MATH 548 – Mathematical Finance I

Course Description from Bulletin: This is an introductory course in mathematical finance. Technical difficulty of the subject is kept at a minimum by considering a discrete time framework. Nevertheless, the major ideas and concepts underlying modern mathematical finance and financial engineering are explained and illustrated. (3-0-3)

Enrollment: Elective for AM and other majors

Textbook(s):

1. Stanley Pliska, *Introduction to Mathematical Finance: Discrete Time Models*, Blackwell
2. Giuseppe Campolieti, Roman N. Makarov, *Financial Mathematics: A Comprehensive Treatment*, Chapman and Hall/CRC

Other required material: None

Prerequisites: MATH 474 or MATH 475 or equivalent

Objectives:

1. Students will understand the basic principles of mathematical finance such as pricing and hedging in complete and incomplete markets, use of self-financing portfolios, etc.
2. Students will understand the role of risk neutral probability measure and its relation with a chosen numeraire asset.
3. Students will understand the use of elementary stochastic analysis (conditional expectations, filtrations, martingale theory, changes of measure – all for discrete time and finite state space processes) in mathematical finance.
4. Students will understand application of basic principles of mathematical finance for pricing and hedging of typical financial securities (such as options, futures and forwards).
5. Students will understand the concepts of risk and performance measures, their role in risk management, and some of their mathematical properties.
6. Students will work on projects that will provide a basis for some topics in the follow-up course MATH 582.

Lecture schedule: 3 50 minute (or 2 75 minute) lectures per week

Course Outline: Hours

1. Single period securities markets 12
    a. Finite market model
    b. Arbitrage
    c. Risk neutral probability
    d. Valuation and hedging
    e. Completeness
2. Multiperiod securities markets 12
    a. Mathematical set-up and basic concepts
    b. Conditional expectations and martingales

c. Return and dividend processes
d. What all this means for valuation and hedging
e. Binomial and Markov models

3. Financial derivatives 12
    a. Contingent claims
    b. European and American options
    c. Futures and forward contracts
4. Risk and performance measure
    a. Coherent and convex risk measures
    b. Performance measures
    c. Applications to risk management and nonlinear valuation

Assessment:	Homework	0-10%
	Quizzes/Tests	45-50%
	Final Exam	45-50%

Syllabus prepared by: Tomasz R. Bielecki and Igor Cialenco
Date (last revision): 09/18/16