

15.435x Derivatives Markets: Advanced Modeling and Strategies

Faculty Member(s):	Prof. Deborah Lucas
Length:	12 Weeks
Related Course(s) at MIT:	15.437 and 15.438
Suggested Prerequisites:	15.415.1x and .2x or other introductory finance course, calculus (required), 15.455x (recommended), basic programming skills (recommended)

Derivative securities, and the analytical methods that have been developed to understand and deploy them, are powerful tools for managing and pricing risk. As part of the MicroMasters® Program in Finance, students in this course will develop a sophisticated and durable understanding of derivative modeling, valuation and hedging methods, a basic familiarity with major markets, instruments and strategies, and insights into current market developments.

The skills acquired are relevant to all financial market practitioners, but will be most useful for those planning a career in sales and trading, portfolio management, commercial banking, investment banking, insurance, hedge funds, financial advising, or in a public sector financial institution or central bank.

Approximate total time of lecture videos: 18 hours, including recitation videos

The lectures emphasize valuation models and risk management techniques, and illustrate their applications with examples. The homework assignments and recitations provide practice in applying the methods to a wide variety of applications.

Grading: 10% graded problem sets, 90% proctored final exam

Course Materials:

▪ Recommended Textbook

John Hull's *Options Futures and Other Derivatives* is the most widely used textbook for these topics, and the 10th edition will serve as the basis for recommended readings and additional practice problems. You can refer to an earlier edition, but be sure to check the alignment of topics and chapters if you do so.

▪ Additional Textbooks

For a more intuitive approach to understanding derivatives, Robert McDonald's *Derivatives Markets* is highly recommended. It has similar topical coverage to Hull.

For a deeper understanding of the topics related to the fixed income securities market, *Fixed Income Securities; Tools for Today's Markets*, **(BTAS)** by Bruce Tuckman and Angel Serrat, 3rd Edition, 2012, Wiley Finance also is highly recommended.

▪ Other Materials

The class slides serve as a fairly comprehensive study guide along with the recitation materials and homework problems. Working through the examples and homework problems are an essential part of the learning experience.

Some analysis tools will be provided in Excel spreadsheets, programmed in Visual Basic. The tools will be necessary to answer homework and exam questions. Students should be familiar with using spreadsheets, and be prepared to learn to use some features of Visual Basic in spreadsheet applications. Alternatively, students can implement the analysis tools in a programming language of their own choosing.

Course Structure:

This course consists of

- A course introductory lecture (Week 0);
- 10 Lectures, 10 Problem Sets, 10 Recitations demonstrating how to solve problems similar to those contained in the problem sets (Weeks 1–10); and
- 1 proctored Final Exam (Week 11)

WEEK	TOPIC
Week 0	Course Introduction and How to Take this Course <ul style="list-style-type: none"> An introduction to derivatives markets (optional)
Week 1	Forward contracts <ul style="list-style-type: none"> Basics of forward contracts No-arbitrage conditions for pricing financial forwards: stocks, bonds, currencies Pricing commodity forwards Key concepts for hedging and speculating Problem Set 1
Week 2	Futures and Swaps <ul style="list-style-type: none"> Futures markets: institutions and popular contracts Plain vanilla interest rate swaps Application: hedging interest rate risk for a bank Currency, commodity and total-rate-of-return swaps Problem Set 2
Week 3	Duration and convexity-based strategies for risk management <ul style="list-style-type: none"> Duration and convexity measures: basic and general Delta and gamma hedging in the cash market Delta and gamma hedging with forwards, futures and swaps Problem Set 3

Week 4	Options strategies and pricing basics <ul style="list-style-type: none"> ▪ Popular options trading strategies ▪ No arbitrage pricing on binomial tree and “risk-neutral” probabilities ▪ Calibrating binomial trees ▪ Pricing American options Problem Set 4
Week 5	Black-Scholes-Merton and the Greeks <ul style="list-style-type: none"> ▪ Deriving and using the Black-Scholes-Merton model ▪ Understanding derivative price sensitivities with the Greeks Problem Set 5
Week 6	Volatility; and other options pricing models <ul style="list-style-type: none"> ▪ Implied and historical volatilities ▪ Trading volatility with the VIX ▪ Incorporating time-varying volatility ▪ Black’s model and applications Problem Set 6
Week 7	Exotic options and numerical methods <ul style="list-style-type: none"> ▪ Bermudan, Binary, Asian, Look-back, Barrier, and others ▪ Pricing with Monte Carlo and binomial trees Problem Set 7

Week 8	Bond and interest rate options <ul style="list-style-type: none"> ▪ Why Black-Scholes-Merton misprices bond options ▪ Valuing bonds and bond options on binomial trees of interest rates ▪ Continuous time models Problem Set 8
Week 9	Credit risk <ul style="list-style-type: none"> ▪ Hazard rate approach and decomposing credit spreads ▪ Default as a put option ▪ Merton model for pricing defaultable bonds ▪ Credit default swaps Problem Set 9
Week 10	Securitization <ul style="list-style-type: none"> ▪ Why securitize? ▪ Basic ABS and MBS structures ▪ Incorporating prepayment and correlated defaults ▪ Waterfalls, valuation and risk assessment Problem Set 10
Week 11	Final Exam

Recommended Readings

These are the recommended readings for each week. Unless otherwise noted, they are from John Hull's textbook, *Options Futures and Other Derivatives*, 10th edition. A "*" denotes related optional material that is background to or more advanced than the topics you will be tested on. "BTAS" denotes readings from *Fixed Income Securities; Tools for Today's Markets*, (BTAS) by Bruce Tuckman and Angel Serrat, 3rd Edition, which has more comprehensive coverage of some of the topics.

Week 0:	Chapters 1, 37*
Week 1:	Chapters 3, 4, 5
Week 2:	Chapters 2, 7, 34*
Week 3:	Chapter 6.4, 6.5; BTAS Chapters 4, 5, 6*
Week 4:	Chapters 10*, 11*, 12, 13
Week 5:	Chapters 15, 19
Week 6:	Chapters 18.7, 18.8, 20, 27.2*
Week 7:	Chapter 26
Week 8:	Chapter 29, 31*, 32*
Week 9:	Chapters 24, 25
Week 10:	Chapter 8; BTAS Chapter 20