 1 due
Monday, July 17: Project Phase II due
Wednesday, July 19: Exam 2 is assigned
Monday, July 31: Exam 2 is due

*Place your exam, in a sealed and signed envelope, in my NYU mailbox. You may not e-mail your exam.
**On Accounting for Derivatives**

FASB recently passed new regulations on the accounting treatment of all derivative products (*FAS133*). Under these new regulations, all derivatives will be on-balance-sheet items (starting 1-1-2001) and, for the income statement/earnings, must be marked-to-market or marked-to-model under a “fair value” system. Qualifications for hedge accounting treatment are considerably more stringent and complex. For more on this topic, see FASB’s web site ([www.fasb.com](http://www.fasb.com)) and use the search engine with key words “derivatives” and “fair value”. Also see *Derivatives and Hedging - An Advanced Analysis of the FASB's New Rules*, Earnst & Young, LLP, *Financial Reporting Developments*, April 1998 and updates.

**A Final Word**

Given our time constraints as well as the intended scope of this course, we obviously will not have covered all there is to know about derivative products at the conclusion of the course. Noteworthy topics not covered include term structure modeling and the valuation of interest rate derivatives dependent upon the evolution of the term structure; alternative numerical procedures and issues related to computational efficiency; pending tax, legal and regulatory matters related to the derivatives industry; the pricing of derivatives on non-traded assets; and other topics.