Proposal:

Minor in Financial Computation and Modeling

Updated: December 1, 2006

Rationale: The Economics Department has been teaching three courses in the field of Financial Economics (Econ 355, Econ 448, and Econ 449), and the Statistics Department has been teaching two courses in Computational Finance (Stat 486 and Stat 421). These courses have been very popular with students (see enrollments in the Appendix). Together they provide an excellent training for students who wish to seek employment in the financial sector.

Current Commitments: The listed courses have been used in various combinations in recent years as core requirements or electives for the Economics major, Mathematical Economics major, Managerial Studies (MANA) major, Statistics major, and the Undergraduate Certificate Program in computational finance offered by the Center for Computational Finance and Economic Systems (CoFES). CoFES, founded in 2002, has facilitated undergraduate research in the area of computational finance through a generous National Science Foundation training grant as well as corporate and private sponsorships. CoFES will continue to seek opportunities to grow the funding base for undergraduate research in computational finance. The Economics and Statistics Departments are already committed to offering the stated courses.

Proposal: We propose pooling our resources to make a Minor degree in Financial Computation and Modeling available to Rice students, with sufficient flexibility in course requirements to make it available to students majoring in economics and mathematical economics, various fields of engineering and science, and MANA, among others.

Curriculum: To earn a minor in Financial Computation and Modeling, students would need to take three courses each from two groups (those courses may also count toward other degrees, as already noted).¹

¹ Please note that many of those courses have prerequisites, some of which may allow student outplacement while others may not. In the current General Announcements: Econ 370 requires (ECON 211 AND MATH 101 OR MATH 111 AND MATH 212); Econ 400 requires (ECON 382 OR STAT 310 OR STAT 381 AND MATH 211 OR MATH 355 OR CAAM 335 or permission of instructor); Econ 355
1. **Basic Tools** *(choose 3 courses):*
   (Econ 211 or Econ 370), Stat 310, (Econ 400 or Stat 410)

2. **Financial Computation and Modeling** *(choose 3 courses):*
   (Econ 355 or Econ 448), Stat 421, Econ 449, Stat 486

requires (Econ 211); **Econ 448 requires** (ECON 370 AND ACCO 305 AND STAT 280 or permission of instructor); **Econ 449 requires** (Econ 211 or 370; Math 211/212; Stat 410 or Econ 400); **Stat 421 and Stat 486 both require** (STAT 310 OR STAT 331).
### Appendix

#### Course Enrollments in Recent Years

<table>
<thead>
<tr>
<th></th>
<th>Econ 211</th>
<th>Econ 448</th>
<th>Econ/Stat 400</th>
<th>Econ 355</th>
<th>Econ 370</th>
<th>Econ 449</th>
<th>Stat 410</th>
<th>Stat 421</th>
<th>Stat 486</th>
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<tbody>
<tr>
<td><strong>Fall 2002</strong></td>
<td>241</td>
<td>47</td>
<td>9</td>
<td>---</td>
<td>106</td>
<td>---</td>
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<td><strong>Spring 2003</strong></td>
<td>143</td>
<td>47</td>
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<td>71</td>
<td>51</td>
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<td>20</td>
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<td><strong>Fall 2003</strong></td>
<td>216</td>
<td>52</td>
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<td>9</td>
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<td><strong>Spring 2004</strong></td>
<td>106</td>
<td>40</td>
<td>16</td>
<td>118</td>
<td>55</td>
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<td>12</td>
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<tr>
<td><strong>Fall 2004</strong></td>
<td>184</td>
<td>65</td>
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<td>45</td>
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<td><strong>Fall 2005</strong></td>
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<td>Spring 2006</td>
<td>78</td>
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<td>31</td>
<td>88</td>
<td>57</td>
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</table>
**Cohesive curriculum:** Students completing the FCAM minor will understand the complexities of financial markets and their role in and impact on world economies. For the last two decades, this sector of our economy has significantly increased its reliance on quantitative probability based methods in assessing risk and implementing financial strategies; strategies on which our economy depends.

The basic tools component of the FCAM curriculum will equip students with the economic (Econ 211 or Econ 370), probability (Stat 310) and statistical tools (Econ 400 or Stat 410) necessary to pursue the advanced analytical courses. In the advanced courses, students will be exposed to state-of-the-art models and methodologies based on long standing assumptions about the behavior of financial markets. They will also be exposed to alternative views of market behavior and investment strategies. The goal is to educate the student to question basic assumptions as well as utilize and understand technologies based on these important assumptions. In the financial industry, a large suite of solutions are implemented and continually enhanced. A goal of the FCAM program is to train leaders in this industry who will not only understand the financial technologies but will also understand the role, impact and potential pitfalls of these technologies.

**Faculty management and advising:** Dr. Katherine Ensor, Chair of the Department of Statistics and Director of the Rice Center for Computational Finance and Economic Systems will serve as the director of the FCAM minor steering committee. Dr. Mahmoud El-Gamal and Dr. James R. Thompson will serve as committee members and undergraduate advisors with an initial commitment of three years. Drs. Riedi (statistics) and Boylan (economics) are available and have agreed to serve on the steering committee and as undergraduate advisors should members of the initial committee need to rotate off the committee before the end of their initial appointment. There is a large pool of faculty members from both departments on which this program can draw.

**Faculty support for curriculum:** The table below provides a listing of existing faculty who can cover each course identified in the program. As you can see from the table, there is substantial tenured faculty support within economics and statistics for this program. There are numerous other faculty at Rice pursuing research in the area of the FCAM minor.

<table>
<thead>
<tr>
<th>Course</th>
<th>Number of Faculty</th>
<th>Identified Faculty</th>
</tr>
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<tbody>
<tr>
<td>Econ 211</td>
<td>All faculty in economics</td>
<td></td>
</tr>
<tr>
<td>Econ 370</td>
<td>9 faculty in economics</td>
<td></td>
</tr>
<tr>
<td>Econ 400</td>
<td>4</td>
<td>Bryan Brown, James Brown, Mahmoud El-Gamal, Robin Sickles</td>
</tr>
</tbody>
</table>
Econ 355 | 4 | Camelia Bejan, John Bryant, Mahmoud ElGamal and Peter Hartley
---|---|---
Econ 448 | 4 | Camelia Bejan, John Bryant, Mahmoud ElGamal and Peter Hartley
Econ 449 | 2 | Bryan Brown and Mahmoud ElGamal
Stat 310 | All faculty in statistics |  
Stat 410 | All faculty in statistics |  
Stat 421 | 5 | Dennis Cox, Kathy Ensor, Rolf Riedi, Javier Rojo, Jim Thompson
Stat 486 | 4 | Dennis Cox, Kathy Ensor, Rolf Riedi, Jim Thompson

Course descriptions:

ECON 211 *Principles of Economics* I
Provides an introduction to the basic nature of economics at the level of individual economic agents; primarily consumers and business firms. Topics covered include the analysis of supply and demand and market equilibria; household decisions regarding demands for consumption goods and supplies of labor and saving; and business decisions regarding the supply of outputs and demands for factor inputs such as labor and capital.

ECON 370 *Microeconomic Theory*
Provides the student with the basic concepts of microeconomic theory. Although the topics covered are similar to those discussed in Economics 211 (Principles of Economics I), theoretical issues are covered in much greater detail, and there is a considerable emphasis on problem solving.

STAT 310 *Probability and Statistics*
Probability theory and the central concepts and methods of statistics. Topics include probability distributions, expectation, estimation, hypothesis testing, sampling distributions, linear models, basic ideas of statistical optimality.

ECON 400 *Econometrics*
Econometrics focuses initially on an analysis of univariate linear models. Subsequent topics include ordinary and generalized least squares estimation, maximum likelihood estimation, analysis of variance, two step regression, constrained least squares, hypothesis testing and prediction.

STAT 410 *Introduction of Regression and Statistical Computing*
A survey of regression, linear models, and experimental design. Topics include simple and multiple linear regression, single- and multi-factor studies, analysis of variance,
analysis of covariance, model selection, diagnostics. Data analysis using statistical software is emphasized.

ECON 355 Financial Markets
Study of the principles of U.S. and international equity and debt markets and the interactions between such markets and various countries’ monetary and exchange rate policies. The role of financial markets and institutions in the allocation and transfer of credit and risk is highlighted, and various existing and suggested regulatory frameworks are discussed.

ECON 448 Corporate Finance
Study of the financial theory and its application to practical problems in corporations. Covers the valuation of stocks and bonds, investment decisions, financing decisions, corporate control and the interaction between investment and financing decisions.

STAT 421 Computational Finance II: Applied Time Series Analysis
Applied time series modeling and forecasting, with applications to financial markets. Fundamental training in time series analysis from theory to practice; examples and methods chosen will be those useful in the area of statistical finance and modern computational finance.

ECON 449 Basics of Financial Engineering
This course covers the use of financial securities and derivatives to take or hedge financial risk positions. Most commonly used instruments, from simple forwards and futures to exotic options and swaptions are covered. The pricing of derivative securities will also be studied, but the emphasis will be on the mechanics and uses of financial engineering methods.

STAT 486 Computational Finance I: Market Models
This is a course based on the analysis of market data without pre-conceived assumptions. Consideration is given to alternative representations of portfolio optimization and pricing reducing the reliance on classical assumptions associated with market behavior such as the Efficient Market Hypothesis. The emphasis is on computational and empirical solutions to the problem of reducing risk while maximizing investment potential in financial markets.