

**NEW YORK UNIVERSITY**

**Leonard N. Stern School of Business**

Advanced Futures and Options  
FINC-GB.3340.01 (B40.3340)  
Fall 2011

Professor Marti G. Subrahmanyam  
Teaching Assistant: Jason Levine

**Course Description:**

This course consists of three parts. The first section of the course is a detailed examination of the pricing and hedging of option contracts, with particular emphasis on the application of these concepts to the design of derivatives instruments and trading strategies. The first part of this section is a review and re-examination of materials covered in the basic course, but with greater rigor and depth of coverage. The emphasis in the second part of this first section is on trading applications and risk management. The second section of the course is designed to provide a broad exposure to the subject of interest rate derivative products, both swaps and options. The last section of the course deals with recent innovations in the derivatives markets such as exotic options, credit derivatives and catastrophe derivatives.

In the first section of the course, the discussion of trading strategies is in the context of the management of the risk of a derivatives book. Although the principles developed in this course are relevant to the pricing and hedging of any derivative asset, their applications to the specific cases of options on stocks, stock indices, foreign exchange, futures contracts and interest rate instruments are analyzed.

The topics covered in the second part of the course include the relationship of swaps to other fixed income contracts such as futures contracts and forward rate agreements, valuation and hedging of swaps, building the yield curve, and valuation and hedging of interest rate options, with particular reference to caps, floors and swaptions, and modeling the term structure of interest rates. The application of these concepts to foreign exchange and commodity derivatives is also discussed in this section.

The third section of the course deals with non-standard option contracts such as exotic options and options on new underlying instruments such as credit, weather and insurance derivatives. Although the discussion of exotic options is fairly broad, some exotic instruments such as barrier options, Asian options and hybrid (correlation) products will be analyzed in more detail. Credit derivatives, with particular reference to credit default swaps and collateralized debt obligations will be the focus of attention in the second part of this section.

The pedagogy is a combination of lectures/discussions and PC-based problem solutions. The course is intensive and requires a fair amount (~ 6-8 hours) of homework each week, in addition to preparation for class. The orientation of the course is the *practical* application of option concepts, rather than a discussion of option theory by itself. However, since option concepts are somewhat mathematical, a strong quantitative background, though not required, would be an advantage.

### **Required/Recommended Textbooks/Software:**

Recommended: J.C. Hull, *Options, Futures and other Derivative Securities*, 8<sup>th</sup> edition, Prentice-Hall, 2011. (H)

Optional: R. Sundaram and S. Das, *Derivatives: Principles and Practice*, McGraw-Hill/Irwin, 2011.

*FINCAD Analytics Suite 2011 for Excel*

The book by Hull is probably the most comprehensive derivatives textbook available today. We will use it as background, but will not follow it closely. The forthcoming book by Das and Sundaram is more intuitive. Since the book has not yet been published, I will distribute selected chapters of the manuscript.

### **Other Materials:**

- Copies of overhead transparencies. [To be handed out in class]
- Problem sets and computer exercises. [To be handed out in class. Also, available on the course website on Blackboard.]
- Option pricing/hedging software. [Available on the course website on Blackboard.]

### **Instructions:**

Students in the course are expected to study the readings and problem sets prior to the assigned dates and come prepared to discuss them in class. The following outline represents the topics, readings, assignments and dates for discussion. The reference dates noted are *rough* estimates for the time allotted to each subject area. Any modifications of the schedule will be announced in class.

There are several problem sets – roughly one per week throughout the course - to be worked out in groups. In many instances, students are required to use PC-based software for the solution of the problem sets. Students should work on the problem sets in groups of three. *No exceptions to this rule will be permitted without the permission of the instructor.* Solutions to the problem sets should be worked out, *printed* and handed in prior to class on the dates they are due. Hand calculators will be necessary for problem sets and examinations. *Students are urged to bring calculators to all sessions.* The lectures and reading materials assigned will, in many instances, provide an appropriate format for analysis and solution of the problem sets.

There will be two *take-home* quizzes and a final examination in the course. Grading for the course will be based approximately on the following weights:

Problem Sets and Assignments	20%
Class Participation	20%
Quizzes	20%
Final Examination	40%
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	100%

The overall grade distribution in the course will be approximately as follows:

A	10-15%
A-	10-15%
B+	15-25%
B	15-25%
B	15-25%
C+	10-15%
≤ C	0% (hopefully)

All class sessions will be videotaped and webcast. However, viewing these recordings is meant to be a supplement and not a substitute for attending class sessions. Based on past experience, much of the learning in the course is from participating in the class discussions.

### **Classroom Etiquette and Related Matters:**

Students registered in the course are expected to attend all sessions and be in class by 10.30 am. They should sit in the same place each class, as per the seating chart circulated in the first session. Students who come in late should enter from the side door of the classroom and take their places on the last row, as quietly as possible. Since class participation is assessed and forms part of the grade in the course, regular class attendance is required. In line with school policy, the use of laptop computers, cellular phones and mobile communication devices, and other electronic equipment is not

allowed during class sessions.

In order to use the class sessions more efficiently, quizzes are scheduled to be taken at home. It is to be understood that students take quizzes *without any external help from others*. Any breach of this rule will be taken seriously. Students should adhere to the MBA Honor Code and every student is obligated to report to the instructor any suspected violation of the code that he or she has observed. Further instructions are available at [http://w4.stern.nyu.edu/scorp/committee.cfm?doc\\_id=4797](http://w4.stern.nyu.edu/scorp/committee.cfm?doc_id=4797).

Students with disabilities are advised to meet the instructor to make arrangements for appropriate help after consulting the Moses Center for Students with Disabilities (CSD, 998-4980).

**Course Prerequisite:**

Pricing of Options, Futures and Other Contingent Claims FINC-GB.3335 (B40.3335)

Students who have not taken the prerequisite are *required* to take the permission of the instructor before taking the course.

**Office Hours:**

Tuesdays, 12 noon – 1 p.m.,  
Thursdays, 12 noon – 1 p.m.,  
and by appointment. (Please call Ms. Hakema Zamdin at 998-0301 for an appointment.)

In addition, there will also be office hours in an internet chat-room, approximately every other week. Details will be announced in the second week of class.

Office:	Room 9-68, KMC	Tel: X80348	e-mail: <a href="mailto:msubrahm@stern.nyu.edu">msubrahm@stern.nyu.edu</a>
Tutor:	Jason Levine	Tel: X80314	e-mail: <a href="mailto:jlevine@stern.nyu.edu">jlevine@stern.nyu.edu</a>

## COURSE OUTLINE

<b>Date</b>	<b>Sess. No.</b>	<b>Subject</b>	<b>Chapter or Source</b>
09/06	I	Introduction and Review	
		* Definition of the Contracts	H, Ch. 1 (review)
		* Payoff Diagrams	
		* Basic Option Trading Strategies	H, Ch. 11 (review)
		* Reverse Engineering of Option Payoffs	
09/08	II	Introduction and Review (Contd.)	
		* No-arbitrage Restrictions	H, Ch. 10 (to p. 220)
		* Early Exercise of American Options	H, Ch. 10 (pp. 224-231)
09/13	III	Introduction and Review (Contd.)	
		* Put-Call Parity	H, Ch. 10 (pp. 221-224)
		The Binomial Model	
		* Single-stage Model	H, Ch. 12 (to p. 259)
		* Riskless Hedge	
		* Replication	

**Problem Sets**

**# 1 and # 2**

**Payoff Diagrams, Reverse Engineering and No-Arbitrage  
Restrictions**

<b>Date</b>	<b>Sess. No.</b>	<b>Subject</b>	<b>Chapter or Source</b>
09/15	IV	The Binomial Model (Contd.)	
		* Risk-Neutral Probability	H, Ch. 12 (p. 229-273)
		* Multiple Stages	R. Sundaram
		* American Options	
		* Dynamic Hedging	

**Problem Set**

**# 3**

**Put-Call Parity**

09/20	V	The Binomial Model (Contd.)	
		* The Limiting Case	
		* Construction of Binomial Lattices	H, Ch. 20
09/22	VI	The Black-Scholes-Merton Model	
		* Intuitive Interpretation of Volatility	H, Ch.14
		* Simple Proof of the Model	

**Problem Set**

**# 4**

**Binomial Model**

<b>Date</b>	<b>Sess. No.</b>	<b>Subject</b>	<b>Chapter or Source</b>
09/27	VII	The Black-Scholes-Merton Model (Contd.)	
		* Alternative Proofs (Intuition)	H, Ch.14
		* Computational Issues	
		* Extensions: Futures (Black)	H, Ch.17
		* Stock Indices, Dividends, Foreign Exchange	H, Ch.16
10/04	VIII	The Black-Scholes Model (Contd.)	
		* Alternative Assumptions	
		* Hedge Ratio	H, Ch.18 (pp. 380-387)
		* Implied Volatility	M. Brenner/ M. Subrahmanyam (1)
		* Measurement of Volatility	H, Ch. 22 (skim)
		* Empirical patterns of volatility: smile, mean-reversion	
10/06	IX	Valuation and Hedging of American Options	
		* The Early Exercise Decision	H, Ch.12 (after p. 263)
		* Binomial Method	
		* Trinomial Method	H, Ch.20 (pp. 442-466)
		* Monte Carlo Method	
		* Finite Difference Method	
		* Geske-Johnson Approximation	R.Stapleton/ M. Subrahmanyam (1)

<b>Date</b>	<b>Sess. No.</b>	<b>Subject</b>	<b>Chapter or Source</b>
10/11	X	Sensitivity Analysis I (Option Values)	
		* Option Delta	H, Ch.18 (to p. 396)
		* Option Theta, Vega (Kappa)	
10/13	XI	Sensitivity Analysis II (Option Hedge Ratios)	
		* Option Gamma	H, Ch.18 (after p. 396)
		* Option Omega	Brenner/ Subrahmanyam (2)

**Problem Set**

**# 5**

**Sensitivity Analysis:  
Option Values and Hedge Ratios**

10/18 XII

**Review Session**

10/20 XIII

**Quiz**

**#1**

<b>Date</b>	<b>Sess. No.</b>	<b>Subject</b>	<b>Chapter or Source</b>
10/25	XIV	Option Position Analysis	
		* Position Delta	
		* Position Gamma	
		* Position Theta	
		* Position Vega	
		Value at Risk	H, Ch. 21
		* Basic Concepts	
		* Measurement Issues	
		* BIS Requirements	
10/27	XV	Futures and Forward Contracts	H, Ch. 2 (review) H, Ch. 3 (skim)
		* Definitions and Basics of Pricing	
		* Over-the-Counter and Exchange-Traded Products	
		* Forward Rate Agreements	Acharya et al.
11/01	XVI	Basics of Interest Rate Swaps and FRA's	H, Ch. 7 (to p. 159) R. Stapleton/ M. Subrahmanyam (2)
		* Relationship between FRA's and Swaps	
		* Relationship between Swaps and Bonds	
		* Spot - Forward Parity, Pricing of FRA's	
		* Convexity Differences between FRA's and Futures	
		* Adjusting for Convexity	H, Ch. 29 (to p. 674)

Date	Sess. No.	Subject	Chapter or Source
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<p><b>Problem Set</b></p> <p><b># 6</b></p> <p><b>Position Analysis</b></p>
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11/03	XVII	Pricing, Valuation and Hedging of Swaps	
		* Valuation of Interest Rate Swaps: Principal and Forward Methods	H, Ch. 7
		* PVBP Analysis and Hedging of a Swap Portfolio	
		*Other Swaps: Currency, Equity, Commodity etc.,	H, Ch. 32

11/08	XVIII	Building the Yield Curve	
		* Zero Curves versus Forward Curves	
		* Using Money Market Rates and Swap Rates	
		* Interpolation and Bootstrapping Methods	

<p><b>Problem Set</b></p> <p><b># 7</b></p> <p><b>FRA's and Swaps</b></p>
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<b>Date</b>	<b>Sess. No.</b>	<b>Subject</b>	<b>Chapter or Source</b>
11/10	XIX	Interest Rate Option Pricing/Hedging	H, Ch. 28 (to p. 652)
		* European Options on Bonds and Interest Rates	
		* Option Payoffs and Strategies for Interest Rate Options	
		* Classification of Interest Rate Options Products	
		* No-Arbitrage Relationships: Caplets, Bond Options, Swaptions	
11/15	XX	Interest Rate Caps and Floors	H, Ch. 28 (pp. 653-659)
		* Valuation Using the Black-Scholes Model	R.Stapleton and M.Subrahmanyam (3)
		* Valuation Using the Black Model	
		* Hedging With Forwards/Futures Contracts	

**Problem Set**

**# 8**

**Building the Yield Curve**

11/17	XXI	Interest Rate Swaptions	H, Ch. 28 (after p. 659)
		Valuation Using the Black Model	

**Problem Set**

**# 9**

**Interest Rate Caps/Floors**

<b>Date</b>	<b>Sess. No.</b>	<b>Subject</b>	<b>Chapter or Source</b>
11/29	XXII	Forward/Spot Models of the Term Structure * Pros And Cons Of Forward Versus Spot Models * Spot Rate Models * Black-Karasinski, Hull-White models * Forward Rate Models: Ho-Lee, Heath-Jarrow-Morton, Libor Market Model (Brace-Garatek-Musiela)	H, Ch. 31 (to p. 694)          H, Ch. 31 (skim)

**Problem Set**

**# 10**

**Interest Rate Swaptions**

**Quiz**

**# 2**

12/01	XXIII	Exotic Options Features of exotics * Main types * Binomial model of valuation/hedging * Uses of exotic options	H, Ch. 25 (to p. 575)
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<b>Date</b>	<b>Sess. No.</b>	<b>Subject</b>	<b>Chapter or Source</b>
		Barrier options	H, Ch. 25 (pp. 575-581)
		* Knock-out, knock-in options	
		* “In-the-money” versus “out-of-the-money” knock-out options	
		* Problems of valuation/hedging	

**Problem Set**

**# 11**

**The Ho-Lee Model**

12/06	XXIV	Exotic Options (Contd.)	H, Ch. 25 (after p. 561)
		Asian options	
		* Effect of averaging: valuation/hedging	
		* General path-dependent structures	
		* Problems of valuation/hedging	
		Hybrid (Correlation) products	
		* Quanto options	
		* Problems of valuation/hedging	
		* Volatility/Variance Swaps	
		* Static options replication	

**Problem Set**  
**# 12**  
**Barrier Options**

12/08 XXV

New Derivative Instruments: Credit H, Ch. 24

- \* Credit Derivatives: Products
- \* Credit Default Swaps
- \* Collateralized Debt Obligations

**Problem Set**  
**# 13**  
**Asian Options**

12/13 XXVI

New Derivative Instruments: Credit (Contd.)

- \* Credit Derivatives: Pricing H, Ch. 24

**Case**

**Nexgen: Structured Collateralized Debt Obligations (CDOs)**

12/15 XXVII

Extra session

**Review Session**

12/20 XXVIII

**Final Examination**

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B40.3340  
Advanced Futures and Options

Professor Marti G. Subrahmanyam  
Fall 2011

**Instructions for the First Three Classes**

1. Get course materials [textbook (recommended, not required), case] from the bookstore.
2. Pick up other materials [course package, readings, problem sets] in the first class.
3. Do Problem Sets 1 and 2.

# DEFAULT POLICIES FOR STERN COURSES-Revised February 2011

*The following are policies students should assume are in force in their Stern courses, unless their instructors explicitly establish different policies:*

## **Laptops, Cell Phones, Smartphones, Recorders & Other Electronic Devices**

May not be used in class.

## **Attendance**

Required and part of grade.

Faculty will excuse absences and entertain requests to change exam and assignment due dates only in cases of documented serious illness, family emergency, religious observance, or civic obligation. If you will miss class for religious observance or civic obligation, you must inform your instructor no later than the first week of class. Recruiting activities, business trips, and vacation travel, and club activities are not acceptable reasons for absences or requests to schedule exams and assignments.

If a student is absent from the first day of an intensive course, the instructor may request that the student be removed from the course.

## **Arriving Late, Leaving Early, Coming & Going**

Students are expected to arrive to class on time and stay to the end of the class period.

Arriving late or leaving class early will have impact on the course grade.

Students may enter class late only if given permission by the instructor and can do so without disrupting the class.

(Note that instructors are not obliged to admit late students or readmit students who leave class or may choose to admit them only at specific times.)

## **Late Submission of Assignments**

Late assignments will either not be accepted or will incur a grade penalty unless due to documented serious illness or family emergency. Instructors will make exceptions to this policy for reasons of religious observance or civic obligation only when the assignment cannot reasonably be completed prior to the due date and the student makes arrangements for late submission with the instructor in advance.

*Note that the following policies are in force for all Stern classes:*

### **General Behavior**

Students will conduct themselves with respect and professionalism toward faculty, students, and others present in class and will follow the rules laid down by the instructor for classroom behavior. Students who fail to do so may be asked to leave the classroom. (NYU Stern Code of Conduct, Stern policy)

### **Collaboration on Graded Assignments**

Students may not work together on graded assignment unless the instructor gives express permission. (NYU Stern Code of Conduct)

### **Grading**

No more than 35% of students will receive grades of A or A- in MBA core courses. (Stern policy)

MBA students who do not submit Course Faculty Evaluations by the deadline will not have access to their final grades until the grade release date, which is determined by program. Faculty are requested not to release final grades to students who fail to submit evaluations and students should not ask. (Stern policy)

### **Recording Classes**

At any time, your classes may be recorded for educational purposes. (Stern policy)

*Endorsed by:*

*MBA Core Course Committee, July 9, 2007*

*Vice Deans, July 13, 2007*

*Academic Programs & Teaching Resources Committee of Faculty Council, August 1, 2007*

*Revision approved by Core Course Committee and program Vice Deans, February, 2011*

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### Some interesting websites on derivatives

There are several websites that offer useful information on derivatives securities and markets. Listed below are some important sites that would be of interest to any student in this area.

1. [www.optionmetrics.com](http://www.optionmetrics.com)

This website has a rich dataset and real-time data on US and some European and Asian equity derivatives. (More detailed historical data are also available to the Stern community in a separate database.) It was put together by one of my former Ph.D. students and is used by many of the major industry players in the area of equity derivatives.

2. [www.msci.com/products/risk\\_management\\_analytics/riskmanager/demos.html](http://www.msci.com/products/risk_management_analytics/riskmanager/demos.html)

This website is a good source of data and research materials on derivatives and risk management. It was spun off by JP Morgan many years ago and was a pioneer in the area of tools and techniques of risk management. It is now part of MSCI. It continues to be a useful source of data and concepts on many aspects of risk management.

3. [www.bis.org](http://www.bis.org)

This is the official website of the Bank for International Settlements (BIS). This organization is the “central bankers’ bank” and has been the coordinator for many of the important recent regulatory initiatives of the world’s central banks, which regulate financial institutions and markets around the world. They compile and publish several databases on the global derivatives industry.

4. [www.isda.org](http://www.isda.org)

This is the website of the International Swaps and Derivatives Association, the trade body for the over-the-counter derivatives market, which handles a substantial proportion of all traded derivatives. It has a wealth of information on various aspects of derivatives

markets including the details of the standard contracts for many of these products in the areas of interest rates, foreign exchange, commodities, credit etc.

5. [www.cme.com](http://www.cme.com)

This is the website of the only major US exchange that trades futures and options contracts on a wide range of underlying assets from equities to interest rates to weather. It provides contract details and real-time quotations on most of the major contracts that are traded on exchanges, other than options on individual stocks.

6. [www.cboe.com](http://www.cboe.com)  
[www.globalderivatives.nyx.com/en/trading](http://www.globalderivatives.nyx.com/en/trading)  
[www.iseoptions.com](http://www.iseoptions.com)

These are the official websites of the three major US exchanges for equity and stock index options. They provide a plethora of information on individual option contracts, although [www.optionmetrics.com](http://www.optionmetrics.com) consolidates all this information in a more "user-friendly" format. The second of these is the NYSE Euronext platform, which links to several European and US derivatives markets.

7. [www.riskcenter.com/](http://www.riskcenter.com/)

This is an interesting website containing links to various interesting articles, news items and reports on various aspects of derivatives contracts and markets.

8. [www.risk.net/](http://www.risk.net/)

This is the website of *Risk* magazine, the leading industry publication in the area of derivatives. This magazine has news about the business, recent trends in the industry and a few technical articles on concepts and models that are of interest to practitioners. This is a great resource for anyone involved with the derivatives industry.

9. [www.moodys.com](http://www.moodys.com)  
[www.standardandpoors.com](http://www.standardandpoors.com)  
[www.fitchratings.com](http://www.fitchratings.com)

These are the websites of the three major credit rating agencies. They present information about the criteria for ratings as well as the ratings for several issues. The sites contain a mass of statistics about credit risk at the macro and micro levels.

10. [www.dtcc.com](http://www.dtcc.com)  
[www.markit.com](http://www.markit.com)

These two websites relate to OTC derivatives. The Depository Trust and Clearing Corporation is one of the several new OTC clearing houses established in recent years. Markit is a leading data vendor, providing a ranging of pricing services for derivatives.

11. [www.cftc.gov/LawRegulation/DoddFrankAct/index.htm](http://www.cftc.gov/LawRegulation/DoddFrankAct/index.htm)  
<http://www.sec.gov/spotlight/dodd-frank.shtml>

These are the links to the Commodities and Futures Trading Commission's and Securities and Exchange Commission pages on the Dodd-Frank bill, the comprehensive bill on regulation of financial instruments, markets and institutions, passed in July 2010. It also provides information on the progress towards the implementation of the bill, which will affect virtually every major company in the US, particularly those in the financial services industry.

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**Some interesting websites for derivatives quotes and risk metrics**

As may be expected, there are several websites that offer useful information on the prices of derivatives securities. While real-time information from sources such as Bloomberg and Reuters would be more comprehensive, there are several websites that offer quotes on the major derivatives markets. Some important examples for the US markets are listed below:

*Stock Option quotes, Greeks and implied volatilities*

[http://www.888options.com/quotes/default.jsp?ReferredBy=SEM\\_Goo\\_0490\\_A\\_30&gclid=CL6HztjiwY4CFRqsOAodi3bMxA](http://www.888options.com/quotes/default.jsp?ReferredBy=SEM_Goo_0490_A_30&gclid=CL6HztjiwY4CFRqsOAodi3bMxA)

<http://www.ivolatility.com/options.j>

<http://finance.yahoo.com>

*Eurodollar and Fed Funds Futures quotes*

[http://www.cme.com/trading/dta/del/delayed\\_quote.html?ProductSymbol=ED&ProductFoiType=FUT&ProductVenue=G&ProductType=itr](http://www.cme.com/trading/dta/del/delayed_quote.html?ProductSymbol=ED&ProductFoiType=FUT&ProductVenue=G&ProductType=itr)

*Swap and Libor quotes*

[http://b2b.thefinancials.com/us\\_interest\\_rates.asp](http://b2b.thefinancials.com/us_interest_rates.asp)

*Credit Derivative Index quotes*

<http://www.markit.com/markit.jsp?jsppage=indices.jsp>