Prefix, Number and Name of Course: ACM 655 Mathematics of Finance II: Modeling, Analysis and Numerical Methods

Credit Hours: 1
In Class Instructional Hours: 1 **Labs:** 0 **Field Work:** 0

Catalog Description:
Prerequisites: Math315,Math325/Math381 or equivalent and Instructor Permission

Black-Scholes equation, partial differential equations, risk-neutral probability, Brownian motion, hedging, continuous and discrete stochastic models.

Reasons for addition:
Mathematics of Finance II is the second of the two one-credit courses designed to enrich and broaden the department's graduate course offerings by integrating probability, differential equations and numerical analysis through in-depth study of their connections to finance and economics. It is a sequence of Mathematics of Finance I, although they are highly related but independent to each other to a large extent. This sequence will enhance the Professional Applied and Computational Mathematics program by providing students with additional knowledge that they can build upon in their internship or projects.

Student Learning Outcomes: Students will:	**Content Reference:**	**Assessment:**
1. Decompose and analyze the classical models in financial mathematics and master some of the other related models and numerical methods to solve them.	I,II, III, V.	Group and individual assignments, examinations, and computer projects.
2. Set up mathematical models and solve the practical problems raised in reality with real data.	I, III, IV.	Group and individual assignments, examinations, and computer projects.
3. Utilize software and develop programs to solve the financial mathematical models.	I, IV.	Group and individual assignments, examinations, and computer projects.

Course Content:

I. Continuous-time models and the Black-Scholes equations
   A. A continuous-time model
   B. The discrete model
   C. An analysis of the continuous model
   D. The Black-Scholes formula
   E. Derivation of the Black-Scholes formula

II. The analytic approach to Black-Scholes
   A. Strategy for obtaining the differential equation
   B. Expanding and simplifying V(S,t)
   C. Solving the Black-Scholes differential equation
   D. Options on futures

III. Models of hedging
   A. Delta hedging
   B. Methods for hedging a stock or portfolio
   C. Implied volatility
   D. The analysis of parameters

IV. Bonds and interest rate models
   A. Interest rates, forward rate and spot rate
   B. Swaps
   C. Interest rate models
   D. Vasicek and Cox-Ingersoll-Roll models

Resources:

Scholarships in the Field:

Ali Hirsa, *Computational Methods in Finance*, CRC, 2012

Chung K. and AitSahlia F., *Elementary Probability Theory: with stochastic processes and an introduction to mathematical finance*, 2003.

Dunbar, N. *Inventing Money: The Story of Long-Term Capital Management and the Legends Behind It*, UK: Wiley 2000

Etheridge Alison, *A Course in Financial Calculus*, Cambridge, 2002

Eberlein Raible, *Mathematical Finance*, Springer 1999

Follmer H. and Schied A. *Stochastic Finance, An introduction in discrete time*, Springer, 2004

John Hull, *Options, Futures, and Other Derivatives* 8^{th}, 2011

Jorion, P. *How Long-Term Lost Its Capital*, 1999

Joseph Stampfli and Victor Goodman, *The Mathematics of Finance: Modeling and Hedging*, Springer 2010

Machiael Steele, *Stochastic Calculus and Financial Applications*, Springer, 2000

Malliavin, *Stochastic Calculas of Variations in Mathematical Finance*, 2005

Salih Neftci, *An Introduction to the Mathematics of Financial Derivatives*, 2000

Thomson, R. and Apocalypse Roulette, *The Lethal World of Derivatives London*, Macmillan, 1998

Periodicals:

Journal of Mathematical Finance

Journal of Computational Finance

Journal of Financial and Quantitative Analysis

Journal of Finance

Journal of Financial Derivatives

Quantitative Finance

The Journal of Fix Income

Finance and Stochastic

Journal of Financial Studies

Journal of Money, Credit and Banking

Journal of Derivatives

Journal of Banking and Finance

Mathematics and Financial Economics

Journal of Futures Markets

Electronic and Audiovisual Resources:

Society of Mathematical Finance, https://win.wisc.edu/organization/smf

International Association of Financial Engineers, http://iafe.org/html/

International Monetary Fund: the statistic measurement of financial derivatives, http://www.imf.org/external/pubs/cat/longres.cfm?sk=2514.0

Department of Mathematics, Financial Mathematics, University of Chicago, http://finmath.uchicago.edu/admissions/lecture_videos.shtml

The Actuarial Profession, www.soa.org/careers

Careers in Applied Mathematics, www.siam.org/careers/

Mathematical Sciences Career Information, www.ams.org/careers

Careers in Statistics, www.amstat.org/careers

101 Careers in Mathematics, www.maa.org/careers.

Occupational Outlook Handbook, www.bls.gov/oco/

Center for Research in Financial Mathematics and Statistics at UC Santa Barbara, http://www.youtube.com/watch?v=bIiQRRllJoA

Financial Engineering & Financial Mathematics
http://www.youtube.com/watch?v=ABhfQk3qgVk&playnext=1&list=PLE981F9D9EA1F7078&feature=results_main