FINAL ASSESSMENT REPORT - DRAFT

Institutional Quality Assurance Program (IQAP) Review

Mathematics M.Sc. and Ph.D. Programs

Date of Review: February 12-13, 2018

In accordance with the University Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response and assessments of the ***Mathematics M.Sc. and Ph.D.*** *programs delivered by the Department of Mathematics and Statistics. This report identifies the significant strengths of the programs, together with opportunities for program improvement and enhancement, and it sets out and prioritizes the recommendations that have been selected for implementation.*

The report includes an Implementation Plan that identifies who will be responsible for approving the recommendations set out in the Final Assessment Report; who will be responsible for providing any resources entailed by those recommendations; any changes in organization, policy or governance that will be necessary to meet the recommendations and who will be responsible for acting on those recommendations; and timelines for acting on and monitoring the implementation of those recommendations.

Executive Summary of the Cyclical Program Review of the Mathematics M.Sc. and Ph.D. Programs

In accordance with the Institutional Quality Assurance Process (IQAP), the Department of Mathematics and Statistics submitted a self-study for the Mathematics M.Sc. and Ph.D. programs in December 2017 to the Vice-Provost and Dean of Graduate Studies to initiate the cyclical program review of its graduate programs. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis. Appendices to the self-study contained all course outlines associated with the program and the CVs for each full-time member in the department.

Two arm's length external reviewers, both from Ontario and one internal reviewer were endorsed by the Dean, Faculty of Science, and selected by the Vice-Provost, Faculty. The review team reviewed the self-study documentation and then conducted a site visit to McMaster University on February 12 - 13, 2018. The visit included interviews with the Provost and Vice-President (Academic); Vice-Provost and Dean of Graduate Studies, Associate Dean of Graduate Studies, Dean of the Faculty of Science, Chair of the department and meetings with groups of current undergraduate students, full-time faculty and support staff.

The Chair of the program and the Dean of the Faculty of Science submitted responses to the Reviewers' Report (July 2018). Specific recommendations were discussed and clarifications and corrections were presented. Follow-up actions and timelines were included.

Strengths

In their report (March 2018), the Review team noted the following strengths of the Mathematics M.Sc. and Ph.D. programs:

- Research strength and visibility of the faculty members;
- High quality supervision;
- Employment rate of graduates.

Areas of Improvement

In their report, the Review Team identified some recommendations for areas of improvement including:

- Faculty renewal
- Teaching Assistant training and formative feedback
- Transparency with respect to assigning the teaching assistant duties
- The variety of the courses offered in pure mathematics

The Dean of the Faculty of Science, in consultation with the Chair of the Mathematics and Statistics department shall be responsible for monitoring the recommendations implementation plan. The details of the progress made will be presented in the progress report and filed in the Vice-Provost, Faculty's office.

Summary of the Reviewers' Recommendations with the Department's and Dean's Responses

Implementation Plan

Recommendation	Proposed Follow-Up	Responsibility for Leading Follow-Up	Timeline for Addressing Recommendation
I. Enhance TA training	We will explore creating a training course for TAs focused on teaching skills. Ensure all TAs receive teaching evaluations from students (where appropriate), from their peers and that a faculty member evaluates their teaching. Work with the MacPherson Institute and/or the Language and Linguistics Department (e.g. MERGE pilot) to Provide ESL (English as a Second Language) training as appropriate.	TA coordinator, Associate Chair (Undergraduate), Associate Chair (Graduate)	2018-2019

	Work with the MacPherson Institute to design specific pedagogy training for math TAs or to provide other resources.		
II. Faculty renewal	Submit proposals to the Faculty for new faculty positions needed to support the Department's academic plan and teaching/research needs. We note that the Department has already been approved to hire next year in the areas of probability and statistics, and geometry.	Chair on advice from the Department and the Appointments Committee	Next five years
III. Student input in scheduling of grad courses	Include a graduate student on the Graduate Committee; organize a meeting of graduate students at the end of the Fall term to produce suggestions for graduate courses. We will explore other ways to better engage graduate students in the planning of the graduate programme.	Associate Chair (Graduate)	2018-2019
IV. More staff resources	Develop a proposal for at least one new staff position dedicated to the Departmental graduate programmes. Note that we currently have less than one staff person to handle four separate graduate programmes and over 400 applications (40% of the entire Faculty's applications!).	Chair, Associate Chair (Graduate)	2018-2019
V. Modify funding model for graduate students	Explore funding models for graduate students that are more sustainable and better balanced for the Department and supervisors.	Chair, Associate Chair (Graduate)	2018-2019
VI. Increase intake of international students	We strongly support this recommendation. The primary obstacle to admitting more international students is lack of available funding. We receive many applications from top quality international students, and we can afford to accept very few. We will explore ways to lower the costs to supervisors and the Department so that we may increase the number of international graduate students.	Chair, Associate Chair (Graduate) (University has already eliminated the tuition differential for international PhD students)	2018-2019

VII. Schedule department meetings sufficiently in advance	Ensure that at least one week's notice is given for all department meetings. It would be helpful if there were a way to schedule a regular meeting time that did not conflict with faculty teaching schedules.	Chair	2018-2019
VIII. Ensure TAs are given a range of assignments during their time at McMaster	This is already done, although the current procedure needs to be communicated better to the TAs. The procedure will be explained in the Graduate Student Handbook (also see recommendation IX below).	TA coordinator, Associate Chair (Graduate)	2018-2019
IX. Make it clear to students the criteria needed to teach a class	Add a section to the Graduate Student Handbook fully explaining how TA duties are assigned and evaluated, and what experience students need to be selected to teach a class. (See also responses VIII and I.)	Associate Chair (Graduate)	immediately

Further Summary from the Department:

The program had extensive discussion about items I (TA training) and V (modified graduate funding). We include some more detailed comments on these points below.

The question of TA training is of critical importance to the departmental mission on several levels. Effective TAs are of obvious importance to the success of our undergraduate teaching, and in order to compete for jobs in academia our graduate students need mentorship in and evidence of effective teaching skills. To enhance the training of TAs, we intend to enlist the support of the MacPherson Institute in providing TA training activities designed specifically for graduate students in math and stats. In fact, Deirdre Haskell and Nicholas Kevlahan met with Greg Van Gastel and Elliot Storm from the MacPherson Institute on May 28 to discuss specific measures we could take, including ESL and orientation for international students. This was a helpful and productive discussion, and MacPherson has agreed to organize a half-day workshop focused specifically on training for mathematics TAs in early September. Unfortunately, the MacPherson Institute has no resources for ESL training, and with roughly 25% of the in-program graduate students at McMaster being international, this is an ongoing concern. Greg and Elliot recognized that the lack of any effective English language training for graduate students (especially those working as TAs) is a major deficiency at McMaster. In their previous incarnation as the Centre for Leadership and Learning, there was an ESL training program specifically designed for international graduate students in mathematics and statistics. That program was exactly what our students need, and it is the kind of thing that we would like to see MacPherson take leadership on.

Bradd Hart addressed graduate student funding (item V) in a presentation given at the retreat. His overview of included a breakdown of graduate revenues, costs and shortfall, on a per capita basis by student (MSc/PhD, domestic/international). The picture that emerged was rather dire, and while it is clear that this model is unsustainable, it is not clear what we can do to address the imbalance. For instance, it was noted that faculty members involved in the program are already committing a substantial percentage of their available NSERC grant funds (72%) in support of graduate students. Options for restructuring graduate funding were presented, and one overarching goal is to increase the number of scholarship holders in the program. Here, we would argue that the

additional staff support called for in item IV would assist our students in competing more effectively for scholarships.

The university's decision to move to equalized tuition for international PhD students is a promising change, but it is not yet clear if and how international BIU funds will flow to the units. Nevertheless, the pool of international talent in mathematics is broad and deep (and is reflected in the hundreds of applications we receive each year), and this change will dramatically improve the opportunities for engagement of students in cutting-edge research.

Faculty renewal remains the most pressing issue for our graduate programs.

Our Department is at a defining moment, with graduate programs in Financial Math and Statistics having recently split off from the Mathematics program. We are also faced with unprecedented growth in the demand for research and training in the mathematical sciences. The information age is in full swing, and students are arriving at university with an appreciation for and an interest in learning more about the power and applicability of mathematical and statistical ideas. Programs like ours will play a key role in training a new generation of leaders and thinkers, graduates who can combine their analytical skills with creative problem-solving to address social, economic, and societal issues. They will be able to use logical reasoning, mathematical and statistical modelling, and computer-assisted analysis to elucidate and illuminate.

There are enormous opportunities for mathematicians and statisticians to contribute to the development of knowledge in big data and data science, and there is a bright future for graduate programs in mathematics at McMaster, which is well-known nationally and internationally for its research strength in math and stats and with our large and active postdoctoral training program. We are encouraged that the reviewers recommended hires in the strategically important research area of geometry, and we look to making other core hires to strengthen the department and build research and supervisory capacity within the fields of pure and applied mathematics.

While we agree with all of the reviewers' recommendations, one particular point (item IV) is noteworthy. In addition to our own graduate programs in math, stats, and financial math, our unit also provides administrative support for the interdisciplinary graduate program in Computational Science and Engineering. Recommendation IV for more staff resources to support these programs is therefore very well received. In the current arrangement, there is one very dedicated administrative assistant for graduate support in the department. This individual is responsible for handling over 400 admissions applications per year and providing direct administrative support for the large number of students across the four graduate programs (Math MSc/PhD, Stats MSc/PhD, Financial Math MFM, CSE MSc/PhD). Additional staff support would help in a myriad of ways, for instance, by providing more assistance for graduate students in preparing for and submitting scholarship applications. While we recognize the heroic efforts of the current staff, and especially this individual, it is clear that the present system is not sustainable, and there is an urgent need for additional graduate support staff in the department.

Dean's Response, Faculty of Science:

The Dean would like to thank the members of the review team for their engagement during the site visit and for their comprehensive Review Team Report. The Dean noted in particular, the context and perspective in terms of the comparison of the graduate programs in Mathematics at McMaster to other Canadian and international programs is very helpful. The Dean would also like to thank the members of the Department of Mathematics and Statistics for the inclusive way that they approached the preparation of the Program Response and for the immediate action they have taken on several of the recommendations.

The Dean stated that the reviewers' report highlighted several areas of strength including the "vibrant"

post-doctoral fellow program, the high-quality faculty research and supervision and the employment landscape for graduates of the program. The Dean agreed with the central challenge stated in the report: to preserve the integrity and excellence of the core program in pure and applied mathematics, while still fostering growth and development in the newer programs in actuarial and financial math and statistics. The Dean believes that adherence to the action plan generated for each of the recommendations in the report will ensure that these program enhancements are obtained.

The Dean agreed with each of the review team recommendations and the program responses to those recommendations. While the purpose of the IQAP review is not to specifically address resource issues, academic programming is intimately linked to resources. In this response, the Dean would like to emphasize that for the first time in a decade, the Faculty of Science is in a positive financial position, and as such, strategic investment in faculty and staff renewal has begun. The program response highlights that the Department of Mathematics and Statistics received approval in the Spring of 2018 to hire 2 new tenure track faculty members in the areas of geometry and statistics, and recently, additional administrative staffing for graduate programs was approved. With respect to some of the other recommendations, some recent developments at the Faculty and University level will serve to enhance the action items identified in the program responses.

For recommendation V: Modify funding model for graduate students, The Associate Dean (Graduate) for the Faculty of Science has been directing a comprehensive review of graduate funding models in all programs in the Faculty of Science and that review is now ready for distribution to all programs. In agreement with the observations of the review team, the graduate programs in the Department of Mathematics and Statistics have some of the highest supervisor contribution rates, and highest percentage of international students along with some of the lowest percentage of students with scholarship support. These data support the plans to increase efforts in terms of scholarship support for graduate students. The comparison funding models used in other graduate programs in the Faculty of Science may also provide some insight in terms of alternative funding models for consideration by the program.

For recommendation I: Enhance TA training, The Dean wrote that the MacPherson Institute is currently in the midst of a review and the request to have more Faculty and Department specific programming and activity aligns with some of the early feedback provided by many stakeholders in the Faculty of Science. The need for a range of ESL support and training opportunities for graduate students has been highlighted by both the Dean of Graduate Studies and the Provost. A strategic plan for the development of these types of resources is currently underway.

The Dean is looking forward to working with this excellent and dedicated academic unit to advance the mission and vision of McMaster University and agreed that this is a very exciting time for mathematics and statistics. The solid foundation of excellence in teaching, research and community engagement established by the graduate programs in Mathematics will be very important to both the Faculty and the University strategic plans and will work in a coordinated fashion to make positive changes and enhancements that align with the recommendations stemming from this review.

Quality Assurance Committee Recommendations

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation and the committee recommends that the program should follow the regular course of action with a progress report and subsequent full external cyclical review to be conducted no later than 8 years after the start of the last review.