# Finance I
# ACTSC 970, Fall 2016

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| **Instructor:** | Ruodu Wang, M3 3122, ext. 31569, wang@uwaterloo.ca |
| **Lectures:** | 11:30-12:50 Tuesdays and Thursdays, RCH 306. |
| **Tutorials:** | N/A. |
| **Office hours:** | Tuesdays 2:00-3:00 and Thursdays 2:00-3:00, or by appointment. |
| | You are welcome to drop by my office at any time, |
| | and if I am not occupied I will be happy to answer your questions. |

## Objectives

We study the mathematical theory for financial derivatives. This is mainly carried out via the no-arbitrage pricing theory, which was developed in the 1960s by R. Merton and later on by F. Black and M. Scholes. The plan is to start from binomial asset pricing models and arrive at continuous-time risk-neutral evaluation, with the hope to also touch on some more advanced relevant topics such as pricing American and exotic options, incomplete markets, credit risk models, utility theory and optimal investment. The derived formulas themselves may be simple but the underlying mathematics is profound, which goes from discrete-time stochastic processes, sigma-fields, change of measure and R-N derivatives, to stochastic calculus, continuous-time martingales and Girsanov's theorem. This course should be treated as a mathematical course.

The course contents have a great overlap with those of ACTSC446/846, with a different focus.

## References

The primary reference will be the lecture notes given in class.

[1] Main reference books

(i) Steven E. Shreve. *Stochastic Calculus for Finance I: The Binomial Asset Pricing Model*. Springer-Verlag, New York, 2004.

(ii) Steven E. Shreve. *Stochastic Calculus for Finance II: Continuous-Time Models*. Springer-Verlag, New York, 2004.

[2] Recommended reading

(i) John C. Hull. *Options, Futures, and Other Derivatives*. 9th edition, Prentice Hall, 2014.

(ii) Tomas Björk. *Arbitrage Theory in Continuous Time*. 3rd edition, Oxford, 2009.

(iii) Hans Föllmer and Alexander Schied. *Stochastic Finance*. 4th edition, De Gruyter, 2016.

Test materials are based on lecture notes.

**Assignments**

I plan to set two individual assignments. The assignments will be equally weighted. Assignments will contribute to your coursework grade. Assignments should be handed in to the instructor by the end of the class on the due day. Late assignments are not acceptable.

**Midterms**

I plan to have one midterm. Tentative schedule: lecture time on Tuesday, October 25th (13th lecture), 2016.

**Course Evaluation Breakdown**

(1) Assignments 10%;

(2) Midterm 25%;

(3) Final Examination 65%.

**Tentative Schedule**

| | **Lectures** | **Topics** |
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| **Part 0** | 1 | **Introduction**<br>basics of options, futures and arbitrage |
| **Part I** | 2-12 | **Discrete-time finance**<br>binomial asset pricing models<br>complete and incomplete markets<br>fundamental theorems of asset pricing<br>probability theory for discrete stochastic processes<br>utility and optimal investment problem<br>American and exotic options in discrete-time models |
| Lecture 13: Midterm | | |
| **Part II** | 14-23 | **Continuous-time finance**<br>Brownian motion and stochastic calculus<br>continuous time market models<br>Black-Scholes equation and Black-Scholes formula<br>hedging and Greeks<br>risk neutral valuation for general European-type derivatives<br>American and exotic options in continuous-time models<br>Credit risk models |
| Lecture 24: Final review | | |