University of Bern
Institute for Financial Management

Fall 2022

## Syllabus

# Derivatives

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### Schedule

- class meets:
  In the Seminarraum 111, Engehalde E8 on Mondays, 10.15 am – 1.00 pm (September 19th – December 19th)

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|---|---|
| Hand in assignment by: | December 12th, 2022 |
| Final Exam: | January 11, 2023—10.15am-12.15am (Engehalde 8, 002) |
| | February 15, 2023—14.15pm-16.15pm (Main Building, 106) |

### Graduate Assistants

Name: Samuel Jäger
Office: Engehaldenstrasse 4, Office 103

### Office Hours

Wednesdays, **by appointment**
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Name: Jan Pichler
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**by appointment**
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## Focus

In recent years, a monthly average of 80 *Wall Street Journal* articles related to derivatives. Sometimes derivatives 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 **December 12th, 2022**. Late submissions will get zero points. The exercise will count 30% towards the final grade.

### Graduate Assistants

The graduate assistants for this class are Samuel Jäger and Jan Pichler. Both will hold office hours by appointment. Please feel free to contact them to schedule an appointment if you have questions regarding class material or regarding grading.

## Course Materials

### Main textbook for the course (Optional)

Robert McDonald, *Derivatives Markets*, Pearson Addison Wesley, third edition, 2009. This book contains an insightful treatment of the use and pricing of derivatives contracts. The author illustrates theoretical concepts with numerous practical examples. Overall, this book offers an intuitive, but rigorous treatment of derivatives markets, and is an appropriate textbook for master and MBA students.

### 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:

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|---|---|---|
| Section 1: | Introduction to derivatives | Chapters 1, 2, 3, 9 |
| Section 2: | Binomial option pricing | Chapters 10, 11 |
| Section 3: | Black-Scholes, Greeks | Chapters 12, 13(, 18), 24 |
| Section 4: | Forwards, futures, and swaps | Chapters 5, 6, 7, 8, App. B |

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)

## References


[1] Hull, J. C. (2012). *Options, Futures, and Other Derivatives* (8th ed.). Prentice Hall.

[2] McDonald, R. L. (2009). *Derivatives Markets* (3rd ed.). Pearson Addison Wesley.