

# Mathematical Methods in Financial Economics – Spring 2009

## Math 40570 & 50570 and Fin 40820 & 70820

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**Description:** This interdisciplinary course is designed to foster interaction between finance and mathematics at Notre Dame. For each unit of the course the mathematical components of the financial problem as well as the problem itself will be addressed. The following topics in financial economics will be included in the course: Arbitrage pricing of financial assets, Pricing of stock options, Risk assessment, Portfolio decisions and risk management, Equilibrium pricing of financial assets. These topics will be addressed in continuous and discrete time. The necessary mathematical background from differential equations and probability theory will be provided. Students will work in interdisciplinary groups to develop final projects which use quantitative methods to address current issues in financial economics such as what risk management techniques led to the sub-prime lending crisis.

**Reference Books/Notes:** (The main reference is [2] accompanied with [3] and/or [4])

[1] Thomas Cosimano & Alex Himonas, Lecture Notes (Posted on <http://www.nd.edu/~mmfe>)

[2] Quantitative Finance: Jaksza Cvitanic and Fernando Zapatero, “Introduction to the Economics and Mathematics of Financial Markets”, The MIT Press, 2002.

[3] Derivative Concepts: Don M. Chance, ”Essays in Derivatives: Risk-Transfer Tools and Topics Made Easy,” second edition, John Wiley, 2008.

[4] Quantitative Finance: Steven Shreve, ”Stochastic Calculus for Finance, I and II, Springer 2004.

[5] Quantitative Finance: Salih N. Neftci, “An Introduction to the Mathematics of Financial Derivatives,” Second Edition, Academic Press, 2000.

[6] Investment: Zvi Bodie, Alex Kane, and Alan Marcus, ”Essentials of Investments,” seventh edition, McGraw-Hill, 2008.

[7] Computer models of Finance: Simon Benninga at <http://finance.wharton.upenn.edu/benninga/wiener.html> is a good source for description of financial engineering problems and Mathematica computer programs.

[8] Option pricing: John C. Hull Options, Futures, and Other Financial Derivatives,” seventh edition, Prentice-Hall, 2008.

**Goals.** Upon completion of this course students should have learned the basic mathematical ideas and techniques that are useful in formulating and solving problems arising in the financing of corporations. Moreover it will enhance problem solving skills, critical thinking, rational decision making and appreciation for the interaction between the disciplines of mathematics and finance. Furthermore students will be exposed to research in this interdisciplinary area. They are expected to develop a final project, which illustrates their understanding of some model of financial mathematics.

**Electronic Course Information:** Most information for this course (homework assignments, lectures, etc.) will be posted on the web at:

<http://www.nd.edu/~mmfe>

## Exam, Homework, Projects and their Grading:

Midterm Exam	March 2	Monday	9:30–10:30 AM	HAYE 129	100
Final Exam	May 4	Monday	8:00–10:00	TBA	100
Homework	collected regularly				100
Projects	including class participation (20 pts)				100
<b>Total points:</b>					<b>400</b>

Your final grade will be assigned on the basis of your total score out of 400.

**Missed exams:** A student who misses an examination will receive **zero points** for that exam unless he or she has a valid excuse (illness, excused athletic absence, etc.). Please see us ASAP (preferably before the exam) and a makeup exam will be scheduled.

**Exam conflicts:** Students with **more than 2** finals in one day, or **more than 3** finals in a 24 hour period, may negotiate to change the time of one of these finals.

**Honor Code:** Examinations, homework and projects are conducted under the honor code. While collaboration in small groups in doing homework and projects is permitted (and strongly encouraged) in this course, copying is not. Exams are closed book and are to be done completely by yourself with no help from others.

**Homework:** Homework problems will be assigned and collected regularly. You are encouraged to work on homework problems in groups, but the assignments must be turned in individually. Remember that you **will not learn anything by simply copying another student's work**. The main purpose of the homework is to help you learn the material.

**Project:** Students working in groups of diverse backgrounds will develop a final project, which illustrates the interaction between Mathematics, Finance and related fields. These projects will integrate financial and mathematical aspects of an asset pricing or financial engineering problem. Each student will have the opportunity to contribute her/his expertise and learn from the expertise of the other group members. For example a mathematics major would provide a derivation and possible solution of the model for the financial asset. A computer science major could develop a computer algorithm to solve a model of the financial asset. While a finance major or MBA student would develop the relation between the institutional details of the financial asset and the mathematical model being used to represent the financial asset. Each group will present its project to the whole class, thus providing additional opportunities for learning and inter-group interaction.

The **rules** are:

- (a) You can work in groups of size 4-6 students.
- (b) Each group should include Math and Finance majors.
- (c) Each group submits one (typed) paper (and e-copy if possible).
- (d) Each member of the group receives same score—a number between 0 and 80.
- (e) Each member of the group must make a **significant** contribution to the project and should be able to **understand** and **present** the project as a whole.

**Class Attendance and participation:** You are expected to attend all classes. Also, you are encouraged to actively participate by answering and asking questions. Please do your best to show up on time and quietly enter the room when this is not possible. Please remember to respect your colleagues who are here to learn.

**Calculators:** You may use a graphing calculator during exams.