# UTQAP Cyclical Review: Final Assessment Report and Implementation Plan

## 1 Review Summary

Program(s) Reviewed:	Master of Mathematical Finance (MMF)		
Division/Unit Offering Program(s):	Faculty of Arts and Science (program-only review)		
Commissioning Officer:	Dean, Faculty of Arts and Science		
Reviewers (Name, Affiliation):	• Professor Jerry L. Bona, Department of Mathematics,		
	Statistics, and Computer Science, College of Liberal		
	Arts and Sciences, University of Chicago Illinois		
	Professor Petter N. Kolm, Courant Institute		
	ofMathematical Science, New York University		
	Professor Antony Ware, Department of Applied		
	Mathematics and Statistics, University of Calgary		
Date of Review Visit:	June 22, 2022 (conducted remotely)		
Review Report Received by VPAP:	September 8, 2022		
Administrative Response(s)	September 21, 2023		
Received by VPAP:			
Date Reported to AP&P:	October 24, 2023		

## Previous UTQAP Review (with the FAS Dept. of Mathematics)

Date: March 25-26, 2013

#### **Summary of Findings and Recommendations**

#### **Significant Program Strengths**

- MMF is a collaborative program of seven departments
- Students develop an in-depth understanding of the current state of quantitative finance,
   viewed from the academic perspective as well as the business perspective
- Highly successful, self-supporting program
- No graduate student from previous years is unemployed, and the program has had a 100% success rate in securing internships for students since the program began in 1998
- Admission to the program is highly competitive, with offer rates below 20%
- The program is very flexible and adaptable to students
- Program is amply funded, so it is relatively easy to find faculty to teach the classes
- MMF students highly motivated to succeed, as demonstrated by the 100% completion rate

Opportunities for Program Enhancement: N/A

## **Current Review: Documentation and Consultation**

#### **Documentation Provided to Reviewers**

Terms of reference; Self-study; Appendices; Previous review report including the administrative response(s); Access to all course descriptions; Access to the curricula vitae of faculty.

#### **Consultation Process**

Acting Vice-Dean, Academic Planning & Vice-Dean, Operations, Faculty of Arts & Science; junior and senior faculty; industry, adjunct, and visiting instructors; graduate students; administrative staff and senior program administrators; employers, industry partners, and professional associates; chairs of cognate units: Department of Mathematics, Department of Statistical Sciences, Department of Economics.

## **Current Review: Findings and Recommendations**

#### 1. Undergraduate Program(s): n/a

#### 2. Graduate Program

Unless otherwise noted, all bulleted comments apply to all programs reviewed.

The reviewers observed the following **strengths**:

- Objectives
  - ▶ The program is consistent with the University's academic plans and mission
  - ▶ Requirements and coursework are clear and align with degree level expectations
- Admissions requirements
  - ▶ Admissions requirements and process are comparable to graduate programs in quantitative finance, mathematical finance and financial engineering in Canada and in the U.S.
  - Acceptance rates for offers made has risen, and the offer rate itself has remained fairly consistent (around 10%) resulting in a cohort size of approximately 30
  - ▶ Low offer rate reflects the program's competitiveness and high standards
  - ► Reviewers commend the inclusion of the 30-minute interview in the admissions process, implemented in response to previous review recommendations
- Curriculum and program delivery
  - Curriculum is solid and provides a good foundation and preparation for students who aspire to careers in the financial industry
  - ► Program has done a good job of updating its curriculum as the financial industry underwent major changes since 2008, as well as subsequent regulatory reforms
  - Current topics such as capital adequacy, capital management and new regulatory trends are covered, as well as the New Basel Accord, banking capital management, and credit risk
  - ► Program has introduced courses in data science and machine learning; these updated and new courses meet increased demand from the industry for graduates with skill and knowledge in these areas
- Innovation
  - ► The MMF works diligently to stay up to date, and to keep abreast of the frequent changes in the financial industry
  - ► The program leverages external expertise among alumni, industry connections, and/or the advisory board to stay on top of changes in the industry
- Assessment of learning
  - Assessment methods include graded assignments, project report presentations, and examinations; this mixture provides appropriate evaluation throughout the program
  - Significant amount of required group work, which is appropriate for a program designed to prepare students for careers where effective teamwork is essential
  - ► Frequent opportunities provided to assess students' ability to communicate effectively to a range of audiences

- Student engagement, experience and program support services
  - ► Students are very happy with instructors and coursework
  - Curricular internship gives students opportunities to bring to practice what they learn in their coursework
  - ▶ Students are well supported in finding internships (100% success rate) and job placement; "The fact that the MMF has never failed in assuring all students obtain internships is certainly a feather in their cap"
  - ► MMF organizes a speaker series ("MMF Global") where invited presenters cover a broad range of topics in finance, and an annual Symposium for students, alumni and industry partners
  - ► Student survey responses not statistically different from the average across all Canadian (U15) professional Mathematical Finance programs, and in line with those across FAS
  - ► MMF's professional development support is a notably strong program attribute, including career mentoring from industry partners and course instructors, and excellent guidance from administrative staff
  - Administrative team is deeply involved with the student experience and are dedicated to supporting the students in a variety of ways
- Quality indicators graduate students
  - Program has a remarkably strong record of ensuring that students do well in their studies and graduate on time; over the entire history of the program, only three students did not complete
- Quality indicators alumni
  - ► Students find employment in the financial sector in banks, pension plans, hedge funds, family offices, and Fintech firms and startups
  - ► Success at finding suitable employment at the 4-month post graduation point is very high (over 95% in the most recent year)
  - ▶ 100% of graduates find industry jobs within a year after completion of the program
- Student funding
  - Internships are paid, which does provide some level of support (a minimum total of \$15K)
  - Students fund their studies by loans if they do not have direct access to funds, and strong employment prospects for graduates make taking out a loan a realistic prospect, particularly for domestic students

#### The reviewers identified the following **areas of concern**:

- Admissions requirements
  - ▶ The number of applications has decreased somewhat in recent years
- Curriculum and program delivery
  - Students noted minor concerns that some course content strayed considerably from the syllabus, and there was some amount of duplication in assignments across courses
  - ► All courses are developed specifically for the MMF program and are mandatory, with no electives available

- Unclear whether the program introduced valuation adjustments such as CVA and DVA, and other XVA metrics
- Student engagement, experience and program support services
  - Response rates to student surveys provided were quite low
- Student funding
  - ▶ Students are self-financed, and program fees are substantial

#### The reviewers made the following **recommendations**:

- Curriculum and program delivery
  - ► The program should improve the coordination of course content and topics across courses
  - Consider introducing valuation adjustments such as CVA and DVA, and other XVA metrics to the curriculum
- Student engagement, experience and program support services
  - Leadership encouraged to explore approaches to increase participation rates in future student surveys
- Student funding
  - Continue to explore the creation of endowed awards and/or scholarships for students who are unable to access other sources of funding

#### 3. Faculty/Research

The reviewers observed the following strengths:

- Overall quality
  - Quality of faculty is outstanding, with a "healthy mix of long-standing and newer adjunct instructors who work in the financial industry"
  - ► Faculty have strong ties with the financial world, and are on the whole distinguished and very well qualified to deliver the MMF program and support its students
- Research
  - Teaching staff who contribute to the MMF are active in research and/or development
  - Teaching staff whose major appointments are in universities are all outstanding
  - Academics enjoy funding support from NSERC, MITACS or similar sources, supervise Ph.D. and master's students outside of the MMF, and mentor undergraduates

#### 4. Administration

Note: Issues that are addressed through specific University processes and therefore considered out of scope for UTQAP reviews (e.g., individual Human Resources issues, specific health and safety concerns) are routed to proper University offices to be addressed, and are therefore not included in the Review Summary component of the Final Assessment Report and Implementation Plan.

The reviewers observed the following **strengths**:

#### Relationships

- ► The program has good connections to its extensive alumni network, and works hard to maintain and extend that network
- Current and former students expressed strong loyalty to the program
- "One of the real strengths of the MMF program is the loyal participation of a coterie of outstanding folks from the financial industry", who contribute expertise in areas such as machine learning, data science, stochastic calculus, and real-world finance experience, and whose participation helps keep the MMF current and contributes to its success in helping students find internships and good jobs
- Drive, morale and sense of community among faculty, students and staff noted as "exceptionally high"
- ► Relationships with cognate units such as Mathematics, Statistical Sciences, and Economics appear strong and collegial, and heads of these units spoke highly of the MMF, its staff and its leadership
- While cognate units offer programs (MFE, MFI, Rotman Risk Management) that are in principle competing with the MMF and one another, all appear to have their own angle and focus, enjoy very strong student success, and exhibit an admirable level of cooperation, organizing a joint annual recruitment event
- ▶ MMF is an Academic Affiliate Member of the International Association for Quantitative Finance (IAQF), a non-profit professional organization dedicated to fostering quantitative finance among academics and practitioners; MMF students actively participate in events organized by the IAQF, including in-person and online seminars, and an annual career fair in NYC; MMF leadership attends program directors' meetings organized by the IAQF in conjunction with its annual career fair
- ▶ MMF Director is "a visionary, with no shortage of creative ideas for the growth of the program", and his commitment and dedication to the program are notable
- Director receives excellent and dedicated support from administrative staff
- Organizational and financial structure
  - MMF receives no direct financial support from FAS, and runs as a full cost-recovery program
  - Program Director reports directly to the Dean and is responsible for managing MMF budget; receives advice and suggestions from an informal Advisory Board
  - ► FAS does provide substantial support in the form of space for the program and it is anticipated that much-improved space will be provided for the program in the Ontario Hydro Tower; this new space is expected to be helpful for morale

- Primary MMF revenue stream is through tuition, and applications continue to vastly exceed the number of students the MMF can accommodate
- With its steady and predictable source of revenue, the program has been able to manage its budget well
- "The autonomy enjoyed by the program has been largely beneficial, allowing it to adapt quickly to the changing needs of the financial industry"
- Long-range planning and overall assessment
  - ► The MMF is organized, administered and running very well
  - ► MMF looking into increasing its revenue; anticipated new space may provide opportunities to enlarge the cohort size
  - ► MMF runs an annual Symposium which generates some income from registration fees, and has moved into e-Learning, with courses that are free for alumni, with paid options for other interested students
  - "The Director is not short of ideas for ways in which the program could grow and adapt"
- International comparators
  - ► MMF currently ranked in the top half of Quantitative Finance programs by Risk.net (though this and other similar rankings are noted as imperfect and biased, often in favor of programs in the U.S).
  - ► The MMF is demanding and fast-paced, similar to other top programs; and students put in a significant amount of work to complete academic requirements, attend seminars and company presentations, network with alumni and industry professionals, and interview for internships and full-time jobs
  - ► MMF is one of the top three programs in Canada, and comparable to other global one-year programs of its kind
  - ► The very strong faculty set the MMF apart from most Canadian programs, and contribute a lot towards the students' experience
  - ▶ The MMF's very strong internship and full-time job placement record are "enviable"

#### The reviewers identified the following **areas of concern**:

- Organizational and financial structure
  - ► MMF differs from other FAS professional programs in having no formal relationship with a particular unit; the program consequently operates with a high degree of autonomy, albeit with some disconnect within the standard structure of FAS
  - ▶ Program is overly reliant on its Director for its continued success; "a high level of dependence on a single leader, however strong, creates risks for any organization"
  - With the present physical space limitations, expanding the program would not be feasible
- Long-range planning and overall assessment
  - ► Program's autonomy within FAS structure may cause challenges in bringing innovative ideas for growth to fruition

#### The reviewers made the following **recommendations**:

- Organizational and financial structure
  - ► FAS's anticipated creation of a School that would include Departments of Computer Science, Mathematics, and Statistical Sciences would provide a natural home for the MMF; might provide opportunities for tighter integration with other units
  - ▶ Reviewers suggest there is a very strong need for a Deputy Program Director, to provide leadership support and to take responsibility in specific areas such as curriculum oversight and student related matters, and to enhance the program's sustainability and growth potential
  - Deputy Director role would ideally be filled by a faculty member from an FAS Department in the Sciences
  - ► FAS might consider hiring directly into this role, rather than from existing faculty, with 50% of funding provided by the MMF
- Long-range planning and overall assessment
  - "[It] is vital for the ongoing growth and health of the program to find a way to make these less dependent on a single person. Therefore, we recommend the creation of a Deputy Director role as the best way to achieve this."
  - ▶ Director has expressed interest in the idea of potentially setting up international MMF satellites; reviewers note that this could be an interesting way to grow the program, and might open up a wider range of options for MMF graduates
  - Reviewers note importance and complexity of finding a new structural arrangement for the MMF within FAS "that retains the advantages of autonomy, but without the structural isolation, and is able to provide institutional support for innovative opportunities for growth"
  - ► Incorporating MMF into the planned FAS School could provide a mechanism for making academic hires directly into the program

## 2 Administrative Response & Implementation Plan



September 21, 2023

Professor Susan McCahan Vice-Provost, Academic Programs University of Toronto

**RE: UTQAP cyclical review of Master of Mathematical Finance Program** 

Dear Prof. McCahan,

I write in response to your letter of June 2, 2023, regarding the June 22, 2022, UTQAP cyclical review, held remotely, of the Master of Mathematical Finance professional graduate program (MMF) and requesting our Administrative Responses.

On behalf of the Faculty of Arts & Science, we would first like to thank the reviewers Jerry L. Bona, University of Chicago Illinois, Petter N. Kolm, New York University, and Antony Ware, University of Calgary, for their very comprehensive review of the MMF. We would also like to thank the MMF Director, Prof. Luis Seco, and faculty, administrative staff, and all those who contributed to the preparation of the self-study. We also want to thank the many staff, students, and faculty members who met with the external reviewers and provided thoughtful feedback. The UTQAP cyclical review process is an invaluable exercise that affords us the opportunity to take stock of our academic units and programs, to recognize achievement and identify areas for improvement.

The review report was finalized on September 8, 2022, after which the director shared it widely with faculty, staff, and students in the MMF program. We are extremely pleased with the reviewers' positive assessment of the overall strength of the MMF as a professional graduate program, and its outstanding, productive faculty. The reviewers observed that the program is "organized and administered very well," with "outstanding faculty" and that there is strong professional development support. The review report also raised several issues and challenges and identified areas for enhancement, including that the program is "overly reliant on its Director for its continued success," that there is some overlap in coursework, and noting that the program could explore new scholarships and endowments.

Each of these recommendations has been addressed in the attached Review Recommendations Table that outlines the Program's response, the Dean's response, and an Implementation Plan

identifying action items and timelines for each recommendation. My Administrative Response and Implementation Plan was developed in consultation with the director and with senior leadership within my office. The Implementation Plan provided identifies timeframes of short- (six months), medium- (one to two years), and long- (three to five years) term actions and who (Faculty, Dean, unit) will take the lead in each area. I also identified any necessary changes in organization, policy, or governance where appropriate, as well as any resources, financial or otherwise, that will be provided, and who will provide them.

The next UTQAP cyclical review of MMF will take place no later than the 2029-30 review cycle. My office monitors progress on Implementation Plans through periodic meetings with the director. I also acknowledge that your office will request a brief Interim Monitoring Report midway between the June 2022 review and the year of the next site visit in 2029-30 to report on progress made on the Implementation Plan as outlined in the accompanying Review Recommendations Table.

Thank you very much for the opportunity to respond to the review report. The reviewers' comments and recommendations will help inform the future priorities of the Master of Mathematical Finance professional graduate program.

Sincerely,

Melanie Woodin

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Dean, Faculty of Arts & Science

Professor, Department of Cell & Systems Biology

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Luis Seco, Director, Master of Mathematical Finance program, Faculty of Arts & Science Gillian Hamilton, Associate Dean, Unit-Level Reviews, Faculty of Arts & Science Suzanne Wood, Special Advisor to the Dean on Unit-Level Reviews, Faculty of Arts & Science Daniella Mallinick, Director, Academic Programs, Planning & Quality Assurance, Office of the Vice-Provost, Academic Programs

Andrea Benoit, Academic Review Officer, Academic Planning, Office of the Dean, Faculty of Arts and Science

#### 2021-22 UTQAP Review of FAS Mathematical Finance - Review Recommendations DRAFT

Please do the following for each recommendation in the table:

- If you **intend** to act on a recommendation, please provide an **Implementation Plan** identifying actions to be taken, the time frame (short, medium, long term) for each, and who will take the lead in each area. If appropriate, please identify any necessary changes in organization, policy or governance; and any resources, financial and otherwise, that will be provided, and who will provide them.
- If you do not intend to act on a recommendation, please briefly explain why the actions recommended have not been prioritized.
- In accordance with the UTQAP and Ontario's Quality Assurance Framework, "it is important to note that, while the external reviewers' report may include **commentary** on issues such as faculty complement and/or space requirements when related to the quality of the program under review, **recommendations** on these or any other elements that are within the purview of the university's internal budgetary decision-making processes must be tied directly to issues of program quality or sustainability" (emphasis added)
- You may wish to refer to the <u>sample table</u> provided by the Office of the Vice-Provost, Academic Programs

Request Prompt verbatim from the request	Rec. #	Recommendations from Review Report verbatim from the review report	Program Response	Dean's Response
The reviewers noted that students report some overlap and duplication in assignments between courses (all of which are mandatory), and recommended enhancing the coordination of content and topics across courses.	1	"Based on student feedback there are unnecessary overlaps across some courses. The program should improve the coordination of course content and topics across courses."	A curriculum review is already under way to address these issues; two existing courses have been replaced with two new courses to update content. A meeting was held with the Curriculum Committee on January 17, 2023 to discuss both current and forward directions for the MMF curriculum. The issue of overlap was discussed and will be monitored on a regular basis through Committee and faculty meetings. Time frame: under way.	Short- to medium-term: The Vice-Dean Graduate Education will continue to engage with the MMF leadership regarding proposed academic changes and any restructuring of the graduate program requirements. The Dean's office is also available to facilitate a consultation with the Curriculum Development Specialist for additional guidance, should MMF wish to do so.
The reviewers observed that MMF students are self-financed, and the program fees are substantial. They recommended exploring the creation of awards and/or scholarships for students who are unable to access other sources of funding.	2	"We suggest the program continues to explore the creation of endowed awards and/or scholarships for students who are unable to access other sources of financing."	This year we have already secured 6 new scholarships for the program from a donor. These awards are the direct result of a fundraising initiative we started two years ago. We expect this to continue as we work closely with the Office of Advancement in FAS to develop sponsors and donors. Time frame: under way	Short- to medium-term: Fundraising efforts remain a priority. The Office of Advancement will continue to work closely with MMF to pursue sources for scholarships and awards.
The reviewers observed that student survey response rates were low, and encouraged	3	"The response rate of student surveys is low. We encourage the leadership to find ways to	We started a new outreach initiative this year, to allow us to be in closer contact with our alumni; we should see, consequently, an	Immediate-term: The Dean acknowledges that the program has begun several promising alumni outreach initiatives and

leadership to explore approaches to increasing response rates for future surveys.	increase the response rate for future surveys."	improvement on this issue over time. We have also hosted two in-person events in June 2023, the first since the pandemic, to reestablish connections. We are also working to create Program Ambassadors from our current cohort of students, in the hope that these students will continue to value their connection to the Program after they graduate and work with us to keep the MMF brand vibrant among alumni. Time frame: short term.	events to address this review report recommendation.
The reviewers highlighted challenges related to the MMF's unique and autonomous structure, as well as its sole dependence on the individual program Director for its continued success. They emphasized the critical importance of developing a strategic plan to ensure the program's long-term sustainability, including pursuing opportunities for enhanced connection and closer integration with the Departments of Computer Science, Mathematics and Statistical Sciences.	"Our main recommendation is to appoin Deputy Director. In our view, the program running extremely well, but is overly reliated on its Director for its continued success. commitment and dedication to the program are notable, but we believe it is vital for ongoing growth and health of the program find a way to make these less dependent single person. Therefore, we recommend creation of a Deputy Director role as the way to achieve this."  5 "During our discussions we learned that FAS is considering the creation of a School that would include the Departments of Computer Science, Mathematics, and Statistics. Such a School would provide a natural home for the MMF and might prother units."	t a Conversations with internal and external faculty as well as with cognate chairs has started. The Director is working closely with the Office of the Vice-Dean, Graduate Education in FAS to explore this issue and create an action plan. The Director's objective for 2023 is to submit to FAS a detailed plan to address these two issues for comments, with an implementation goal of 2024-2025. Time frame: medium-term, in recognition of the complexity of this process.  Even though the Faculty of Arts and Science does not currently have a plan for this type of school, there was an initiative of the Department of Mathematics to create one. MMF would like to act as a catalyst for any joint initiatives with its new administrative home and any cognate program.	Short- to medium-term: The Dean's office is working with the Director of MMF regarding a new administrative home for the program. We are currently in discussion with cognate A&S units to determine the best new location for this program. This move will alleviate the dependence upon a single person for the longevity of MMF, as the Director will continue to lead the program, but will also report to the unit Chair or Director.  Short- to medium-term: Discussions around the new administrative home for MMF have focused upon cognate units with proven track records of longevity and stability.
Other recommendations not prioritized in the Request for Administrative Response		is with the curriculum changes which we	Short- to medium-term: The Vice-Dean Graduate Education will continue to engage with the MMF leadership regarding proposed academic changes and any restructuring of the graduate program requirements. The Dean's office is also available to facilitate a consultation with the Curriculum Development Specialist for additional guidance, should MMF wish to do so.

	"An interesting point that emerged during our review was the Director's idea of setting up MMF satellites internationally. As we have all become more comfortable with long range and online communication, this prospect has become more realistic. This could be an interesting way to grow the program and it would potentially open up a much wider range of options for MMF graduates."	The Director continues to be very interested in developing this idea, and finding ways that such initiatives could be developed, which has its challenges. A new administrative home for MMF would provide a first step which, in the long term, could develop into such an international network.	Medium- to long-term: To help ensure the longevity of this program, the Dean's office primary focus is to secure an administrative home for MMF. Any discussions about future potential growth would take place after a secure structure has been established.
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# 3 Committee on Academic Policy & Programs (AP&P) Findings

The spokesperson for the reading group reported that the review summary had accurately reflected the full review and that the administrative response fully addressed the issues identified and no further questions or issues needed to be considered.

No follow-up report was requested.

## 4 Institutional Executive Summary

The reviewers praised the Master of Mathematical Finance as very well organized and administered, noting that it is well-regarded by students, alumni, faculty, cognate units, program affiliates and industry contacts; program requirements and coursework are clear, and the MMF has done a good job in updating its curriculum as the financial industry underwent major changes; faculty are outstanding, and a "healthy mix" of longer-standing faculty, and adjunct instructors who work in the financial industry; students are very happy with their instructors and coursework; the program provides very strong professional development supports; students are extremely well-supported in finding internships; graduates are remarkably successful at finding employment in the financial sector; the MMF enjoys strong connections to its extensive alumni network; the drive, morale and sense of community among faculty, students and staff is "exceptionally high"; connections with similar U of T professional masters programs are strong; the MMF runs as a full-cost recovery program and the director is described as "visionary" with many creative ideas for future directions; finally planned new space for the program is expected to be a positive development.

The reviewers recommended that the following issues be addressed: enhancing the coordination of content and topics across courses; exploring the creation of awards and/or scholarships for students who are unable to access other sources of funding; exploring approaches to increasing response rates for future student surveys; and developing a strategic plan to ensure the program's long-term sustainability, including pursuing opportunities for enhanced connection and closer integration with the Departments of Computer Science, Mathematics and Statistical Sciences

The Dean's Administrative Response describes the Faculty and program's responses to the reviewers' recommendations, including an implementation plan for any changes necessary as a result.

## 5 Monitoring and Date of Next Review

The Dean will provide an interim report to the Vice-Provost, Academic Programs midway between the June 2022 review and the year of the next site visit on the status of the implementation plans.

The next review will be commissioned no later than the 2029-30 review cycle.

## 6 Distribution

On June 30<sup>th</sup> 2024, the Final Assessment Report and Implementation Plan was posted to the Vice-Provost, Academic Programs website and the link provided by email to the Dean of the Faculty of Arts and Science, the Secretaries of AP&P, Academic Board and Governing Council, and the Ontario Universities Council on Quality Assurance. The Dean provided the link to program leadership.