

Saunders College of Business

Concept Paper: Proposal for a MS. in Computational Finance

Abstract

The proposed MS program in Computational Finance (hereafter, MCF) is a collaborative effort of three RIT colleges, SCB, GCCIS and COS with the possibly participation of one or two other colleges. The program seeks to address a vital and growing market niche, a demand for persons with a background in quantitative finance. Such persons are often referred to as “quants” in the financial world and have the capability to understand and use complex financial models, often involving differential and stochastic calculus. Also, quants are expected to be familiar with programming; expected capabilities are in languages such as C++ as well as in industry-standard scripting tools for mathematics/statistics such as R and SAS. Quants are expected to add value to their employers by using these financial and computing tools to solve business problems. Salaries for quants are in the upper end of the distribution of salaries for finance professionals.

As evident in the above description, an inter-disciplinary approach is vital for the program. Using this approach, we seek to satisfy the following general goals:

- Provide the mathematical foundation for using complex financial models
- Provide knowledge of financial markets and institutions
- Stress financial applications that have their base in statistics and mathematics but involve extensive use of computational methods generally and data mining methods specifically.

The program addresses a vital and documented market demand for practitioners of quantitative finance.

Overview and Justification of the Program

The confluence of three factors has led to the emergence of *quantitative* finance as a key business competency. *First*, starting with the option pricing model developed by Black, Scholes and Merton (the latter two were awarded Nobel prizes for their efforts in this regard) there has been an explosion of knowledge about financial derivatives and risk management. The market for financial derivatives is estimated to be in the hundreds of trillions of dollars, a reflection of their importance to financial and industrial enterprises. The study and use of derivatives is a key aspect of quantitative finance. *Second*, the financial crisis that started in 2007/8, and more recently, events such as hurricane “Sandy” remind us about the importance of risk management. This idea has not been lost of regulators of financial markets and institutions. For example, banks face regulations such as Basel III requiring sophisticated risk assessment. Needless to say, quantitative methods are required in such endeavors. *Third*, in a development noted by experts in diverse fields such as medicine, marketing and engineering, we are awash in data. The science of

data mining (computing, more generally) has much to offer in terms of making inferences from financial data such as the data generated in mortgages or credit card transactions.

The MCF program will address the three considerations discussed above. In particular, the program will focus on the third issue which is why we chose to label the program as one in “computational finance” rather than the more general descriptor “quantitative finance.”

A recent search of the popular job placement website www.careerbuilder.com indicates more than 1,000 openings in quantitative finance. The firms seeking employees are a roll call of prominent financial institutions and corporations. Yet, there are only about 25 programs explicitly addressing this space. Most programs are offered by leading institutions such as MIT, Stanford, NYU, California-Berkeley and Chicago, perhaps indicating that a necessary condition for operating in this space is the availability of considerable institutional capability. We believe RIT has the capability to compete in this market. Furthermore, we have specialized institutional assets and more importantly an innovative mindset that will allow us to carve out a valuable niche in the quantitative finance market.

Summary of the Curriculum

The program is expected to be a three-semester program, possibly constructed as a Fall-Spring-Summer program. We anticipate the following elements:

- Mathematics: topics such as probability, properties of random variables, Brownian motion, Ito calculus, applications to pricing of derivatives, time-series analysis, using numerical methods to solve PDEs
- Finance: topics such as markets, institutions and instruments, regulations, various derivatives contracts pricing/usage, risk management, financial engineering, equity portfolio analysis, bond portfolio analysis, interest rate models, hedging models
- Computing: data cleaning and preparation, databases, big data concepts, data mining, analytics.

The program will consist of 10 courses. We envision a required set of 7-8 courses of which at least two will be mathematics courses and two will be computing courses.

Most, if not all courses will stress applications. Students going through the program will be exposed to industry-standard tools (e.g., SQL, R, SAS, Matlab).

We plan on designing a capstone experience, one that will stress applications of mathematics/computing tools to solve a real problem (that is, using real data). We hope to engage industry partners to design this experience.

Fit with RIT Mission and Strategy

The proposed program is highly aligned with RIT's mission. The key elements in our mission and the program's contribution to it are listed below:

- *Pursuit of emerging career area:* Quantitative finance generally and computational finance specifically has only recently emerged but is the fastest growing subfield in finance. Financial institutions in particular (Wall Street firms, commercial banks, insurance firms) recruits “quants” and ask for specific skills such as the ones we propose to teach in our proposed program.
- *Motivating students through collaborative experiences:* The proposed program's key strength is the explicit collaboration between at least three colleges at RIT. Key components of the program will be designed and delivered by faculty from SCB, GCIS and COS. Furthermore, there are opportunities for collaboration with faculty from COLA and COE. Inter-disciplinary collaboration is the key behind the proposed program.
- *Internal and External Partnerships to expand experiential learning:* The proposed program will have a strong practical component, one which will be honed by conversations with industry partners. This approach well fits the RIT ethos.

Synergy with Other Programs

The Saunders College of Business at RIT already offers a rich portfolio of graduate programs. Perhaps the most successful of these programs is the MS in Finance. The proposed program in Computational Finance would draw on and add to the faculty servicing this other program. We also expect synergies to flow to the undergraduate finance program.

Enrollment Management Expectations and Sustainability

The following paragraphs are taken from the report by the Office of Enrollment Management.

The proposed Computational Finance Master of Science program offers the opportunity to enhance SCB offerings and leverage the technological aspect of the RIT brand. The program would complement the MS Finance program, and leverage coursework/content from applied mathematics, industrial engineering, quality and applied statistics, and computing and information sciences, and this degree would create a strong interdisciplinary value proposition and increase awareness in the marketplace.

We would encourage consideration of the title “Financial Engineering” as we have had many inquiries from students in India and China asking for this particular program. Many students are looking for focused, shorter programs (MS degrees rather than MBA programs with concentrations or dual degrees in finance and engineering/math/stats) and are more likely to ask about “financial engineering” rather than “computational finance”.

We anticipate that enrollment would be relatively small, from 10 – 15 new students initially, as the target market is somewhat narrow, there is significant competition in the market, and admission requires that applicants have a strong academic record in a science or engineering

field, (including applied mathematics, economics, mathematics, physics, statistics, computer science, or engineering). This will limit the number of interested, qualified applicants for admission. For example, 124,500 of the GMAT test takers last year earned their bachelor's degrees in business or commerce, as compared to only 55,000 in engineering and science.

Impact on Resources

We are in the initial stages of program design. The mix of courses will determine resources needed in the three colleges behind the initiative. To offer the 10 semester courses annually and to oversee any capstone/thesis elements, approximately 3 FTE would be required in total.