

MIT Sloan School of Management
15.437/15.4371 – Options and Futures Markets
Spring 2025

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Tuesdays and Thursdays, 8:30-10am, E51-335

Syllabus

Overview

This is a course about futures, options and other derivatives. The size of the global over-the-counter derivatives market is estimated to be at more than \$600 trillion (in notional principal), not to mention exchange-listed derivatives. Moreover, numerous types of financial contracts have embedded derivatives that affect their value and risk. The prevalence of derivatives makes it more important than ever to understand the strategic opportunities offered and the associated risks. The course explores these markets and instruments with a mixture of lectures and case discussions. The lectures will emphasize fundamental financial economics principles and valuation tools, and aim to develop your intuition. The cases and homework provide an opportunity to practice applying the principles in a variety of situations.

The main theme of this course is on (1) the pricing and hedging of derivative securities, and (2) the use of derivatives for investment and risk management. We apply the principles of no-arbitrage to price derivatives. For options pricing in particular, we explore binomial tree models, the Black-Scholes-Merton option pricing model, and the simulation-based risk neutral pricing methodology. We discuss a wide range of applications, including the use of derivatives in asset management, the valuation of corporate securities with embedded options, and the pricing and uses of equity, interest rate, foreign exchange, commodity and exotic derivatives. Special attention will be given to the practical challenges to valuation and hedging arising from tail risk, liquidity risk, counterparty risk, and failures of no-arbitrage relations. Students will also gain familiarity with market structures and institutions, current events, and regulatory issues.

Prerequisites

Mastery of basic financial concepts, as covered in an introductory class (i.e., 15.401/15.411, 15.414/415 or equivalent), is required. Please speak to Prof. Zhu if you have a question about the adequacy of your preparation.

Some valuation tools will be made available in Excel spreadsheets with embedded Visual Basic code. You should be familiar with spreadsheets and also be prepared to use programming tools, which could be Visual Basic or a programming language of your choosing.

Materials

Class notes for each topic, related spreadsheets and programs, and supplementary readings covering current events will be made available on Canvas or Study.net, or distributed in class. Homework assignments, additional practice problems and practice exam questions will also be posted on Canvas over the course of the term. **It is highly recommended that you look over the notes before class and write notes on them during class.** They are an essential part of the course, and are intended to serve as a fairly comprehensive study guide along with the text. It is necessary to print them because computer/tablet/phone usage is not allowed in class unless explicit permission is given.

Required text:

John Hull's "Options Futures and Other Derivatives" is the most widely used textbook in this area. The reading assignments refer to the 11th edition, but the coverage of earlier editions is similar and you also can use one of those versions. However, be sure to check on the alignment of topics and chapters if you do so.

Cases and projects:

We may use a number of cases as the basis for class discussions and homework problems, which will illustrate how the tools you acquire can be put to practical value. Those will be available on Canvas.

In addition, I may suggest ideas for projects. Students can take the projects, at their discretion, for extra credits or in lieu of certain assignments. The exact arrangement will depend on the nature and time commitment of the projects.

Optional texts:

For a more intuitive and rigorous approach to understanding derivatives, I recommend Robert McDonald's *Derivatives Markets*. It has similar topical coverage to Hull.

Grading and expectations

The final letter grade is based on these components:

1. **(30%) Assignments:** There are five graded assignments that are an important part of the learning process. They can be completed individually or in self-selected **groups of up to 4 people**. Only one copy per group should be submitted for grading. People can switch between groups during the semester without special permission; just be sure to include all current members' names on each submission. You are not required to join a group, but doing so can enhance your understanding of the material. It is highly recommended that you work through **all** the questions on your own first for the best learning experience.

Use of AI programs like ChatGPT is permitted and it can enhance learning and the clarity of your writing. However, you are responsible for the accuracy of your answers. AI tools will not be permitted for use during exams, and over-reliance on them will be an impediment to doing well in the class. **It is an honor code violation to include your**

name on an assignment where you have not made a meaningful contribution to the work submitted. Assignments must be submitted in class or online by 11:59pm on the date indicated with no exceptions.

2. **(25%) Midterm:** In-class.
3. **(30%) Final exam:** Cumulative and in-class (on the last day of class).
4. **(10%) In-class pop quizzes.** These are short questions that gauge your basic understanding of the materials. The quizzes are given in class, on a random set of days, and are to be completed individually. If you miss a class when a pop quiz is given, you lose the credit for that quiz. If there are N quizzes, the best N-1 count toward your grade. There is no separate category for in-class attendance (except the participation credit for guest lectures, see next point).
5. **(5%) Class participation in guest lectures.** I plan to invite some guest speakers, likely senior people from the financial industry or policy circles. Because you represent MIT, it is important to attend and actively participate in these guest lectures.
6. **(TBD) Optional projects.**

Exams: Exams must be completed independently and within the allotted time. Students are allowed to bring two double-sided letter-sized cheat sheets and a hand calculator. You may not consult other materials.

Classroom etiquette: Except for taking notes or other permitted in-class activities, **no in-classroom usage of laptops, tablets or cellphones is permitted.** I highly recommend printing out the class notes in advance for in-class notetaking. Arriving late or leaving early can be disruptive to others; inform me or the TA in advance by e-mail if you must do so. (As noted above, however, late arrivals or early departures do not harm your final grade unless we have a pop quiz or guest lecture that day.)

Listeners: Taking the class for a grade is highly recommended for a superior learning experience. Listeners are welcome to attend the class if there is sufficient space in the classroom, but listeners don't have access to the course website or other class resources.

Prof's Office Hours

By appointment. Email zhuh@mit.edu.

Recitation Sessions and TA Office Hours

TBA

Topics

*denotes optional reading

1. Module 1 – Forwards, Futures, and Swaps
 - Hull Chapters 1, 2, 3, 4, 5, 6, 7, 24, 25, 34*, 35*
 - This module covers derivatives whose prices are typically “linear” in the price of the underlying. As such, these derivatives give investors more flexibility in expressing views or hedging risks related to cash markets: equities, interest rates, credit, commodities, currencies, etc. A major theme in these markets is to transfer risk with the minimum transfer of cash. The no-arbitrage principle is the predominant method of pricing.
2. Module 2 – Options: basic topics
 - Hull Chapters 10, 11, 12, 13, 15, 19, 21, 14*
 - Option prices are nonlinear in the price of the underlying. This fact gives this derivative class its richness, technical challenges, and ample opportunities for profits and mistakes. No-arbitrage remains a powerful tool, as demonstrated by the put-call parity of European options and their dynamic replication. Black-Scholes-Merton formula for pricing European options is a significant breakthrough. We introduce risk-neutral pricing as another important tool and seemingly counterintuitive intellectual exercise. The binomial model is a conceptually important way to think about price dynamics, implemented by numerical methods. All these are connected: you can derive the BSM formula through dynamic replication in a binomial model or as the risk-neutral expectation of the option payoffs.
3. Module 3 – Options: advanced topics and more applications
 - Hull Chapters 16, 17, 18, 20, 26, 27, 29, 37
 - There are a few ways in which options exhibit more complex (and fun) behavior. First, the payoffs can be more complex (exotic options). Second, options can be laid over on other derivatives, such as futures and swaps. Third, certain parameters that are fixed in Black-Scholes-Merton can be modeled as time-varying. Finally, and perhaps most interestingly, life is full of options if you look at it this way.
4. Guest lectures, interspersed throughout the semester. Schedule and topic TBD.