Ryerson University Graduate Studies

Office of the Vice-Provost and Dean
Yeates School of Graduate Studies

Final Assessment Report (FAR) and Implementation Plan

Periodic Program Review (PPR)

Graduate Program in Applied Mathematics (MSc)

Last Updated: November 20, 2019

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 graduate program in **Applied Math.** This report identifies the peer review identified strengths of the program, together with opportunities for program improvement and enhancement, and it sets out and prioritizes the recommendations that have been selected for implementation.

The report also 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

The department has 19 tenured/tenure-track faculty members and one LTF. Together, along with 4 staff members the department delivers two undergraduate programs, a Master's program in Applied Mathematics and a PhD program in Mathematical Modelling and Methods. Furthermore, the department has one of the largest service teaching roles in the University, offering courses to thousands of students in its own and other faculties.

The MSc program in Applied Mathematics is relatively small. At steady state, it has about 20 students. With some exceptions, in the time frame of this report, it has met its enrollment targets. The goal of the MSc program is to provide excellent training in modern Applied Mathematics. This is the first Periodic Program Review for this program. The program has set out its Learning Outcomes and has measured these against the

courses it offers and the Graduate Degree Level Expectations (GDLEs). The Learning Outcomes are met by the curriculum at all levels of accomplishment: Foundation and Proficiency.
This Periodic Program Review allowed the program to evaluate, for the first time, the strengths, opportunities and weaknesses through a number of meetings and surveys. The faculty members constitute one of the strengths of the MSc program, along with the structure of the program. The breadth requirements provide the students with a solid foundation in Applied Mathematics, while the two options, the thesis and the major research paper option, offer students flexibility in meeting their academic goals and advancing their career. Among the weaknesses are the low number of elective courses in the students' research area and of opportunities of interacting with industry and participating in internships. The program should ensure that the targets are met and that competitive levels of student funding are maintained.
The department plans to focus on the following areas: curriculum and research intensity. One area in need of improvement is curriculum, specifically the program should increase the number of elective graduate courses supporting the three research areas (Biomathematics and Fluids, Discrete Mathematics and Networks, and Financial Mathematics). The department will ensure that faculty members are available to teach these graduate courses, while at the same time maintaining quality of teaching in under-graduate service courses offered. The program will make significant efforts to maintain, or even exceed, the set targets in graduate enrollments, will offer competitive funding levels to all graduate students and will aim for more industrial collaborations and internship opportunities for the students. A goal is to increase the quality of graduate students, which will enhance not only the quality of the graduate program, but also that of the undergraduate education in the Department of Mathematics, given that the majority of teaching assistants in the mathematics undergraduate courses are MSc students in the Applied Mathematics program.

Periodic Program Review and Peer Review Team

The graduate program in Applied Math (MSc), Faculty of Science, submitted a Self-Study Report to the Yeates School of Graduate Studies that outlined program descriptions and learning outcomes, an analytical assessment of the program, program data including data from student surveys and the standard data packages. Course outlines and CVs for full-time faculty members were also appended.

Two external and one internal arm's-length reviewers were selected from a set of proposed candidates. The Peer Review Team (PRT) for the Periodic Program Review (PPR) of the Master of Science Program in Applied Mathematics consisted of Dr. Gail Wolkowicz (McMaster University), Dr. Ruodu Wang (University of Waterloo), and Dr. Ali Miri (Ryerson University).

The appraisal committee spent two days at Ryerson. The visit included interviews with the University and Faculty Administration including the Provost and Vice-President Academic, Faculty of Science Associate Dean, Vice-Provost and Dean Yeates School of Graduate Studies (YSGS); Associate Dean YSGS, Graduate Program Director of the Graduate Program, and meetings with Faculty, a group of current students, and support staff.

The PRT site visit was conducted on July 4 and 5, 2018. The PRT report was communicated to the Associate Dean, YSGS on August 2, 2018, and the response to the report from Applied Math was communicated on November 26, 2018.

Program Strengths and Observations

The PRT has an overall positive impression of the Applied Mathematics MSc program and made the following observations:

- The MSc Applied Mathematics program currently has two options: The Thesis option and the Major Research Paper (MRP) option. Over the past three years all of the students were enrolled in the Thesis option. Our assessment is mainly based on the Thesis option. For additional comments and suggestions specific to the MRP option, please see the Recommendations section below.
- Overall, the program meets the learning goals well. The program structure is consistent with other similar programs offered in Ontario.
- The department is small, but distinguishes itself by focusing on three research areas: Biomathematics and Fluids, Discrete Mathematics and Networks, and Financial Mathematics. The program reflects the strengths of the department very well.
- The program has met their enrollment targets over the past several years.
- The students are very satisfied by the interactions with their faculty members and the supporting staff. They specifically mentioned that they appreciate the approachability and helpfulness of all those involved in the delivery of the program.
- The PRT is very impressed with the diversity and the gender balance of the graduate students.
- The program has a successful track-record of students moving on into academic and industrial positions after graduation.
- Most past students have successfully finished their program in the prescribed timeframe.
- A significant number of students' work has appeared in external scholarly publications. This suggests a high quality of research activities.
- The students are receiving an amount of funding support that is comparable to similar programs.

Summary of PRT Recommendations, Graduate Program and YSGS Responses, and Implementation Plan

Academic Recommendations

Recommendation	Program Response	YSGS Response	Proposed Action	Responsibility to Lead Follow Up	Timeline
1. Restructure the MRP Option to the MSc degree to reduce from 5-term, 9-courses to 4-term, 7-courses.	The program agrees with the recommendation. The Graduate Program in Applied Math (GPAM) analyzed the restructuring of the MRP Option. The program engaged with faculty, current students, and YSGS to understand benefits and drawbacks and make an informed decision for the benefit of the program. The GPAM will recommend restructuring the MRP Option. The program will begin work on this during the Fall 2018 term. Further details are available on pages 3 and 4 of the program's response to the PRT report.	YSGS supports the program response. YSGS notes that any curriculum modification needs to be undertaken in accordance with Ryerson University Policy 127. This proposed change appears to be a Category 2 minor revision under the policy, though YSGS encourages the program to consult with the Associate Dean, Programs of YSGS as needed.	GPAM analyzed the restructuring of the MRP Option. Engaged with faculty, current students, and YSGS to understand benefits and drawbacks and make an informed decision for the benefit of the program. The GPAM will recommend the restructuring on the MRP Option. GPAM has already modified the MSc Seminar course to replace the requirement to attend weekly two-hour seminar to attend a certain	GPAM, Faculty of Science (FOS), Yeates School of Graduate Studies (YSGS).	(2018) Fall
2. Restructure the MSc Seminar AM8000.	The program agrees with the recommendation. GPAM has already modified the MSc Seminar course to replace the requirement to attend a weekly two-hour seminar with a requirement to attend a certain number of seminars/colloquia and deliver one presentation. Further details are available on page 4 of the program's response to the PRT report.	YSGS supports the program response. YSGS notes that revisions to the course description in the graduate calendar is a Category 1 minor revision under Policy 127. If any changes to the course description have been made, the approvals designated in Policy 127 will need to be obtained.	GPAM has already modified the MSc Seminar course to replace the requirement to attend weekly two-hour seminar to attend a certain number of seminars/colloquia and deliver one presentation.	GPAM	(2018) Fall

Recommendation	Program Response	YSGS Response	Proposed Action	Responsibility to Lead Follow Up	Timeline
3. More elective courses offerings in each of the Fall and Winter. Offer Applied Statistics course each year.	The program agrees with the recommendations. GPAM will work on restructuring the elective course offerings, including the possibility of cross-listed courses with other departments, in both the Fall and Winter terms in 2018-2019 to create new electives. Further details are available on pages 4 and 5 of the program's response to the PRT report.	YSGS supports the program response. YSGS notes that the addition of any new courses to the curriculum are considered a Category 2 minor revision under Policy 127. As above, the program is encouraged to consult with the Associate Dean, Programs of YSGS as needed.	GPAM works on restructuring the elective course offerings in both the Fall and Winter terms and to create new electives.	GPAM, FOS, YSGS.	(2018-2019)
4. Increase the size of the program.	The program agrees with the recommendation. GPAM will work with FOS and YSGS to expand the MSc program from a target of 10 MSc students/year to at least 12 MSc students/year. Further details are available on page 5 of the program's response to the PRT report.	YSGS is open to discussing the target for the MSc program with the program and the Faculty of Science. It notes, however, that any adjustment to the program's target needs to take into account slot allocations within both the Faculty of Science and the university as a whole.	GPAM works with FOS and YSGS to expand the MSc program from a target of 10 MSc students/year to at least 12 MSc students/year	GPAM, FOS, YSGS.	2019

Recommendation	Program Response	YSGS Response	Proposed Action	Responsibility to Lead Follow Up	Timeline
5. Recruit more outstanding international students, with substantial resources and funding from the University.	The program agrees with the recommendation. The GPAM will work with Faculty and YSGS to provide additional funding to attract very strong international students. Further details are available on pages 5 and 6 of the program's response to the PRT report.	YSGS supports the program response. YSGS notes, however, that the university already provides substantial funding to the program. YSGS also notes that it will continue to advocate for international graduate scholarships as a part of a broader university strategy for international graduate student recruitment and retention. YSGS encourages the program's faculty to continue to pursue external funding to continue to provide strong funding packages for international students. YSGS further encourages faculty members interested in supporting specific international students to contact the Associate Dean, Research and Graduate Studies in the Faculty of Science.	The GPAM works with Faculty and YSGS to provide additional funding to attract very strong international students	GPAM, FOS, YSGS.	2019

Recommendation	Program Response	YSGS Response	Proposed Action	Responsibility to Lead Follow Up	Timeline
6. Change the requirement that students must take both core courses, to requiring one of them and counting the other as elective.	The program will study this recommendation and investigate the implications. The current structure of the program, including the core courses, ensures training in modern Applied Mathematics (AM). The GPAM will investigate if such a change is appropriate for a degree in AM, since other Applied Mathematics graduate programs in Ontario have similar requirements. Further details are available on page 6 of the program's response to the PRT report.	YSGS supports the program response. As previously noted, any curriculum modifications will need to be completed in accordance with Policy 127.	The current structure of the program, including the core courses, ensures training in modern Applied Mathematics (AM). The GPAM will investigate if such a change is appropriate for a degree in AM, since other Applied Mathematics graduate programs in Ontario have similar requirements.	GPAM, FOS, YSGS.	2020

Administrative and Financial Recommendations

Recommendation	Program Response	YSGS Response	Proposed Action	Responsibility to Lead Follow Up	Timeline
1. Reduce the TA portion of the student funding support (currently at 50%) and replace it by additional student scholarships.	The program agrees with the recommendations. The program notes that there are ongoing efforts to support the MSc students financially at competitive levels, while exploring funding opportunities other than teaching assistantships. Further details are available on page 5 of the program's response to the PRT report.	YSGS supports the program's efforts to provide strong funding packages for its graduate students. In addition to providing support through TA positions and Ryerson Graduate Fellowships, YSGS encourages the program to provide funding through stipends wherever possible.	Ongoing efforts to support the MSc students financially at competitive levels, while exploring funding opportunities other than teaching assistantships.	GPAM, FOS, YSGS.	2019-2020

A report on the progress of these initiatives will be provided in the Follow-up Report which will be due in one year from the date of Senate approval.