Offered on the Main Campus and Online, Fall 2009!

MATH 565 Monte Carlo Methods in Finance

Monday & Wednesday 1:50–3:05 pm, Stuart Building Room 204

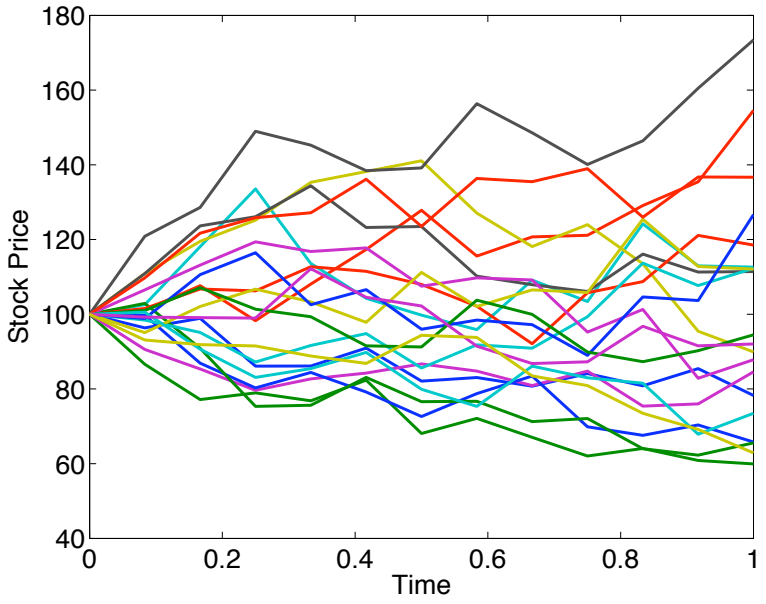
Instructor: Fred J. Hickernell, hickernell@iit.edu, 312-567-8983

Prerequisite: Math 474 Introduction to Probability & Statistics

Monte Carlo methods use random numbers to obtain approximate answers to problems that cannot be solved efficiently otherwise. These methods are valuable for evaluating complicated and high-dimensional integrals arising in chemistry, physics, engineering, statistics, and finance. In finance, Monte Carlo methods are used to evaluate the fair price of exotic options and compute value-at-risk. These quantities depend on the future movements of stock prices. Since such prices are not known, one computes many possible scenarios of stock movements via random numbers (see the plot below). The option price or value-at-risk is estimated as the average over these possible scenarios.

This course assumes a basic understanding of probability and statistics, but no knowledge of Monte Carlo methods nor finance. We will study how to generate random stock paths, how to approximate various quantities of financial interest, and how to estimate the error of our approximations. Because clients often need answers in real-time, we will study ways of obtaining accurate answers with fewer stock paths using variance reduction methods and quasi-Monte Carlo (or low discrepancy point) methods. (This latter topic is an area of active research of the instructor.)

Monte Carlo Methods in Financial Engineering by Paul Glasserman is the textbook for this course. Students will have the opportunity to read recent articles in the field and present and discuss their contents in class. Calculations will be done using MATLAB, JMP and other software packages or computer languages. This class is part of the Masters of Mathematical Finance program, but is suited for graduate students interested in Monte Carlo methods and/or financial applications. It has been taken by students in several different disciplines.



Math 565 Monte Carlo Methods in Finance

Course Description from Bulletin: In addition to the theoretical constructs in financial mathematics, there are also a range of computational/simulation techniques that allow for the numerical evaluation of a wide range of financial securities. This course will introduce the student to some such simulation techniques, known as Monte Carlo methods, with focus on applications in financial risk management. Monte Carlo and Quasi Monte Carlo techniques are computational sampling methods which track the behavior of the underlying securities in an option or portfolio and determine the derivative's value by taking the expected value of the discounted payoffs at maturity. Recent developments with parallel programming techniques and computer clusters have made these methods widespread in the finance industry. (3-0-3).

Enrollment: Graduate elective

Textbook(s): Paul Jaeckel, *Monte Carlo Methods in Finance,* Wiley and Sons
Paul Glasserman, *Monte Carlo Methods for Financial Engineering,* 1st ed., Springer

Other required material: None

Prerequisites: MATH 474

Objectives:

1. Students will understand the basics of Monte Carlo and Quasi-Monte Carlo Methods.
2. Students will understand how these methods are used for financial computations and as derivative parity.
3. Students will understand how to assess the performance of Monte Carlo methods and improve their effectiveness.
4. Students will understand basic implementation issues in performing Monte Carlo calculations.

Lecture schedule: 2 75 minute lectures

Course Outline:	Hours
1. Introduction	3
a. What is a Monte Carlo method?	
b. Why are Monte Carlo methods useful in finance?	
2. General asset sample path	6
a. Pseudo-Random numbers	
b. Random vectors with different distributions	
3. Option pricing	12
a. Asian options	
b. American options	
c. Error estimation	
4. Enhancing efficiency	15
a. Variance reduction techniques	

b. Quasi-Monte Carlo methods
c. Parallel Computing

5. Selected topics 9

Assessment:	Homework	25%
	Computer Programs/Project	25%
	Final Exam	50%

Syllabus prepared by: Fred Hickernell and Xiaofan Li
Date: 12/17/05