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.

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


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

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


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


**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](https://win.wisc.edu/organization/smf)


The Actuarial Profession, [www.soa.org/careers](http://www.soa.org/careers)

Careers in Applied Mathematics, [www.siam.org/careers](http://www.siam.org/careers)

Mathematical Sciences Career Information, [www.ams.org/careers](http://www.ams.org/careers)

Careers in Statistics, [www.amstat.org/careers](http://www.amstat.org/careers)

101 Careers in Mathematics, [www.maa.org/careers](http://www.maa.org/careers)


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

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