Program Progress Report
Institutional Quality Assurance Program (IQAP) Review
MATHEMATICS AND STATISTICS UNDERGRADUATE PROGRAMS

Date of Site Visit: February 12-13, 2018
Progress Report Prepared by: Matheus Grasselli, Chair, Mathematics and Statistics

Please outline below how recommendations from the initial program review have been addressed. [Please fill in one table for each recommendation from the original Final Assessment Report]

Recommendation: **1a. Introduce aspects of data science early, perhaps even into Math 1MP3**
Responsibility for Implementation: Undergraduate committee, under guidance of associate chair (undergraduate**)**
Anticipated Timeline for Completion: One year for discussion, two or more years for implementation.
Additional Notes/Commentary: Intensively pursue the idea of introducing data science into the curriculum, at some level. Note that both Math 1MP3 instructors have reservations about fitting this material into the existing course.
Progress (check one) ☐ Completed X In Progress ☐ Other (please explain)
Department's Comments: A new Level 3 course, STAT 3DS3 (Introduction to Data Science Theory), was created and offered for the first time in Fall 2019 and every year after that, with great success. Work is currently underway on STAT 2DS3 (An Introduction to Data Science Methods), with the intent to move some of the more introductory material from the Level 3 course into a Level 2 course. At the same time, we plan to update STAT 3DS3, with the proposed new name "Data Science Methods", so that it naturally follows from and builds upon STAT 2DS3. It is expected that these courses will be presented to the Department and Faculty of Science Academic Planning and Policy Committee (AP&PC) for approval in Fall 2021. The new Level 2 course is proposed to be offered for the first time in Fall 2022. Together with Math 1MP3 (Introduction to Mathematical Scientific Computing), STAT 3DS3 and the restructuring of an existing Level 4 course, STAT 4P03 (Advanced Applied Statistics), this will provide a sequence of four undergraduate courses that can form the core of a specialization on Data Science and Computational Statistics.

Dean's Comments: I think the department has responded to this recommendation very comprehensively. The data science components are now/or will be implemented at all levels of the programs.
QAC Comments (to be filled in by Quality Assurance Committee): QAC reviewed this report and had no further comments or concerns.

Recommendation: **1b. Offer enhanced versions of some of level I and II courses**
Responsibility for Implementation: Undergraduate committee, under guidance of associate chair (undergraduate**)**
Anticipated Timeline for Completion: Strike a committee to start work in summer 2018.
Additional Notes/Commentary: We will explore the details of creating enriched sections of our 1st-year required courses in linear algebra and calculus, and consider repercussions for upper-year courses, including possibly enhanced or honors versions of the curriculum in second year
Progress (check one) X Completed ☐ In Progress ☐ Other (please explain)
Department's Comments: A new Level 1 course, Math 1XA3 (Proofs in Calculus), was created and offered for the first time in 2020-21. This is a 3-unit course spanning both Fall and Winter and optional for students enrolled in the existing Math 1X03 (Calculus for Math and Stats I) and Math 1XX3 (Calculus for Math and Stats II) sequence. This new course teaches additional material on proofs of results in the first-year calculus sequence that are related to the subject of Analysis. Relatedly, a new Level 3 course, Math 3IA3 (Introduction to Analysis) was created to teach essentially the same material. Students can then take either Math 1XA3 or Math 3IA3, depending on their preference. Similarly, a new Level 2 course, Math 2LA3 (Applications of Linear Algebra), was created and offered for the first time in 2020-21, as an alternative to the existing Math 2R03. This course is more suitable to students primarily interested in applications of linear algebra. Math

2R03 was renamed (Theory of Linear Algebra) to highlight the emphasis on proofs and theory in this course. Students in the Math sub-plan are now required to take Math 2R03, while students in other programs can take either course (or both) depending upon their preferences.

Dean's Comments:

The department has responded to this recommendation in full. There has been considerable growth in the enrollment in Math and Stats undergraduate programs and courses in the last few years and the approach to create additional enhancement opportunities for students has been helpful in addressing enrolment pressures. The Dean's office, does however request attention be paid to efficient utilization of resources and guarding against duplication.

QAC Comments (to be filled in by Quality Assurance Committee):

See above

Recommendation: **1c. Expand teaching of communication skills**

Responsibility for Implementation: Undergraduate committee, under guidance of associate chair (undergraduate)

Anticipated Timeline for Completion: Summer 2018, for submission to AP&PC in Fall 2018, and addition to the calendar for 2019-20

Additional Notes/Commentary: Create a list of courses that would be deemed to satisfy a "communications requirement", and create a requirement that students in honors programmes take at least one of the courses from the list. Syllabus (or the calendar copy) of each course would identify it as such. Examples of such courses are Math 4FM3, Math 3MB3, Math 3Z03, Math 4P06, Stats 4T06.

Progress (check one)
X Completed
☐ In Progress
☐ Other (please explain)

Department's Comments:

We have added a "Scientific Communication Course List" for the following programs offered by the Department: 1) Honours Mathematics and Computer Science, 2) Honours Mathematics and Physics, and 3) Honours Mathematics and Statistics (including all subplans and co-op options). All students in these programs must complete at least one course on the list. This requirement became official as part of the 2019-20 Academic Calendar.

The "Scientific Communication Course List" consists of 22 courses (10 Level III Math Courses, 3 Level II Stats Courses, 4 Level IV Math Courses, and 5 Level IV Stats Courses). Students can take these courses at any time in the third or fourth years of their programs. This list consists of many popular electives, e.g., Math 3CY3 (Cryptography), and Stats 3DS3 (Introduction to Data Science).

The communication skills introduced in these courses cover a number of different forms of communication. For example, Math 4P06/Stats 4T06, is our traditional senior research thesis, where students are required to write a 20–25-page thesis and give an oral presentation. Oral presentations are used in Math 4FM3 (Financial Markets and Derivative), while for other courses, e.g., Math 3V03 (Graph Theory), students are required to prepare short reports, using LaTeX, on open problems in graph theory. Some courses, like the popular Math 3Z03 (History of Mathematics), place a very strong emphasis on communication; for example, the most recent final exam for Math 3Z03 asked the students to propose an outline for a textbook on the history of mathematics.

Dean's Comments:

The department has addressed this recommendation in full. The Faculty of Science has highlighted Science Communication in our 2020-2025 strategic plan and is advancing initiatives to support enhanced activities in all of our academic units.

QAC Comments (to be filled in by Quality Assurance Committee):

See above

Recommendation: **1d. Increase emphasis on computing in upper-level courses**

Responsibility for Implementation: Undergraduate committee, under guidance of associate chair (undergraduate)

Anticipated Timeline for Completion: One year for information gathering, one year for further discussion

Additional Notes/Commentary: Hold some workshops in Department presenting practical ways to include computing element in upper-level courses. Then discuss whether to mandate this use and in what courses.

Progress (check one)
☐ Completed
X In Progress
☐ Other (please explain)

Department's Comments:

The pandemic has limited our ability to move forward on this recommendation, since we did not wish to impose additional workshops on faculty/staff during the last 18 months. However, the Department still believes in the importance of computing in upper-level courses, and over the upcoming academic year (2021-22), the undergraduate committee will look into this topic more closely.

Having said that, the pandemic has enabled a large number of instructors to experiment with different types of software platforms. Courses like Math 2LA3 (Applications of Linear Algebra) and Math 2R03 (Theory of Linear Algebra) allowed students to make use of linear algebra programs like Matlab and Octave for both their assignments and exams. We have recently hired a new Canada Research Chair (Dr. Boudin) who will be offering a new topics course, Math 4FT3 (Topics in Differential Equations: Introduction to the finite elements method for elliptic problems), which will have a strong computational aspect. The Department is open to requests to trial new software, so faculty are encouraged to include computational problems when appropriate.

In addition, the Department has established an annual problem-solving workshop with The Co-operators (a large Canadian insurance company) targeted for students in the AFM program, where an important component consists of programming.

Finally, there is now a mandatory computing component on both Stats 3ST3 (programming using R) and Math 4FM3 (programming using Python).

Dean's Comments:

As stated by the chair, the pandemic has placed restrictions on the progress of this recommendation. However, progress is being made and no doubt will continue as we return to campus and capacity for forward facing initiatives increases.

QAC Comments (to be filled in by Quality Assurance Committee):

See above

Recommendation: **1e. Consider aligning AFM courses more with exams, using consultation with actuarial expert**

Responsibility for Implementation: Chair, associate chair (undergraduate), David Lozinski, new faculty member

Anticipated Timeline for Completion: One year

Additional Notes/Commentary: Work with our shortly-to-be-hired actuarial teaching professor to conduct this review

Progress (check one)
X Completed
☐ In Progress
☐ Other (please explain)

Department's Comments:

The courses below are some of the Actuarial and Financial Mathematics (AFM) program courses that were recently revamped and adapted to cover and align with the syllabus of the preliminary actuarial exams offered by the Casualty Actuarial Society (CAS)/Society of Actuaries (SOA):

- Stats 2D03 (Introduction to Probability): covers Exam 1/P - Probability
- Math 2FM3 (Introduction to Mathematical Finance): covers Exam 2/FM – Financial Mathematics
- Math 3FM3 (Mathematics of Finance) and Math 4FM3 (Financial Markets and Derivatives): cover Exam 3F/IFM – Financial Economics
- Stats 3G03 (Actuarial Mathematics I) and Stats 4H03 (Actuarial Mathematics II): cover LTAM exam – Long Term Actuarial Models

Furthermore, we would like to specifically highlight the recent addition of three new courses in the AFM program. Starting from the 2019-2020 academic year, a new course on Data Science (Stats 3DS3 – see Recommendation 1a above) has been created and is now recommended for the AFM students.

In addition to this course, two new courses, Stats 3ST3 (Actuarial models in non-life insurance) and Stats 4G03 (Advanced Topics in Actuarial Science) were introduced to the Actuarial and Financial Mathematics (AFM) and have been taught regularly since 2020-2021. The two courses are now required in the program (3 units each). These three courses were designed to cover topics from the CAS actuarial exams (MAS-I, MAS-II and part of Exam 5) and to better prepare the students to the property and casualty practice.

These efforts in the AFM curriculum were recognized in 2020 when McMaster University became only the second Canadian university to win the Casualty Actuarial Society University Award (https://www.casact.org/mcmaster-university-2020-winner)

Dean's Comments:

The department has fulfilled this recommendation and is making great contributions to our academic excellence in these areas.

QAC Comments (to be filled in by Quality Assurance Committee):

See above

Recommendation: **2a. Decrease tutorial sizes, at least in some classes**

Responsibility for Implementation: Chair, associate chair (undergraduate), Aaron Childs

Anticipated Timeline for Completion: One year

Additional Notes/Commentary: Consider whether TA budget would allow this, and what courses would benefit from a smaller tutorial. Also discuss how to improve attendance and TA training in order to make these more effective.

Progress (check one)
☐ Completed
X In Progress
☐ Other (please explain)

Department's Comments:

Currently, the main obstacle for decreased tutorial sizes is the limited availability of graduate TAs, as the courses that would benefit from smaller tutorials tend to be more specialized upper-level courses. We will continue to monitor attendance and feedback from students to make sure that resources are fully utilized.

Regarding TA training, as explained in detail in the accompanying Program Progress Report for the Mathematics M.Sc. and Ph.D. Programs, this has been greatly enhanced and now encompasses the 5 hours of mandatory training received by all TAs at McMaster, in addition to 2 hours of specific training for Math and Stats.

Furthermore, we placed increased emphasis on enhancing the Math Help Centre (see Recommendation 2d below).

Finally, during the pandemic, TAs were also heavily involved in assisting instructors with remote learning and invigilation, as well as continuing to conduct tutorials (and the Math Help Centre) in virtual format.

Dean's Comments:

The thoughtful approach to this complex issue is appreciated. TA training has been enhanced by a new partnership between the MacPherson Institute for Learning and the Faculty of

Science which saw 2 staff members directly affiliated with the Faculty of Science in an effort to address specific issues such as TA training in Math and Stats. Furthermore, there were some positive outcomes during the pandemic related to accessible modes of tutorial delivery that were supported by our Faculty of Science IT team and many individuals in the Math and Stats Department.

QAC Comments (to be filled in by Quality Assurance Committee):

See above

Recommendation: **2b. Have instructional assistants**

Responsibility for Implementation: Chair

Anticipated Timeline for Completion: September 2018

Additional Notes/Commentary: The chair expects to be able to hire Chris McLean and Erin Clements as instructional assistants, with responsibilities for Math Help Centre, assistant course coordinators, acting as liaison for TA training, etc.

Progress (check one)

X Completed
☐ In Progress
☐ Other (please explain)

Department's Comments:

Chris McLean and Erin Clements were hired as instructional assistants in September 2018, with the responsibilities mentioned above.

Subsequently, Erin Clements applied for a teaching-stream position in the Department and was hired as an Assistant Professor in July 2020.

Chris McLean remained as an instructional assistant on a permanent basis.

Dean's Comments:

This recommendation has been implemented.

QAC Comments (to be filled in by Quality Assurance Committee): See above

Recommendation: **2c. Have more administrative support for undergraduate associate chair, especially for student advising**
Responsibility for Implementation: Chair
Anticipated Timeline for Completion: One year
Additional Notes/Commentary: Find out how this is done in other departments, decide on case to make to Faculty of Science
Progress (check one) X Completed ☐ In Progress ☐ Other (please explain)
Department's Comments: Taryn Sutton was hired in January 2020 as an additional Administrative Assistant (Undergraduate), sharing responsibilities to support the Associate Chair (Undergraduate) with Paula Marcoux, a long-term staff member in the Department. In addition, Dr. Anas Abdallah was appointed Coordinator for the Actuarial and Financial Mathematics (AFM) program in July 2020, with responsibilities including student advising (as well as admissions, pre-requisite waivers, and oversight for accreditation – see Recommendation 1e above), thereby alleviating the load of the Associate Chair (Undergraduate).
Dean's Comments: This recommendation has been fulfilled by the department through careful consideration of resource implications and organizational development. The Department Chair should be commended for his collaborative approach to balance advocacy for the Department and understanding of resourcing needs across the Faculty of Science.
QAC Comments (to be filled in by Quality Assurance Committee): See above

Recommendation: **2d. Make the organisational support for Math Help Centre more permanent via an instructional assistant position and commit to funding of Math Help Centre**
Responsibility for Implementation: Chair, associate chair (undergrad), associate chair (grad)
Anticipated Timeline for Completion: One year
Additional Notes/Commentary: See response to Recommendation 2b. Discuss ways in which the Faculty of Science could make a commitment to its continued funding.
Progress (check one) X Completed ☐ In Progress ☐ Other (please explain)
Department's Comments: Chris McLean was hired as an Instructional Assistant in July 2018 and remains in this position on a permanent basis. His responsibilities include organizational oversight of the Math Help Centre (assigning hours and roles to TAs, deciding on material to be covered, monitoring usage, collecting feedback from students, etc.).
Dean's Comments: This recommendation has been fulfilled by the department.
QAC Comments (to be filled in by Quality Assurance Committee): See above

Recommendation: **2e. Hire more faculty, and also explore blended learning models to leverage technology to compensate for higher student/instructor ratio**
Responsibility for Implementation: Undergraduate committee, under guidance of associate chair (undergraduate)
Anticipated Timeline for Completion: One year for initial discussions; two or more years to implement

Additional Notes/Commentary: Discuss using blended learning in some courses, make case to Faculty of Science for funding to do so.

Progress (check one)
☐ Completed
X In Progress
☐ Other (please explain)

Department's Comments:

Since the site visit, the following hires have been completed:

Dr. Anas Abdallah (Assistant Professor, teaching stream, Actuarial Sciences), January 2019
Dr. Siyuan Lu (Assistant Professor, tenure track, Differential Geometry), July 2019
Dr. Noah Forman (Assistant Professor, tenure track, Probability and Statistics), July 2019
Dr. Jenna Rajchgot (Assistant Professor, tenure track, Algebraic Geometry), July 2020
Dr. Cameron Franc (Assistant Professor, tenure track, Number Theory), July 2020
Dr. Erin Clements (Assistant Professor, teaching stream, Mathematics), July 2020
Dr. Caroline Junkins (Assistant Professor, teaching stream, Mathematics), July 2020
Dr. Pratheepa Jeganathan (Assistant Professor, tenure track, Statistics and Data Science), January 2021
Dr. Blaise Bourdin (Professor, tenured, Mathematical Analysis and Applications), July 2021

In addition, the Faculty of Science approved a tenure-track Assistant Professor position in Data Science in Actuarial and Financial Mathematics and a teaching-stream Assistant Professor position in Statistics, both to start in July 2022.

These new hires greatly expanded the teaching capacity in the Department and, together with the ongoing teaching commitment in the Postdoctoral program, essentially eliminated the need for contractually-limited and other temporary employment instructors, with the exception of the opportunities provided to graduate students to acquire teaching experience as sessional instructors in select courses.

Regarding blended learning models, it goes without saying that the global pandemic accelerated the plans for implementation of delivery modes making heavier use of technology (e.g., live streaming of synchronous remote lectures, pre-recording of asynchronous modules, recording of live sessions for later viewing, as well as extensive use of other online tools).

Part of the post-pandemic plans in the Department include the assessment of these blended learning models and select implementation of remote learning tools for courses where it proved to be successful.

Dean's Comments:

It is always preferable to have permanent instructors rather than sessional or even CLA appointment. The recent hires in the department signal a significant move towards this stable

resourcing model in the department. As the Chair has stated, the pivot to online delivery of the last 18 month (an ongoing) has provided opportunities for all to explore different avenues of teaching and learning. It is now important to establish in what environments this can work to the benefit of students. We will continue to evaluate the implementation of online learning considering multiple perspectives and impacts.

QAC Comments (to be filled in by Quality Assurance Committee):

See above

Recommendation: **3a. Communicate rotating schedule of courses more effectively to students**

Responsibility for Implementation: Associate chair (undergraduate), staff of undergraduate team

Anticipated Timeline for Completion: Summer 2018

Additional Notes/Commentary: Changes currently being made to course list on departmental website to implement this recommendation. All courses will be listed with informal description. Courses not being taught in current year will be listed in separate section.

Progress (check one)
X Completed
☐ In Progress
☐ Other (please explain)

Department's Comments:

The Department website was upgraded in 2019 and now features a "Course Outlines" page that lists all MATH and STATS courses currently active in the McMaster Undergraduate Calendar, together with the corresponding outline, the instructor assigned to each and the next term in which the course is scheduled to be taught (or a note saying that it will not be taught in the current academic year).

We have also streamlined all the pairs of courses to be offered in alternating years and this information is also provided on the same page where courses are listed.

Dean's Comments:

This recommendation has been fulfilled by the department and all course outlines are now posted and available to students in advance of course registration each year.

QAC Comments (to be filled in by Quality Assurance Committee):

See above

Recommendation: **3b. Increase communication/consultation/transparency in departmental decision-making, perhaps through more frequent meetings**

Responsibility for Implementation: Chair

Anticipated Timeline for Completion: On-going

Additional Notes/Commentary: This can be implemented by the chair.

Progress (check one)
X Completed
☐ In Progress
☐ Other (please explain)

Department's Comments:

Department meetings are now scheduled on a monthly basis with all the dates communicated in advance to Department members at the start of the academic year. The Chair also began a tradition to send a monthly message to all Department members ("From the Chair's desk") with a summary of all important decisions, announcements, and upcoming events in the Department.

All committee meetings (including search committees) are announced by committee chairs to the entire Department and are open for anyone to attend (although when a formal vote is needed, only committee members can vote).

Dean's Comments:

This recommendation has been fulfilled by the department. The Department Chair and Associate Chairs should be acknowledged for their substantial efforts to increase internal communication, consultation and transparency.

QAC Comments (to be filled in by Quality Assurance Committee):

See above

Recommendation: **3c. Explore opportunities to collaborate with other Faculties such as Business and Social Science**

Responsibility for Implementation: Chair

Anticipated Timeline for Completion: On-going

Additional Notes/Commentary: Did not discuss at retreat but open to creating and exploring further opportunities

Progress (check one)
☐ Completed
X In Progress
☐ Other (please explain)

Department's Comments:

The Department continues to monitor its existing joint undergraduate programs with the other departments in the Faculty of Science (Biology and Mathematics; Mathematics and Physics); with the Faculty of Engineering (Mathematics and Computer Sciences); with the School of Arts and Science (Arts and Science and Mathematics); with the Faculty of Social Sciences (Economics and Mathematics); and with
the Faculty of Humanities (English and Cultural Studies and Mathematic,
French and Mathematics, History and Mathematics, Philosophy and Math).

Adjustments are continuously being to ensure viability and attractiveness to students.

In addition, preliminary discussions took place with the Faculty of Business for the creation of a new joint 5-year Mathematics and Business program, potentially leading to direct admission to either an MBA or the MFM (Master in Financial Mathematics) programs.

Dean's Comments:
The department has always been active in collaborating with other faculties and offers a number of joint programs. However, many of these programs have very few students enrolled in them. While encouraging this type of collaboration, joint programs need to be well researched to ensure interest is there.

QAC Comments (to be filled in by Quality Assurance Committee):

See above