UNIVERSITY OF CALGARY

FACULTY OF SCIENCE
Department of Mathematics and Statistics

Applied Mathematics 481 Introduction to Mathematical Finance

(see Course Descriptions for the applicable academic year: http://www.ucalgary.ca/pubs/calendar/)

Syllabus

Topics	**Number of Hours**
Introduction to basic notions assumptions. One period models. Definitions of portfolio and wealth. Assumptions of divisibility, liquidity, and short-selling. No arbitrage principle. Expected return and risk.	2
Basic financial derivatives. Forward contracts. Finding the forward price in a one-period model. Call and put options and their arbitrage free evaluation in a one-period model. Managing risk with options.	3
Risk free assets. Time value of money and interest rate. Periodic compounding. Continuous compounding. Streams of payments. Comparison of compounding methods. Zero coupon bonds and coupon bonds. Money market account.	3
Risky Assets. Multi step models. Computation of expected return. Binomial tree model. Risk neutral probability and martingale property. Continuous time limit.	4
Discrete time stock and money market models. Assumptions. Investment strategies. Fundamental Theorem of Asset Pricing. Applications to the binomial tree model. Extended market models with derivatives. Pricing European options in the binomial tree model. Cox-Ross-Rubinstein formula. Review of continuous time results. Black Scholes formula.	7
General properties of options. European options. Put-Call parity. American options. Bounds on option prices. Option prices as a function of strike price, maturity, and the price of the underlying stock. American Options in the Binomial tree model.	4
Forward and futures contracts. Forward price of a stock with no dividends. Including dividends. Finding the value of a forward contract. Pricing of futures contracts. Hedging with futures.	4
Portfolio management. Variance as a measure quantifying the risk of a portfolio. Computation of the minimum variance portfolio with and without shortsales. Efficient frontier. Capital asset pricing model.	5
Hedging. Hedging options. Delta hedging. Greek parameters. Hedging business risk. Value at risk. Hedging with options and forward contracts. Speculating with derivatives.	4
TOTAL HOURS	**36**

Course Outcomes

Students successfully completing this course will be able to:

1. Describe the main ideas, concepts, notions and models in mathematical finance, and define a simple market model

2. Identify the difference between risk-free and risky assets

3. Define the risk-free assets as different forms of interest rates or bonds, including simple, periodic and compounded continuously interest rates

4. Construct discrete time binomial market model as the simplest model for a risky asset/stock

5. Distinguish various kinds of financial derivatives, such as forwards, futures, options, and their properties, and get insight into the pricing of financial derivatives, including forward, futures, options

6. Explain how to use Cox-Ross-Rubinstein formula for option pricing in binomial model's setting for a stock price

7. Define geometric Brownian motion as continuous time model for a stock price

8. Apply Black-Scholes formula for option pricing in a geometric Brownian motion setting for a stock price
9. Get insight into the financial engineering in risk management

10. Define different kinds of risk parameters, such as delta, gamma, kappa, vega, rho, theta, and understand of their use in financial engineering to manage the risk

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