Mathematics of Financial Markets
ACTSC 446/846, Winter 2021

Online Course

Instructor	Ruodu Wang
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Course website:	`https://learn.uwaterloo.ca/`

Format

The instructor will provide online recorded lectures and slides, supplemented by notes and exercises. Lecture slides will be available on Learn before the corresponding lectures. A few short lecture videos will be uploaded every week before or on each Monday. They will be available on Learn. You are required to read the slides (corresponding to the lecture videos each week) by yourself before watching the lecture videos.

Office hours and Piazza

- Every Wednesday 10am to 11am (EST) I will host office hours on WebEx. The information can be found on Learn.

- Piazza is used only as a discussion forum. TA will work a couple of hours per week to answer some of the questions.

- Please attend offie hour or contact me by email if you have any course related questions.

References

1. Main reference book:

   [1] Tomas Björk. *Arbitrage Theory in Continuous Time*. 3rd edition, Oxford, 2009.

   We do not exactly follow this book. The primary reference will be the lecture notes and lecture videos. Test materials are based on lecture notes.

2. Recommended reading on the understanding of financial markets:

[2] Robert L. McDonald. *Derivatives Markets*, 3rd edition, Pearson, 2013.

[3] John C. Hull. *Options, Futures, and Other Derivatives.* 9th edition, Prentice Hall, 2014.

3. Recommended reading on advanced mathematical materials:

[4] Steven E. Shreve. *Stochastic Calculus for Finance I: The Binomial Asset Pricing Model.* Springer-Verlag, New York, 2004.

[5] Steven E. Shreve. *Stochastic Calculus for Finance II: Continuous-Time Model.* Springer-Verlag, New York, 2004.

Teaching Assistants

- Carlos Araiza Iturria, `caraizai@uwaterloo.ca`

- Agassi Iu, `aiu@uwaterloo.ca`

- Weinan Qi, `w7qi@uwaterloo.ca`

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Course evaluation

Tentative exam schedule and evaluation breakdown:

1. Take-home assignments, 15%

    (a) Monday of Week 3 (due Friday of Week 4)

    (b) Monday of Week 5 (due Monday of Week 6 - after reading week)

    (c) Monday of Week 11 (due Friday of Week 12)

2. Midterm 1 (February 25, Thursday), 2 hours, 25% (Lectures 1-11)

3. Midterm 2 (March 25, Thursday), 2 hours, 25% (Lectures 12-18)

4. Final exam (date to be determined), 2.5 hours, 35% (All)

All assignments and exams will be given and collected using Crowdmark. For questions regarding exam regrading, please first contact the TAs who mark your paper. I will be the last resort in case you and the TAs remain to disagree.

Course Content and Tentative Schedule

	Weeks	Topics	Björk reference
Part I	1-3	**Introduction to derivatives markets** options, futures and other derivatives arbitrage and trading strategies model independent properties of options	Chapter 1
Part II	3-6	**Discrete-time models** one-period models binomial tree models American and exotic options fundamental theorems of asset pricing	Chapters 2-3
Part III	7-8	**Basic stochastic calculus** Brownian motions and martingales Itô integrals and the Itô lemma	Chapter 4
Part IV	9-11	**The Black-Scholes framework** basics of continuous-time financial markets Black-Scholes equation Black-Scholes formula hedging and Greeks risk-neutral valuation	Chapters 6-9
Part V	12	**General continuous-time models** risk-neutral valuation in general models basics of fixed income products short-rate models	Chapters 10, 22-23

CIA Accrediation

This course is accredited under the Canadian Institute of Actuaries (CIA) University Accreditation Program (UAP) for the 2020-2021 academic year. Achievement of the established minimal grade in this course may qualify a candidate for CIA credit toward certain preliminary exams. Please note, a combination of courses may be required to achieve a single exam credit. Please see `http://www.cia-ica.ca/membership/university-accreditation-program---home/information-for-candidates` for full details.

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Relevant University Policies:

Policy 71 - Student Discipline   Policy 73 - Intellectual Property Rights