

June 15, 2020.

To:

Dean of FOS David Cramb,
Provost and Vice-President Academic Michael Benarroch,
Vice-Provost Academic Kelly Mackay.

CC: Director, Curriculum Quality Assurance Bettina West.

Re: One year *Follow-up Report to PPR of Mathematics and its Application Program*.

This document is the *Follow-up Report* from the Department of Mathematics, it represents a follow-up to the *Periodic Program Report* (PPR) of the Undergraduate Program Mathematics and its Applications (MIA).

The PPR is dated December 20, 2018; in that document, the Peer Review Team (PRT) provided feedback that describes how the MIA program meets the Institutional Quality Assurance Process evaluation criteria and is consistent with the University's mission and academic priorities. The PRT indicated that the current program is relevant to society at large and produces graduates capable of moving into a variety of fields, both in academia and in industry. The curriculum is generally comprehensive and includes well-organized lab components and an option for co-op placement.

A copy of the complete June 11, 2019 Academic Standards Committee (ASC) report to Senate, containing the PPR Final Assessment Report, is available through the following link:

https://www.ryerson.ca/content/dam/senate/senate-meetings/reports/ASCReports/2018-2019/Jun_11_2019.pdf

Following Senate Policy 126, Section 12, and the ASC Evaluation excerpt from the Senate report, this document includes:

1. A status report on the initiatives outlined in the Implementation Plan, including changing options to an appropriate alternative (minors, concentrations, majors – see Senate Policy 2);
2. List of Updated course outlines (a separate file bundle contains the actual course outlines);
3. A status report on the new communications course.

As additional information, the two-year follow-up report, due June 30, 2021 is to include: Employment data for graduates of the Mathematics and its Applications program.

Item **1** above is addressed by first quoting the relevant material from the reviewer's recommendation and the original responses from the department and Dean. The actual follow-up material is then presented in **bold type and colored**.

Notice that the PPR analysis and report was originally broken down into *Recommendations* and *Recommendations and Implementations*. Hence, there is some repetition in the original organization but we have decided to preserve the original ordering.

Some recommendations do not require a follow up as the original Departmental and Dean's responses provided a suitable clarification implying that there was no need to attend to the said recommendation. Whenever relevant, we summarize the program changes approved by the Senate in 2019 and refer to the accompanying document titled "Proposal for a Major Program Change to the Mathematics and its Applications Program (**PMPCMIA**)" (found in the pdf file `majorProgramChangesMIAFinalToSenate`) that provides a longer and detailed rationale for the program changes. The referred program changes initiative were a result of the PPR evaluation.

1. A status report on the initiatives outlined in the Implementation Plan, including changing options to an appropriate alternative (minors, concentrations, majors – see Senate Policy 2);

RECOMMENDATION 1. (SPACE)

It is recommended, with high priority, that the University considers consolidating space for the Mathematics department. In addition, for the sake of integrity, social and academic life, it is recommended that the University considers creating new (dedicated) space for the students.

Department Response: The department agrees with this recommendation wholeheartedly. We realize that a long term solution to our space issues will take time, creativity and good will to resolve. In short, there is no quick fix to this challenge, and the department commits to work in good faith on this with the Dean. With regard to the program, we point out that our students may be the only ones in the Faculty that do not have their own dedicated space. The department resolves to engage with both the students and the Dean to meet this recommendation.

Dean's Response: This is the top priority of the university. There is great momentum towards breaking ground on a new Science building, which has in its plan to consolidate the Mathematics Department. Dedicated Mathematics student space, however is not part of that plan. It could be that some of the vacated space currently occupied by the department could retrofitted for student occupation. In the shorter term, to accommodate Mathematics operations, there will be a further dispersing of the department. This involves the move of the department office to Kerr Hall.

Follow-Up: [Faculty of Science is moving ahead with the project for the new Science Building at 202 Jarvis St. location. The initial intention was based on the idea that the project will be realized in two stages: Phase I \(which would provide unified space for the Mathematics](#)

Department) and Phase II. This project was placed on hold due to the lack of funding, but was reactivated earlier this year with both phases moving ahead. The architectural firm of Henning-Larsen has held consultation with different users' groups and the plan is being actively developed with the entirety of Mathematics department being housed at a single floor of the new building, which will include space for our Student Unions as well as break-out spaces in which students could work individually, collaboratively, or meet with the faculty members and graduate students. The anticipated move-in time is 2026. The architectural plans are being refined at the moment.

RECOMMENDATION 2. (STREAMS)

It is recommended that the program considers creating two streams.

Department Response: The department feels that it would be unwieldy to offer two distinct streams as suggested by the report. This program takes in 50 students per year and is therefore a small program. Rather, through curriculum changes discussed below it is felt that the two groups of students, pure and applied, can be satisfied moving forward. These changes will address the needs of both groups.

Dean's Response: The department and the Dean are in agreement on this.

RECOMMENDATION 3. (ENTRANCE REQUIREMENTS)

It is recommended that the program should increase the minimum entrance requirements and should revisit the high school courses required for admission.

If the decision is to not change the entrance (high school) course requirements, it is recommended that a mandatory diagnostic test be utilized. For students who do poorly on the diagnostic test, they would either be offered extra help in the summer before enrollment, or placed in a new one-term course that teaches the material of *Calculus & Vectors* which would be a prerequisite for *Calculus I*.

Department Response: The department will explore, with the Registrar's office and the Dean, the idea of changing the enrollment criteria.

Regardless of the outcome the department has recently implemented a diagnostic test given to all first year students. Incoming students are offered help through a summer program, and students who do not do well on the diagnostic test are offered resources through the Math Help Centre to improve their pre-calculus abilities.

Dean's Response This recommendation may be unattainable at present.

RECOMMENDATION 4. (PROGRAMMING LANGUAGES)

It is recommended to enhance more programming languages (e.g. R, SAS, Python and C++) in the existing courses, or even create new ones to address this issue.

Department Response: In the curricular changes discussed below it will be evident that the department embraces this recommendation. We are actively seeking that R, SAS and Python be added to the program.

Dean's Response: The Dean supports the department response.

Follow-Up: The first change is that first year MIA students take CPS 109 (Computer Science I) instead of CPS 118 (Introductory Programming for Scientists) as their first introduction to computer programming. One of the stated goals of the program in the PPR is for students to have strong programming skills as they relate to mathematics. The very first course that students take in programming is the most important, and the department feels that CPS 109 is much better suited to this than CPS 118. It has been the experience of the department that CPS 118 is inadequate to address the needs of our students. In later courses in mathematics, where a degree of programming is involved, the students complain that they do not feel adequately prepared to do this programming. The department's curriculum committee has looked at the details of CPS 109 and is satisfied that it will meet the needs of the program and its students. The curriculum committee was pleased to learn that the language of choice in CPS 109 is Python, which fits the recommendations of the PRT. This course is the first programming course taken by all Computer Science students and is the beginning of a chain of prerequisites that allows students to take most other courses offered by the computer science department. As a result, students who desire to do so will find it easier to take more advanced programming courses. Students will also be better prepared to encounter the programming material they find in their mathematics (and other) courses. This will improve the level of computer programming in all aspects of the program.

RECOMMENDATION 5. (ORDERING OF COURSES)

In terms of core course delivery, the PRT suggests offering the existing courses according to the following plan:

Year	Fall Semester	Winter Semester
1	Calculus I Discrete I Science I Liberal	Calculus II Discrete II Science II Liberal
2	Linear Algebra I Statistics I Calculus III	Linear Algebra II Statistics II ODE
3	Analysis	Algebra
4	Complex Analysis	

Department Response: Looking at the included table, one will see that the revised curriculum follows the recommended changes.

Dean's Response: The Dean supports the department response. Additionally, the trading out of a Communications course to an internal "communications" course should also be seriously thought through. The ethos of the CMN course is to help science students communicate to the public. The suggested Math course seems more about communications within the math culture. Both are important. The Dean suggests talking with FCS about making a section of the CMN course more appropriate for math students, if possible. And if not, then communicating math to the public should be integrated into the courses within the math program itself.

Follow-Up: Pages 5 and 6 of the document PMPCMIA compare, in a table format, the previous version of the program with the new, Senate approved, version of the program. That document also explains the changes to the program due to the PPR recommendations, some of them have been reported above (see RECOMMENDATION 4 on Programming Languages). Here we explain some other changes related to ordering of courses as well as new courses.

Common (to all program options) First Year: The "SCI I" and "SCI II" have been amalgamated into the "Required Science" table in the first year. All students are still required to take two science courses in their first year, but the amalgamation allows them more flexibility. Therefore, a student might, for example, take first semester physics and first semester biology, whereas formerly they would have to take the first/second semester sequence of only one of, say, physics or biology. Also, CPS 209, second semester computer science, is added to this new table for the sake of those students with a deeper interest in computer science to take the follow-up course to CPS 109.

The common first year also sees the repositioning of MTH 108, introductory linear algebra, from the third semester to the second semester. This change is made at the recommendation of the Peer Review Team, as they note that most programs in mathematics have introductory linear algebra in the first year. Fortunately for the department this change is easily implemented with no cost to anybody as this course is offered in both the fall and winter terms.

The next major change for all MIA students is the addition of MTH 260 (the nature of this course is fully explained later in this document) to the third semester of the curriculum and the removal of CMN 600 from the sixth semester.

Related to this change is the repositioning of MTH 525 and MTH 617 from semesters 7 and 8 to semesters 5 and 6 respectively. The addition of MTH 260 is the introductory stage of the learning outcomes dedicated to rigorous and logical thinking. Changes have been made in previous years to the curriculum to bring proficiency to these learning outcomes. The final level of mastery of proof writing is to be gained in the two abstract mathematics courses, MTH 525 Analysis and MTH 617 Algebra. Presently, with the extant curriculum, the students

find that they are unprepared to take these courses. Many have to take one or the other a second time. This causes many students difficulty as these courses are offered in the fourth year. Since they are small courses, the Department may only offer them once per year. Students who might otherwise be graduating have to wait a full year to take the course again. It is felt that with the changes outlined above, the students will be adequately prepared to engage these courses in the third year. These two courses will be moved from the 7th and 8th semesters respectively to the 5th and 6th semesters. In this way if a student still has difficulty with one or another of these courses they have an opportunity in their regular program to take it again. This change will first take effect in the 2022 academic year (i.e., the third year of the changed curriculum). In that year, and a few years subsequent, the courses MTH 525 and MTH 617 will see larger than usual amounts of students. Since the enrollment on these courses is small (about 25—30 students) even a doubling of size will not represent an issue as only one instructor and one TA will be necessary. The rest of the changes made to the program is a shuffling of courses to accommodate the above changes. For example, the course MTH 640 is moved from the fifth semester to the seventh semester. Academically speaking, this change is neutral. From the point of view of the students in the old program, this change has no effect on their curriculum. The open elective in the first year of the old program is moved to the later years. This is for the best since students are typically not ready to choose such an elective in their first year. In the concentrations some liberal courses, Table II/III courses and Table I courses are shuffled. Nothing new is added or taken away otherwise. Such changes have no effect on the old program students.

RECOMMENDATION 6. (MORE TA HOURS)

It is recommended that additional TA positions be made available for the program and reduce tutorial section sizes accordingly. As a positive side effect, increasing the number of TA's would have the additional benefit of providing employment for Ryerson mathematics graduate students.

Department Response: The department agrees that tutorial sizes can be overlarge and hopes that the requisite funding is made available to meet this recommendation. The department realizes that in order for this resource to be cost effective it is crucial that the faculty members of the department diligently endeavor to make the best use of it. Spending money on smaller tutorials is only as effective as the effort that is put into making them an effective learning experience.

Dean's Response: The Dean supports the department response. Altering tutorial size may require resources, which will have to be considered and designed carefully.

Follow Up: So far, there have not been significant resource allocations to this end besides the expected increase in the annual budget and its portion set aside for TAGA salaries. Our ability to address this recommendation is heavily dependent on the budgetary constraints and cuts that the Faculty of Science and the university on the whole are facing. As it is, the vast

majority of our TAGA contracts are allocated to Mathematics graduate students. There is an increased need to create more TAGA contracts to cover the growth in our undergraduate programs which is something that will need to be addressed but, as of yet, we do not have the resources to reduce the sizes of tutorial sections significantly, neither in terms of financial viability nor in the terms of constraints posed by the Scheduling.

RECOMMENDATION 7. (MORE FREQUENT ELECTIVE COURSES)

It is recommended to have a long term plan for the delivery of program elective courses so students can appropriately plan their studies and complete their program in a timely fashion.

Department Response: The department acknowledges that the offering of electives on a yearly basis can be improved. The main strategy is to offer certain electives every other year. We have pursued this strategy, but we have not been as rigorous as we could have. In order to commit to this strategy, and to help students in their long-range planning, the department will commit to publishing which electives will be offered for the next two to three years.

Dean’s Response: The Dean supports the department response.

IMPLEMENTATION PLAN

RECOMMENDATION AND IMPLEMENTATION PLAN
Recommendation # 1
Recommendation: Curriculum modification I: Computer Science
Rationale: Identified in self-study and PRT report that computer science knowledge is crucial to the discipline.
Objective: Improve and strengthen LO 8: essential programming skills.
<p>Actions:</p> <p>Removal of CPS 118 in semester 1 and replace with CPS 109. Done starts 2020/2021</p> <p>The addition of CPS 209 as a potential second science course. Done starts 2020/2021</p> <p>Addition of R language programming to statistics courses. Done MTH 304/404</p> <p>More coherent use of programming in later courses.</p>

More extensive use of programming has been included in the following courses: MTH 501 and MTH 719.

Timeline: 2018-19 academic year with submission of proposal to VPA by June 30, 2019; commences Fall 2020

Responsibility for leading initiative: Program Director and Chair

Responsibly for approving recommendation, providing any resources made necessary by the recommendation, and overall monitoring of the implementation of the recommendation: Chair and Faculty
Dean

RECOMMENDATION AND IMPLEMENTATION PLAN

Recommendation # 2

Recommendation: Curriculum Modification 2: *Restructure program.*

Rationale: Self-study and PRT report identify the need to modify the program to address retention issues.

Objective: To improve student retention and time-to-graduation by improvement of the curriculum structure.

Actions:

Add one hour of lecture to the first year calculus courses, MTH 207 and MTH 310 to allow more time to develop the same material.

Done: 2019/20

Provide added learning resources through SLGs offered through the Learning Centre.)

Done: Through the Student Learning Center Ann Wilkin provides SLG (Supported Learning Group) support. A student is hired to sit in the lectures and then help students with the material during dedicated times at the Student Learning Centre. This is done for MTH 207/310/108.

Move MTH 525 and MTH 617 from 7th and 8th semesters to the 5th and 6th semesters respectively.

Done: starting 2020/21

Move MTH 719 from 8th semester to 4th semester

Done: completed 2019

Timeline: 2018-19 academic year with submission of proposal to VPA by June 30, 2019; commences Fall 2020

Responsibility for leading initiative: Program Director and Chair

Responsibly for approving recommendation, providing any resources made necessary by the recommendation, and overall monitoring of the implementation of the recommendation: Chair and Faculty Dean

RECOMMENDATION AND IMPLEMENTATION PLAN

Recommendation # 3

Recommendation: Curriculum modification 3: Proof writing

Rationale: Self-study and PRT report identify students' weakness in developing and communicating mathematical proofs.

Objective: To improve students' achievement of LO 7a—d.

Actions:

Develop a new course to introduce students to proof writing.

Done : [MTH260, Introduction to Mathematical Inquiry](#)

Better reinforce mathematical writing in the core mathematics courses.

[Excerpt from PMPCMIA document pages 2-3, more (related) comments can be read in that document] It is felt that the program should start the training in this discipline as early as possible. Currently, students only see proof writing as a rigorous part of their program in their later years. Various courses along the way are assumed to prepare students for this. But a well thought out progression through this material is lacking. A course dedicated to proof writing, MTH 260 *Introduction to Mathematics Inquiry*, will be added to the third semester (notice a typo here in the document PMPCMIA). This course is not meant to teach new mathematics to students but to begin the journey of learning the art of analytical thinking and proof writing. It is complementary to the material learned in first and second semester. This course will replace CMN 600, *Science, Communication and Society*. This communications course is intended to meet the Undergraduate Degree Level Expectations (UDLEs) requirements regarding written communication skills. The students have made it clear that this is not an appropriate course for the program as the material is geared to chemistry, physics and biology students. Indeed, the inclusion of CMN 600 in the program is a vestige of the past when all science students shared a common first year. The department sees that the style of communication needed for the sciences is not the same as for mathematics. Therefore, the inclusion of this new course is dedicated to the style of communications appropriate to mathematics: rigorous and logical thinking. Related to this change is the repositioning of MTH 525 and MTH 617 from semesters 7 and 8 to semesters 5 and 6 respectively. The addition of MTH 260 is the introductory stage of the learning outcomes dedicated to rigorous and logical thinking. Changes have been made in previous years to the curriculum to bring proficiency to these learning outcomes. The final level of mastery of proof writing is to be gained in the two abstract mathematics courses, MTH 525 Analysis and MTH 617 Algebra.

Timeline: 2018-19 academic year with submission of proposal to VPA by June 30, 2019; commences Fall 2020

Responsibility for leading initiative: Program Director and Chair

Responsibly for approving recommendation, providing any resources made necessary by the recommendation, and overall monitoring of the implementation of the recommendation: Chair and Faculty
Dean

RECOMMENDATION AND IMPLEMENTATION PLAN

Recommendation # 4

Recommendation: Better planning of electives

Rationale: As provided by the self-study and the PRT report, students find the present system of elective offerings confusing.

Objective: To give students better opportunity to plan their elective choices in the long term.

Actions:

Develop a two- to three-year plan of elective course offerings.

This is, in fact, something we have planned to address but was made difficult this year due to the COVID-19 closure as well as a number of other issues (office moves, administrative issues, etc.) The Dean has asked the departments to start thinking about how to implement a 3-year teaching plan, which would be based on the availability of the faculty members to teach certain courses over the three year period, taking into account their sabbatical and other leaves, administrative positions, expertise, etc. The latest changes in the undergraduate curriculum have created a more favorable situation where a number of existing electives, which have never run in the past or were offered very rarely can now be offered to the students in their fourth year, after they have completed core courses such as MTH525 or MTH617. As it is, we do try to completely rotate electives, the rule being: if an elective is offered in the current year, it will not be offered in the following year, but an elective from a cluster of related courses will run instead. There are exceptions, such as MTH607, which are very popular with a number of programs and, hence, run every year.

Publish this plan so students are aware of which electives they can count on in future years.

The plan for the coming academic year: there will be consultations (late Summer/early Fall 2020) with different research groups to come up with a plan indicating which electives they would like to offer and rotate over the period of 3 years. Then, we will have a faculty meeting in which we will finalize the teaching plans for all faculty for the next 3 years, with the understanding that there may be minor changes based on unexpected medical leaves, administrative appointments, etc.

Timeline: 2018-19 academic year with submission of proposal to VPA by June 30, 2019; commences Fall 2020

Responsibility for leading initiative: Program Director and Chair

Responsibly for approving recommendation, providing any resources made necessary by the recommendation, and overall monitoring of the implementation of the recommendation: Chair and Faculty Dean

2. List of Updated course outlines (a separate file bundle contains the actual course outlines):

MTH 108, Fall 2019;
MTH 110, Fall 2019;
MTH 131, Fall 2019;
MTH 140, Winter 2019;
MTH 141, Fall 2019;
MTH 207, Fall 2019;
MTH 210, Winter 2019;
MTH 231, Winter 2019;
MTH 304, Fall 2019;
MTH 310, Winter 2019;
MTH 312, Fall 2019;
MTH 314, Winter 2019;
MTH 330, Fall 2019;
MTH 380, Fall 2019;
MTH 404, Winter 2019;
MTH 410, Winter 2019;
MTH 425, Fall 2019;
MTH 430, Winter 2019;
MTH 500, Fall 2019;
MTH 501, Fall 2019;
MTH 503, Fall 2018;
MTH 510, Fall 2019;
MTH 514, Fall 2019;
MTH 525, Fall 2019;
MTH 599, Winter 2019;
MTH 600, Winter 2019;
MTH 603, Winter 2018;
MTH 607, Winter 2020;
MTH 617, Winter 2019;
MTH 630, Fall 2019;
MTH 640, Fall 2019;
MTH 655, Fall 2019;
MTH 700, Fall 2019;

MTH 707, Fall 2018;
MTH 710, Fall 2019;
MTH 712, Winter 2019;
MTH 719, Winter 2020;
MTH 732, Winter 2019;
MTH 800, Winter 2019;
MTH 814, Winter 2019;
MTH 820, Winter 2019.

3. A status report on the new communications course.

The course MTH260, Introduction to Mathematical Inquiry, is a new required course for the MIA program, which students will take in their first or second year. It will run for the first time in Fall 2021 or Winter 2022.

Calendar Description:

MTH 260

Introduction to Mathematical Inquiry

This course is about proof methodologies and mathematical writing motivated by concepts covered in the prerequisites with a focus on recognizing and writing rigorous mathematical proofs. Topics used as a vehicle for proof writing include set theory, number theory, and analysis. Special emphasis is placed on epsilon-delta proofs.

Weekly Contact: Lecture: 3 hrs.

GPA Weight: 1.00

Course Count: 1.00

Billing Units: 1

Prerequisites

MTH 110

Antirequisites

None

Co-Requisites

None

Custom Requisites

None