UNIVERSITY OF WATERLOO

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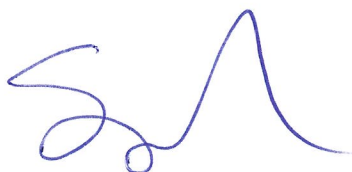deanmath@uwaterloo.ca | uwaterloo.ca/math

MEMORANDUM

January 8, 2019

Re: Quality Assurance (Academic Programs)

The Math Faculty endorses the Final Assessment Report for the Mathematical Students program. I have met recently with the Associate Dean Undergraduate who oversees this program and discussed in detail many of the issues in this report. I am satisfied with the proposed actions to the reviewers' recommendations.

Regards,

Stephen M. Watt
Dean, Faculty of Mathematics

Final Assessment Report
Mathematical Studies (BMath)
July 2019

Executive Summary

External reviewers found that the Mathematical Studies program (BMath) delivered by the Faculty of Mathematics was in good standing, but there were some concerns.

> *"The Mathematical Studies program … successfully prepares students for careers in business, teaching, or public service. However, although the program is important to the Faculty (for student retention), it is clear that the program has been neglected by the Faculty. The program is in need of a Director who can address long-standing issues."*

A total of 6 recommendations were provided by the reviewers. The majority of these recommendations were aimed at improving the perception and purpose of the program. In response, the program created a plan outlining the specific actions proposed to address each recommendation as well as a timeline for implementation. The next cyclical review for this program is scheduled for 2022-2023.

Enrollment over the past three years

	Honours	Honours Co-op
2016-17	117	66
2015-16	100	67
2014-15	59	47

Background

In accordance with the University of Waterloo's Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response of the Bachelor of Mathematics in Mathematical Studies delivered by the Faculty of Mathematics. A self-study (Volume I, II, III) was submitted to the Associate Vice-President, Academic on October 6, 2017. The self-study (Volume I) presented the program descriptions and learning outcomes, an analytical assessment of the programs, including the standard data package prepared by the Office of Institutional Analysis & Planning (IAP). Appended to Volume I were the course outlines for all courses in the program. The CVs for each faculty member with a key role in the delivery of the program was included in Volume II of the self-study.

From Volume III, two arm's-length external reviewers were selected by the Associate Vice-President, Academic: Dr. Timothy Sibbald, Associate Professor in the Schulich School of Education, Nipissing University, and Dr. Gerda de Vries, Professor in the Department of Mathematical and Statistical Sciences, University of Alberta.

Reviewers appraised the self-study documentation and conducted a site visit to the University on November 16 and 17, 2017. An internal reviewer from the University of Waterloo, Dr. Eric Helleiner, Professor of Political Science, was selected to accompany the external reviewers. The visit included interviews with the Vice-President Academic and Provost; Associate Vice-President, Academic; Dean of Mathematics; Associate Dean, Undergraduate Studies of Mathematics; Director of Mathematics Teaching, Faculty members, staff and current undergraduate students. The review team also had an opportunity to meet with representatives from the Library and Co-operative Education, and tour the facilities.

This final assessment report is based on information extracted, in many cases verbatim, from the self-study, the external reviewers' report and the program response.

Program characteristics
The Mathematical Studies (BMath) program is meant for students whose mathematical interests are broadly based. Its high degree of flexibility makes it suitable for those who wish to design a course of study that suits their individual tastes. Under this plan, there is ample scope for students to obtain a minor in an area of mathematics or a minor from another Faculty. With judicious course selections, graduates of Mathematical Studies can confidently pursue careers in business, teaching, or public service.

Summary of strengths, challenges and weaknesses based on self-study
Strengths
- Mathematical Studies is more flexible than other plan in Mathematics
- Students are prepared for successful careers in business, teaching, or public service, as well as other areas
- Helpful for retention of students who have failed more than four courses since this program allows students to fail up to 8 courses, unlike all other majors in the Faculty
- Academic advisors are an important resource and extremely supportive

Challenges
- The plan lacks a Director who has the time to take care of the plan
- There is a stigma of Mathematical Studies being the easiest plan in the Faculty and that students are "not good enough" for other plans
- The Mathematical Studies plan is viewed as a low priority by some faculty

- Forced entry into the plan can be traumatic for students
- Cohesion amongst students can be improved
- More student mental health support is needed

Weaknesses
- Students do not always have access to as wide a range of courses as they would like
- Scheduling seems to restrict the course selection further
- Co-op is effective but there are not many jobs targeted to these students
- There is a lack of functional space due to the growing university population

Summary of key findings from the external reviewers

The Mathematical Studies program is in good standing. It successfully prepares students for careers in business, teaching, or public service. However, although the program is important to the Faculty (for student retention), it is clear that the program has been neglected by the Faculty. The program is in need of a Director who can address long-standing issues. If the Faculty wishes the program to continue and thrive, changes are necessary. The necessary changes can happen only if the program has an advocate in the form of a Director with sufficient time and authority.

Program response to external reviewers' recommendations

Recommendations

1. We strongly recommend the appointment of a Director for the Mathematical Studies program. The Director needs to be someone who has the time and authority to evolve the program, solve problems (for example, to work with departments to resolve simple course scheduling conflicts or to resolve course sequencing issues), and advocate for students in the program.

   Response
   This plan consists of three components: 1) Mathematical Studies core, 2) a selection of ten 300- and 400-level Faculty of Mathematics courses and 3) other courses. To be successful, the Director must be able to oversee changes to the Mathematical Studies core and the creation and modification of upper-level courses offered from the school and four departments in the Faculty.

   The Associate Dean Undergraduate Studies (ADUG) oversees changes to Faculty of Mathematics core requirements of academic plans and is thus the person best positioned to lead changes to the Mathematical Studies core. At present, the ADUG also assumes the position of Director of Mathematical Studies. Unfortunately, the ADUG does not interact as frequently with the Mathematical Studies students as the plan's advisors, thus the ADUG may not fully appreciate some challenges faced by students in this plan.

In the past, the ADUG has asked the units to create courses that are of interest to a non-specialist audience, and some courses have been created, but perhaps not enough.

We propose to form a Mathematical Studies Committee, which consists of the following:
- Mathematical Studies advisors (presently there are three);
- Several students in the plan;
- Assistant Dean of Students; and
- Associate Dean, Undergraduate Studies who will chair the committee

This committee will meet regularly to discuss the plan and how it can, and should, be improved.

2. The stigmatization of students in this program and the program itself needs to be addressed. We recognize that this will be a challenge since the institution promotes high-performing students while many students in the Mathematical Studies program are there because of low averages or exceeding the maximum number of failed/excluded courses for departmental programs.

Response
As will be addressed in Recommendation 3, the program will attempt to remove the plan's stigma by celebrating its graduates in a public setting. Also, the Mathematical Studies Committee will investigate how we can further remove the stigmatization of students in this plan.

Student Mental Health on campus is an important issue, as is apparent from the President's Advisory Committee on Student Mental Health (PAC-SMH) whose 2017 report includes 36 recommendations. The Faculty of Mathematics has also created a committee for Student Wellbeing, chaired by the Vice-Dean of Mathematics. Because students enrolled in other Faculty of Mathematics baccalaureate plans are forced into Mathematical Studies if they earn more than four failures, students in Mathematical Studies may need more support than what is typical across other plans.

As a result of the PAC-SMH efforts, there is going to be more support for all students on campus. In particular, Faculty of Mathematics' students will benefit from: 1) two new academic advisors who advise Mathematical Studies students and 2) a second counsellor situated in the Mathematics Undergraduate Office (MUO). Combined, these steps should help students in Mathematical Studies to obtain more counselling and academic support when needed.

3. To aid with the removal of the stigma, we recommend that the Faculty reviews its Calendar entry and promotional materials for the program to highlight the opportunities that students have to personalize this program (for example by adding the Business Specialization and/or a Minor). Celebrating successful students in the program (especially those who may have struggled at the outset) should also help.

   Response
   Mathematical Studies is described in current brochures distributed to students interested in doing undergraduate studies in the Faculty of Mathematics. The brochures indicate that this plan is the most flexible of all Faculty plans and gives students a broad education in mathematics. It also mentions that there is a possibility for specialization in Business. The new Mathematical Studies Committee is working on revising this text.

   To celebrate successful students who have graduated from Mathematical Studies, the program hosted a Mathematical Studies Career Panel discussion November 7, 2018. To do this, several graduates from the plan were invited to talk to students currently in the plan and answer their questions about career options for the future. The Mathematical Studies Committee will consider holding this event on an annual basis.

4. The Faculty may wish to consider making the Mathematical Studies program the point of entry for all students, from which students can launch into departmental programs if they so desire.

   Response
   The Mathematics Undergraduate Affairs Committee (UAC) has decided to form a committee that will discuss the possibility of having all BMath students start in a plan that is either Mathematical Studies or similar to Mathematical Studies. The plan is to discuss the various pros and cons of making this change based on how it would impact the Faculty. The committee first met in November 2018. At UAC, there was support for this idea but there were also some concerns. In particular, would an unintended/undesirable message be sent to students, if we accept students into a program that allows for a greater number of fails than all other Faculty programs? The next step is to discuss the logistics of this change with the Registrar's Office.

   It is recognized that if direct entry into Mathematical Studies were available, it would perhaps remove some of the stigmatization that is currently associated with this plan. However, there are some concerns that need to be discussed by the Faculty before a decision can be made. It is not clear that this change will remove the trauma of students who fail out of another academic plan, or that it sends the right message to incoming students.

5. It will be a worthwhile endeavor for the Faculty to review the prerequisite structure of its courses. Are there unintended or outdated barriers to certain courses that can be removed? Perhaps some courses can have multiple entry points (for example, either a specific specialist course or a certain combination of non-specialist courses). Alternatively, a prerequisite waiver system (whereby students gain permission to take a certain course upon approval by the instructor and program Director) might address issues surrounding course sequencing.

    Response
    One advantage of the Mathematical Studies plan is that it allows students to take some non-specialist courses in their core, if they are not able to successfully complete the specialist version. As previously mentioned, this degree of flexibility early on has the disadvantage that it restricts the options of the subsequent courses the students can take.

    UAC is the body that deals with changes to courses in general, and prerequisites in particular. Each academic unit understands their courses the best and brings suggested changes to the Committee, so that they can be discussed Faculty-wide. This committee works continuously to update and improve the courses and programs offered by the Faculty. UAC is very effective in evolving the curriculum but it is recognized that there may be less interest given to the non-specialist courses. The proposed Mathematical Studies Committee mentioned above is the first committee that will discuss these limitations and how they might be overcome with consultation with the different units.

6. We recommend that the Faculty invests in getting to know the students in the Mathematical Studies program, and evolve its curriculum accordingly. How did the students arrive in the program? What needs do the different constituencies have? We expect that the needs of students who purposely choose the program for its flexibility are different than the needs of students who are forced into the program due to low averages or exceeding the maximum number of failed/excluded courses for departmental programs. Likewise, the needs of students in the program who started in the Faculty may be different than the needs of students who transferred from another Faculty. For students who were forced into the program, are there support systems that can and should be put in place to help them adjust and succeed?

    Response
    The academic advisors for Mathematical Studies are the ones who have the most contact with these students and know the students the best. Unfortunately, to date, there has not been a discussion with these advisors about the Mathematical Studies students and this is something that we will change.

The proposed Mathematical Studies Committee will create a means through which the advisors and the students can more easily voice their concerns about Mathematical Studies and important issues going on with these students. This would be a valuable opportunity to learn about the two different study streams of Mathematical Studies and how student needs might differ.

The Mathematical Studies program has started working with the Student Success Office (SSO) to track students throughout their undergraduate career. Part of this is to better understand what factors have helped to contribute to their success but also to learn what we can do differently to better support our students. The Faculty of Mathematics plans on profiling the Mathematical Studies students to see what can be done differently to make their undergraduate education more successful.

Implementation Plan

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	We strongly recommend the appointment of a Director for the Mathematical Studies (MS) plan.	Form a Mathematical Studies Committee that will meet periodically to discuss what needs to be done to maintain and improve the plan. This committee will consist of the following: • MS advisors (presently there are three) • Several students in the plan • Assistant Dean of Students • ADUG (chair)	ADUG	Committee formed November 2018 (Completed)
2.	The stigmatization of students in this plan and the plan itself needs to be addressed.	1. Remove the stigma that appears to exist in MS by celebrating the success stories of previous graduates. See recommendation 3. 2. The MS committee will investigate this issue in more detail. 3. Give more support to students who are not able to stay in the plan of their choice. In the last year we have hired two new	ADUG and MS Committee	MS Career Panel November 7 2018 (Completed) MS Committee to discuss (Ongoing) Two advisors and counsellor arrived 2018 (Completed)

		academic advisors and a second counsellor in the MUO.		
3.	To aid with the removal of the stigma, we recommend that the Faculty reviews its calendar entry and promotional materials for the plan to highlight the opportunities that students have to personalize this plan.	Recruitment brochures already advertise the flexibility in the Mathematical Studies plan but the text has recently been updated. Organized a Mathematical Studies Career Panel where alumni shared their experiences and answered questions of the current students.	MS Committee	June 2020 November 7, 2018 (Completed)
4.	The Faculty may wish to consider making the Mathematical Studies plan the point of entry for all students, from which students can launch into departmental plans if they so desire.	UAC will discuss the advantages and disadvantages of having direct entry of all Math students into Mathematical Studies.	Mathematics UAC	July 2020
5.	It will be a worthwhile endeavour for the Faculty to review the prerequisite structure of its courses. Are there unintended or outdated barriers to certain courses that can be removed? Perhaps some courses can have multiple entry points (for example, either a specific specialist course or a certain combination of non-specialist courses). Alternatively, a	The new Mathematical Studies Committee will discuss this with the different units to see whether the prerequisites for the courses can be changed.	MS committee	Ongoing

	prerequisite waiver system (whereby students gain permission to take a certain course upon approval by the instructor and plan Director) might address issues surrounding course sequencing.			
6.	We recommend that the Faculty invests in getting to know the students in the Mathematical Studies plan, and evolve its curriculum accordingly. How did the students arrive in the plan? What needs do the different constituencies have? We expect that the needs of students who purposely choose the plan for its flexibility are different than the needs of students who are forced into the plan due to low averages or exceeding the maximum number of failed/excluded courses in departmental plans. Likewise, the needs of students in the plan who started the Faculty may be different than the needs of students who transferred from another Faculty. For students who were forced into the plan, are there support systems that can and should be put in place to help them adjust and succeed?	The Mathematical Studies Committee consists of the academic advisors of the plan as well as students. This will create dialogue whereby the needs of the students can be heard. The SSO will look at the distribution of students in this plan to better understand how students end up in the plan and what factors most contribute to their success.	ADUG SSO	Ongoing – Estimate to complete July 2021 July 2020

The Department Chair/Director, in consultation with the Dean of the Faculty shall be responsible for monitoring the Implementation Plan.

Date of next program review	**2022-2023**
	Date

Signatures of Approval

Francs Pan	_Dec 18, 2018_
Chair/Director	Date

AFIW Administrative Dean/Head (_For AFIW programs only_)	Date

[signature]	_2019-01-09_
Faculty Dean	Date

Note: AFIW programs fall under the Faculty of ARTS; however, the Dean does not have fiscal control nor authority over staffing and administration of the program.

[signature]	July 11, 2019
Associate Vice-President, Academic (For undergraduate and augmented programs)	Date

Associate Vice-President, Graduate Studies and Postdoctoral Affairs (For graduate and augmented programs)	Date