Syllabus

Derivatives
Core Module Asset Pricing (Master)

Julien Cujean

Office 214, Engelhaltenstrasse 4, Phone: +41 31 631 3853, Email: julien.cujean@ifm.unibe.ch

Schedule

- class meets:
  Thursday, 2.15 pm – 5.00 pm (February 20 – May 28)
  Engehaltenstrasse 8, Room 002

Hand in assignment by: May 7, 2020
Final Exam: June 4, 2020—9.15am-11.15am (Engehalde 8, Room 001)
September 11, 2020—12.15pm—14.15pm (Engehalde 8, Room 001)

Graduate Assistant
Name: Marc Brunner
Office: Engehaltenstrasse 4, Office 217

Office Hours
Monday/Tuesday, 9am to 6pm, by appointment
marc.brunner@ifm.unibe.ch

Focus

In recent years, a monthly average of 80 Wall Street Journal articles related to derivatives—derivatives sometimes make headlines, AIG’s losses on credit default swaps being one example among many. Not only does the use of derivatives represent a major part of financial markets’ daily activity, but the pricing theory of derivatives is also a cornerstone of modern finance. Back in 1969, three researchers—Fisher Black, Myron Scholes, and Robert Merton—started working on option-pricing problems. Their work would change the way we think about risk and valuation. Thirty years later, Robert Merton and Myron Scholes won the Nobel Prize in Economics for their contribution to option
pricing theory. The huge theoretical impact of option pricing theory and its practical significance make it one of the most exciting areas in finance.

The main thread running through this course is the use and pricing of derivatives contracts. The course focuses on three main types of such contracts: i) forwards and futures, ii) swaps, and iii) options. While the theoretical treatment of futures and swaps only involves Net Present Value computations, the pricing of options additionally calls for an underlying model; the course covers two such models, the Binomial model and its close relative, the Black-Scholes model.

We will discuss several important applications, such as financial and commodity forwards and futures, interest rates derivatives, swaps, and risk management. At the end of this class, you will be able to i) draw the payoff/profit diagrams of various derivatives contracts and derivatives-related strategies, ii) compute the price of futures, forwards, and swaps through a cash-and-carry, iii) price European and American options (as well as real options, exotic options, and credit instruments if time permits) with a binomial tree, and iv) use the Black-Scholes formula to price options (and corporate securities, if time permits) and implement hedging strategies using the greeks.

Prerequisites

Basic knowledge of economics, capital markets, statistics, and mathematics. Derivatives are necessarily an analytical subject, but most derivations in this course only require little technical knowledge. An exception is, perhaps, the Black-Scholes model that places slightly higher quantitative demand on students—basic notions of probability theory and calculus are needed.

Organization of the Course

Course Structure

The course is structured in a traditional lecture format, with weekly lectures based on a set of 4 lecture notes and a final exam (no midterm exam). Lecture notes, project information and hand-outs will become sequentially available on Ilias.

Students will have to work on one large exercise in groups of at most 5 students. Cooperation between the groups is not allowed. If you are not able to form or join a group during class, I encourage you to reach out to your colleagues through Ilias – it is likely that some other students or existing groups are on the lookout for a group or additional members. The exercise is due on May 7th, 2020. Late submissions will get zero points. The exercise will count 30% towards the final grade.

Note that the points from the assignments from previous years cannot be used this year, and the points from this year cannot be transferred to the following years.
Graduate Assistant

The graduate assistant for this class is Marc Brunner. Marc will hold office hours by appointment. Please feel free to contact him to schedule an appointment (preferably on Monday or Tuesday from 9am to 6pm) if you have questions regarding class material or regarding grading.

Course Materials

Main textbook for the course (Optional)


Additional textbook

John Hull, *Options, Futures, and Other Derivatives*, Prentice Hall, eighth edition, 2012. This book is very popular and widely used; it is a useful reference for students who want to deepen their technical understanding of derivatives pricing.

Grades

70% final exam, 30% exercise.

Course Outline

The following is a tentative agenda for this class:

<table>
<thead>
<tr>
<th>Section 1:</th>
<th>Introduction to derivatives</th>
<th>Chapters 1, 2, 3, 9</th>
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<tbody>
<tr>
<td>Section 2:</td>
<td>Binomial option pricing</td>
<td>Chapters 10, 11</td>
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<td>Section 3:</td>
<td>Black-Scholes, Greeks</td>
<td>Chapters 12, 13(18), 24</td>
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<tr>
<td>Section 4:</td>
<td>Forwards, futures, and swaps</td>
<td>Chapters 5, 6, 7, 8, App. B</td>
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<tr>
<td>Section 5: if time permits</td>
<td>Corporate Securities, other topics</td>
<td>Chapters 16, 17, ...</td>
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*Julien Cujean  Derivatives (Core Module Asset Pricing, Master), Spring 2020*
In particular, the tentative list of topics for each class is:

Section 1
- Introduction to derivatives: payoff and profit diagrams, forwards and options (McDonald Chapters 1, 2, 3, 9)

Section 2
- Binomial option pricing, risk-neutral pricing (McDonald Chapters 10, 11)

Section 3
- Continuous-time limit of the Binomial model (McDonald Chapters 11, 18)
- Black-Scholes: basic formula, greeks, delta-hedging (McDonald Chapters 12, 13)
- Volatility (McDonald Chapter 24)

Section 4
- Financial forwards and futures, commodity forwards and futures (McDonald Chapters 5, 6, Appendix B)
- Interest rates forwards and futures (McDonald Chapter 7)
- Swaps: interest rate swaps, currency swaps, commodity swaps, swaptions (McDonald Chapter 8)

Section 5
- Additional topics as time permits:
  - corporate securities (McDonald Chapter 16)
  - real options (McDonald Chapter 17)

References

The capital asset pricing model is a model which is primarily used in determining a possible and appropriate required rate of return of a security. This theory describes the connection. Woellner, R., Barkoczy, S., Murphy, S., Evans, C. and Pinto, D., 2016.