UNIVERSITY OF CALGARY | FACULTY OF SCIENCE

CURRICULUM REVIEW REPORT
PROGRAM: GENERAL MATHEMATICS PROGRAM
DEPARTMENT: MATHEMATICS AND STATISTICS

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Curriculum Review Team

The Curriculum Review process has extended over a few years. Committee and team membership lists include all members having served on the committees/teams during parts or all of this period.

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Data analysis and Action plan: All faculty members and all sessional instructors invited to participate

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Executive Summary

The General Mathematics program currently has a clearly defined role amongst the other existing programs in the Department of Mathematics and Statistics. It is flexible enough to allow practical entries for students pursuing another major, and lends itself favorably to those wishing to teach mathematics at the primary or secondary school levels. Over half of students registered in the program are either currently enrolled in a combined degree with Werklund School of Education, or they intend to pursue a Bachelor of Education after matriculation. This makes current and future students in education a very important cohort when assessing the future of the program.

Students generally seem satisfied with the courses offered by the program, and they enjoy the plethora of choices available to them. General Mathematics allows students to use any of the five course designations (ACSC, AMAT, MATH, PMAT, STAT) towards their degree, and all five are well-enrolled by General Mathematics students. Faculty members are also generally satisfied with the program, though there are concerns over the (perceived lack of) mathematical rigour and sophistication offered, in addition to the lack of a capstone experience which will exist in other department programs moving forward.

This document puts forward four action items summarized below:

1. Reach a departmental consensus on whether or not to continue offering a General Mathematics program.
2. Address the lack of soft skills developed over the course of the program; the lack of a unified capstone experience; and the possibility of failing to address several program level outcomes.
3. Developing and encouraging interdisciplinary degrees, collaboration with other departments and faculties
4. Differentiating the General Mathematics Program from the new Mathematics Program

The consequence of these action items give the follow possibilities for the future of the program:

1. General Mathematics is left in its current form.
2. General Mathematics is left in its current form, but only allowed for students pursuing a second major.
3. General Mathematics is removed, with the new Mathematics program subsuming all incoming students.
4. General Mathematics is differentiated more substantially from the new Mathematics program.

Overview and Context of the Program

The general mathematics program is the second-most enrolled program offered by the Department of Mathematics and Statistics, second to Actuarial Science. As of the Fall 2016 term, the program had the following number of students enrolled:

- Year 1: 60
- Year 2: 28
- Year 3: 20
- Year 4: 21
- Year 5 and higher: 19
- Total: 148

These figures include double majors—the majority of which are pursuing a combined degree with the Werklund School of Education. As of the Fall 2015 term, there were 50 students pursuing a 5 year concurrent or combined degree from Werklund (Bachelor of Science in General Mathematics and Bachelor of Education). Of these students, 39 are specializing in secondary education. Additionally, 5 of 14 general mathematics respondents in the mathematics student surveys indicated they wished to pursue a bachelor of education concurrent with general mathematics. Another 5 students indicated they would be pursuing an education degree after their matriculation. The above points strongly suggest that primary and secondary education is the desired career path for the largest group of students within the general mathematics program. A small number (less than 10) of students pursuing double majors within science, typically in physics and geoscience, are also present.

The general mathematics program is extraordinarily flexible and broad, especially in comparison to our current other programs (much less so in comparison to the new Mathematics program—see below) and other programs in the Faculty of Science. This is primarily due to the field of general mathematics courses within the university calendar encompassing all of our courses (including MATH, AMAT, PMAT, ACSC and STAT labelled courses). Students are required to take a certain number of FCEs at the 300 and 400 level: 2.5 and 1.5 respectively. In addition, there is a common set of core courses required at the 200 and 300 level, including basic courses in calculus, linear algebra, statistics and computer programming. Once the new Mathematics program is in place, the number of required FCEs for the general mathematics program at the 400 level will drop to 0.5, as many mathematics courses will be downgraded from the 400 level to the 300 level.

There are significant consequences to the flexibility of the general mathematics program. Since there are so many courses in the field, the range of course outcomes available to students varies considerably. It is entirely possible to complete a general mathematics program in such a way as to avoid the "advanced" treatment of program-level outcomes. Nonetheless, many students in General Mathematics follow predictable course progressions which do target all program-level outcomes. See the section: Analysis and Summary of Program Mapping Data.

Another important consideration is that students are able to fill their 400-level course requirements with courses that are typically not open to students in other mathematics programs. Some examples of this are Math 331, required for Geoscience and Chemistry students, and Applied Mathematics 415 and

433, required for Geophysics and Physics, respectively. Since these courses are already required by other majors within Science, allowing credit for them in the general mathematics programs makes a compelling case for choosing it as a second major. In practice, however, the number of students pursuing this option is in the single digits.

By its very nature, the general mathematics program is multidisciplinary. Its intention is to encourage students from other quantitative disciplines to enroll in mathematics courses, and then follow a relatively straight forward path to a second major. As discussed above, this is the route chosen by a large number of Werklund students. If this group is removed, the bulk of students enrolled in general mathematics intend on completing the program without a second major.

The new Mathematics program, with a targeted introduction of Fall 2018, includes similar features to the general mathematics program. Most importantly, it is substantially more flexible in terms of course selection than the current Applied Mathematics, Pure Mathematics and Statistics programs it is replacing. It has a similar structure to the general mathematics program, but also requires 1 FCE (versus 0.5 for general mathematics) at the 400 level, in addition to a capstone course at the 500 level. Moreover, courses in the "mathematics" field will be more restricted than the "general mathematics field." In particular, students will be unable to apply most actuarial science courses and some science program-specific courses (like MATH331, AMAT415 and AMAT433 mentioned above). Thus, the general mathematics program will continue to be a more flexible choice for students wishing to pursue a double major within science, or a combined degree outside of science.

Survey Program Outcomes for the General Mathematics Program

At the end of the program, students will be able to

1. Demonstrate working knowledge of both the practice and foundational theory of the basic mathematical subject areas (calculus, linear methods and elementary statistics).
2. Formally develop a major mathematical theory through definitions and theorems.
3. Broadly apply mathematical models and methodologies in addressing real-world quantitative problems, as well as making inferences from a data set or model.
4. Create computer algorithms capable of solving numerical problems.
5. Formulate well-posed mathematical questions and to offer solutions to problems that are accessible.
6. Acquire knowledge in specific topics by individual reading and research.
7. Practice mathematics as an inherently honest subject where assertions are always supported by proofs and uncertainties are quantified.
8. Uphold a high standard of accountability by habitually providing evidence in support of one`s claims.

Alignment with Priorities of the University of Calgary's Academic Plan

How does this review and your program align with the Eyes High Academic Plan?

The University of Calgary Academic Plan includes three fundamental commitments:
1) sharpen the focus on research and scholarship;
2) enrich the quality and breadth of learning;
3) fully integrate the university with the community

Focus on research and scholarship.
Mathematical research is difficult to address at the undergraduate level, particularly for the more abstract sub-disciplines. It is often the case that that current research in a field is totally inaccessible to someone with only undergraduate training. There are many areas within the field of General Mathematics were the opposite holds, however. Students are able to choose courses from the entirety of the Actuarial Science, Statistics and Mathematics catalogues. Many courses within each of these categories contains treatment of current research in the field.

Enhancing the quality and breadth of learning.
Foundational to the General Mathematics program is the flexibility of its requirements, and the enormous range of courses available to students. By including all courses labelled Mathematics (MATH), Statistics (STAT) and Actuarial Science (ACSC) in the field of "General Mathematics", students in this program can choose to specialize in virtually any sub-discipline of the subject. For students planning on becoming teachers, or those pursuing an additional major in another discipline, the general mathematics program offers significant mathematical training within an extremely broad, flexible and practical framework.

Integrating the university with the community.
The largest group of students within the General Mathematics Program are those currently completing a concurrent degree with a Bachelor of Education from Werklund School of Education, and those that wish to pursue the same degree after completing their Bachelor of Science. Consequently, this program provides a pivotal service: training the next generation of primary and secondary mathematics teachers with discipline-specific knowledge. In addition to the obvious benefit of training teachers with significant subject knowledge, this also aligns with the recent Government of Alberta initiatives to encourage teachers to return to a post-secondary environment for additional training.

Guiding Questions

The following two guiding questions were selected not only for the General Mathematics programs, but also for the new Mathematics program and the Actuarial Science program.

1. Where will students next apply the skills they acquire in this course in the context or upon completion of the program?

2. What skills obtained in this course will a successful student be able to translate into a CV or resume item, or in support of a scholarship or other application?

Based on the data from the National Survey of Student Engagement, the Faculty of Science is seeking additional information regarding High-Impact Educational Practices

1. Are High Impact Practices being used regularly in this program?
2. If not, what is preventing these practices from being used?

Timeline of the Curriculum Review Process

June 2014 – May 2015	Graduate attributes and program level outcomes development
November 2015 – May 2016	Curriculum review and Guiding and survey questions discussions
January 2016 – May 2016	Course outcomes discussions and development
April – September 2016	System set-up
May – October 2016	Data collection – Course outcome mappings, student and alumni surveys
June – December 2016	Data analysis – Focus groups, data analysis discussions and action plan development
July – December 2016	Draft of report
January 2017	Departmental approval

Data Collection

Data Sources Used:
The main source of data was the curriculum mapping including all the courses presently offered by the department, OIA data, student surveys, alumni surveys (only 1 respondent for general mathematics), two focus groups for faculty members in July 2016. Additionally, two data review sessions for faculty members in December 2016 were conducted. All faculty members were invited to review and comment on the above collections of data.

For the curriculum review data, usually the last 1-3 instructors teaching the course in the last 2-5 years were involved in course outcomes preparation. However, for many second and especially first year courses brainstorming group were formed to develop and discuss course outcomes. For calculus and linear algebra courses, this exercise took up to one month.

Analysis of Student Survey Data

Summary of the Students Survey

Overview

- 14 General Mathematics students took the survey.
- 60% were females and 40% males, with the majority aged 18-24. See OIA data for gender balance across the whole program.
- 50% are completing only the General Mathematics program. 30% are pursuing a combined degree with Werklund School of Education, and 20% have an additional major other than Education.
- 40% chose General Mathematics because they had an interest in mathematics as a whole, 30% because they acquired enough credits in mathematics in their other degrees which made the General Mathematics program a flexible addition to their program.

Positives

- The students are pleased with the flexibility of scheduling and the number of courses offered.
- Courses build on each other in sequence, which admits the possibility of depth in the program in addition to breadth.
- Double major students found their mathematical discipline knowledge helpful in their other degree
- 75% plan to have another major in addition to General Mathematics.

Commented [CG1]: Is this necessarily a negative?

Negatives

- Only 40% think the General Mathematics degree will prepare them for employment in their field.
- None of the students surveyed got involved in research.

Analysis of the Curriculum Mapping Data and Faculty Surveys

1. Despite the field of General Mathematics consisting of several course designations (ACSC, AMAT, MATH, PMAT, STAT), all program levels are typically addressed at the developed and advanced levels by senior course offerings.
2. There are certainly many exceptions to the above observation. For example, Math 429: Cryptography-Design and Analysis of Cryptosystems addressed all outcomes at an advanced level, whereas Applied Mathematics 491: Numerical Analysis I was a mixture of introductory and developed knowledge. Each of these courses is a reasonable addition to a general mathematics program. This phenomenon is described in more detail below.
3. There was significantly more variability in graduate attributes achieved in each course. It is conceivable that a student could take a degree path that misses several of them entirely. Ethical practice, sustainability and social responsibility are broadly underrepresented in the field (particularly sustainability, which is addressed in fewer than 10% of courses).
4. Research activities incorporated into courses is a consistently weak area across all disciplines. The majority of mathematics courses (even at the senior level) either had no research incorporated, or a limited amount through lecture content. Statistics and Actuarial science had significantly more pronounced and diverse treatments of current research incorporated. This is not necessarily surprising, since current mathematics research tends to be completely inaccessible for the majority of undergraduate mathematics courses.
5. The vast majority of teaching and learning activities were carried out either in traditional lectures or independent study. Courses in the field (at the 300 level and above) tend to have lengthy and involved take-home assignments.
6. Interactive learning tends not to be employed at the 200 level, but its usage increases slightly with the seniority of the course.
7. Several instructors went into additional detail on teaching and learning practices outside of the given categories. Examples include: two stage midterms, midterm corrections, peer assessment, and lectures based around testing computer code.
8. For types of learning, the majority of courses focused on direct learning and independent study. Interactive learning and experiential learning were broadly underrepresented, even at the senior levels.
9. Some examples of positive classroom practices employed by instructors were: group assessment including midterms, quizzes and assignments, open discussions, written projects, presentations, traditional homework assignments, and Tophat/clicker assignments in lecture.
10. For the purposes of improving teaching, common suggestions were for more interactive learning practices, more in class use of software and numerics, the use of case studies, adopting more prerequisites for many courses, and lengthening or expanding lab activities.
11. The majority of assessment across the whole field is done via exams and take-home assignments. More senior courses tend to include oral presentations and/or written projects, but this is not the norm.
12. Many instructors commented that oral presentations are particularly effective assessment tools.
13. Almost no instructor mentioned improving or altering the structure of final examinations as a means of better evaluation of students. Nearly all respondents focused on different assessment tools for improving both student learning and accuracy of assessment.
14. Only 24% of courses employed high impact activities. The largest group of those that did (11 out of 27) included some type of research project. These courses are typically at the 500 level, and

thus are not required by general mathematics students. It would be extremely easy for a general mathematics student to completely avoid these 27 courses.

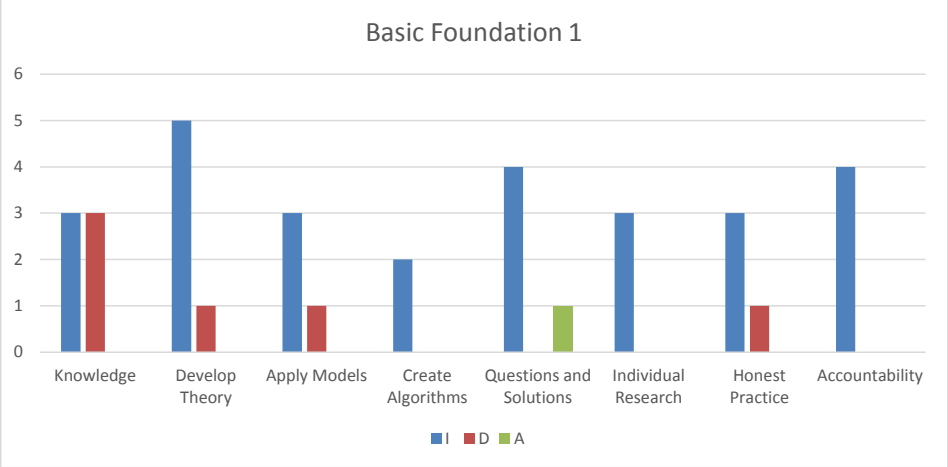
15. The largest hindrance to implementing high impact practices was time/resources.
16. Only 29% of respondents indicated a desire to implement high impact practices. Perhaps this question could have been better qualified with a statement like "If resources were not a concern…."
17. Many of the courses in the field may not be appropriate for high impact practices.
18. For the guiding question:
    Where will students next apply the skills they acquire in this course in the context or upon completion of the General Math Program?
    There was an enormous range of responses, but nearly all of them fell into three categories: future courses, industry, and graduate studies in mathematics. For actuarial science and applied mathematics courses in finance and statistics, the answers, unsurprisingly, focused on industrial mathematics. For many of the core courses in calculus, linear algebra and statistics, future course progressions in the field was the most selected. For senior courses in mathematics, graduate studies in mathematics was frequently selected.

Case Study: Examining for the mapping data for "example" students.

Given the breadth of the field of General Mathematics courses, the whole exercise of mapping outcomes does not reveal what a typical student completing the program actually experiences. Presently, we will examine two typical student progressions within the field at two time intervals: at the conclusion of their "core" course completion and then again at the conclusion of their mathematics requirements. The first student represents a typical progression through pure and applied mathematics topics with an emphasis on analysis and algebra. The second student has a statistics focus.

Examination of the total number of Introduced, Developed, and Advanced Concepts in relation to the Program Learning Outcomes (PLOs) in the various Math clusters

(1) Basic Foundation I: Math 265, Math 267, Math 211, Math 311, Stat 205, Math 271
(2) Basic Foundation II: Math 265, Math 267, Math 211, Math 311, Stat 205, Stat 321
(3) Algebra and Analysis Emphasis: Math 265, Math 267, Math 211, Math 311, Math 271, Math 315 (PMAT 315), MATH 367, MATH 376 (AMAT 311), MATH 335, STAT 321, MATH 307 (MATH 421), MATH 445, MATH 431 (PMAT 431), MATH 351 (MATH 411)
(4) Statistics Concentration: Math 265, Math 267, Math 211, Math 311, Stat 321, Stat 323, Stat 429, Stat 431, Stat 423, Stat 425, Stat 505, Stat 507, Stat 517, Stat 519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Apply Models
Create Algorithms
Questions and Solutions
Individual Research
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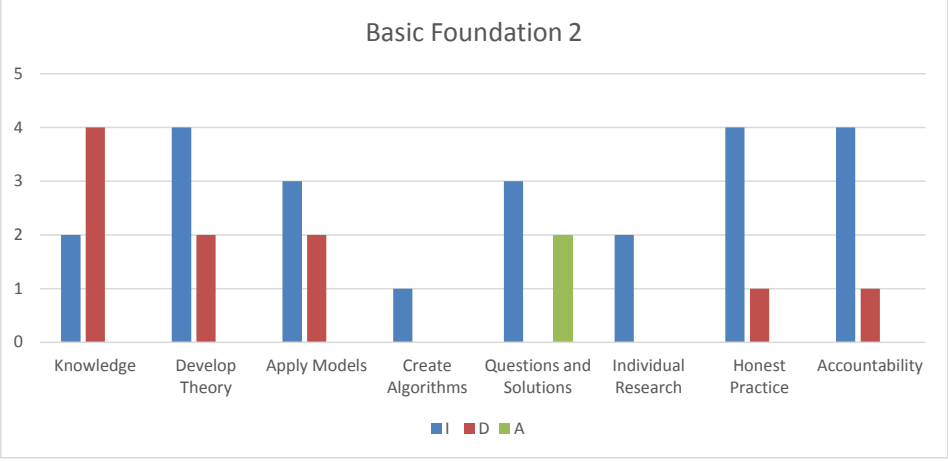
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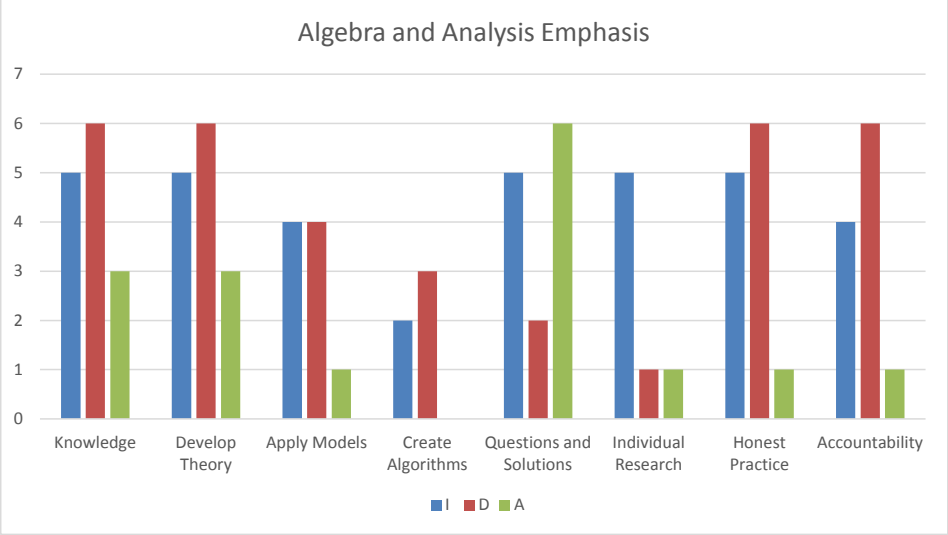

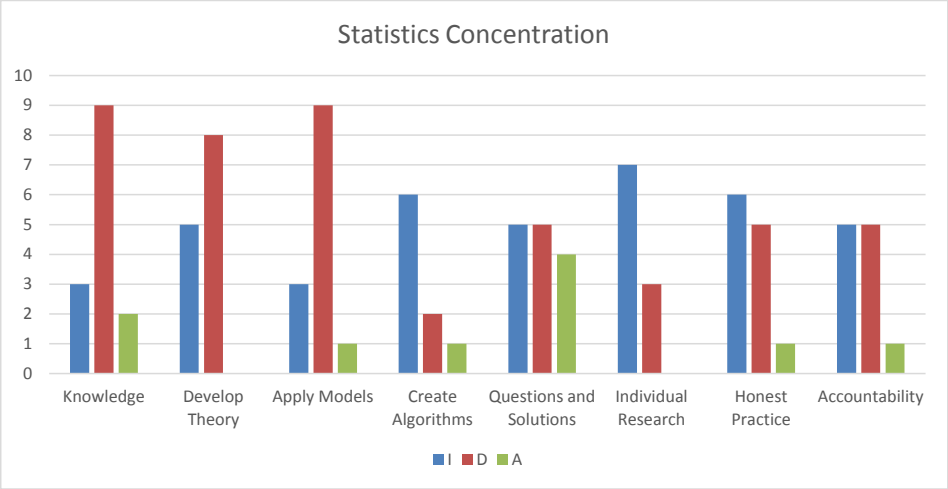

These examples convey some positive findings. Even at the basic level, all program outcomes are at least introduced and many others are developed. The computational algorithm outcome is slightly troublesome, since it is only targeted by Statistics 205 (and even then only nominally), which is not a program requirement. However, Computer Science 217/231 *is* a program requirement, and one that maps to this outcome far more readily.

After completing the required number of mathematics courses, the algebra and analysis concentration attained an advanced level for all program outcomes. The statistics concentration attained the developed level in all outcomes, and advanced in all but two.

For several of the outcomes, there appears to be large difference between the two students, particularly in the first three: knowledge, develop theory, and apply models. The latter is troubling, since statistics courses are typically more able to deliver on modelling themes, whereas more abstract mathematical courses often do not reference models at all. Instead of a glaring omission for one or more courses, there are some more plausible explanations for this:

1. Course outcomes for 300 and 400 level courses were created in small groups or (more often) individually.
2. Course outcome selection criterion was not uniform across all courses.
3. The precise statement of course outcomes and their mapping to program-level outcomes are susceptible to the perception of those producing the outcomes and responding to the survey.

Overall, however, both students target all program outcomes at various levels and typically across multiple choices, which is remarkable and perhaps surprising. There is no doubt that alternative course selections could be made where several of the outcomes are missed or underrepresented. In practice, most students fall roughly into the above two categories for course selections, however.

Summary and Analysis of Faculty Focus Groups

Two focus groups were held in July 2016 with all faculty members (including sessional /postdoctoral appointments) invited. Between both sessions, 11 faculty members attended.

Analysis and Recommendations

The discussion in these focus groups was open-ended and energetic. Both groups reached the consensus that in its current form, General Mathematics really is a "light" version of the new mathematics program. However, due to the size of the Werklund cohort in the program, the group felt that outright deletion of the program would be imprudent and alienating to a large group of important stakeholders.

The principal components of the discussion were:

1. The group was extremely emphatic that there is a reputation problem with the General Mathematics program. Their perceptions and anecdotal evidence suggested the view that General Mathematics is typically selected over other department offerings by weaker students, often wishing to avoid more challenging courses required in other programs. They felt this view was shared by students as well.
2. Better development of "soft" skills such as mathematical communication and exposition is essential. This would be typically done through a senior project or capstone course, like the ones

being developed for the new mathematics program. The groups felt that this course should not be interchangeable with the offerings in the new math program. Instead, it should allow a wide range of student submissions, beyond discipline knowledge. Examples of such a project might include mathematics history or mathematics education. The Department UPPC later met to expand this discussion. It became quickly apparent that resource considerations might severely dampen the department's ability to offer a project course to such a large group of students (which would ultimately include every single student registered in a department program). The principal alternative suggestion was to incorporate soft skill development into other courses, a practice previously used by the department.

3. The group endorsed the idea that students perusing combined degrees (or post degrees) with Werklund are the most important subset of students in this program. The department can do more to differentiate the program from new Mathematics by specifically targeting education students. New course offerings with interests broader than discipline knowledge (mathematical history, mathematical pedagogy and teaching, etc.) would be an appropriate way to achieved this. In the context of a project-based course, allowing students to select projects with educational themes would be prudent. Examples of this include projects based around primary and secondary mathematical learning.
4. Ensuring that proper advising of students in the general mathematics programs was specified as a priority. This program does not serve as a prerequisite for graduate studies in mathematics, and this needs to be made explicit to enrolled students as early as possible. For the majority of students, the new mathematics program will serve as better preparation for postgraduate mathematics (even outside of mathematics disciplines) and industrial mathematics. Consequently, this program should be recommended only to students wishing to teach mathematics at the primary or secondary level, or students wishing to add mathematics as a second major. The latter is particularly important for students from Schulich, Haskayne and Arts, where their own degree requirements and schedules may significantly reduce the practicality of having a second major.
5. The group felt that in the absence of altering the program in some substantial way, it pales in comparison to the new Mathematics program by any metric. It should be a priority of the department to explicitly differentiate General Mathematics from the new Mathematics program using the above suggestions.

Commented [CG2]: Given the new math program one option to be considered is whether you need the GMAT program for anything other than the concurrent degree students. You could change it so that it is only a BSc/BED path. No BSc alone path. If MATH is much more flexible now, it may be a better option for students and likely students would still be able to transfer back and forth between programs without very much difficulty. GMAT could then be modified to make it a much stronger program for teacher preparation. Just a thought.

Summary and Analysis of Faculty Data Review Sessions

Two sessions were held in December 2016 where all faculty (including sessional and postdoctoral appointments) were invited to comment on the various pieces of collected data. These meetings were also used as an additional opportunity to follow up on the focus groups held the previous summer (summaries of which were available to faculty for review). Excluding the program review leads, these sessions were only attended by 6 people in total. Nonetheless, there was significant discussion in several key areas.

Discussion on high impact and/or effective classroom practices: current and future.

From the faculty surveys, only 24% of courses in the General Mathematics field employed high impact practices. Faculty responses indicated there was a desire to implement (or continue to implement) the following practices:

- Term project/essay
- More independent learning activities
- Open discussions
- More software in lecture
- Group projects
- Encouraging students to struggle with the material on their own before resorting to help from peers or online resources.
- Introduce for-credit components in tutorials and labs.
- Proactive supervision of projects
- Invite guest speakers to lectures (internal faculty, external faculty, grade-school teachers, industrial representatives)
- Tophat

Comments on high impact practices by the discussion group:

- One participant advocated the use of student presentations in all higher level courses. This would alleviate a "soft skill gap" that can reveal itself through certain course progressions.
- One participant indicated a negative experience with student presentations, citing the work was low quality and low information.
- Several participants reveal concern over workload creep with student presentations (and other high impact practices). Consideration for APR was discussed.
- There was a brief discussion on tools for dealing with student accessibility with respect to presentations. The group agreed that for higher level mathematics courses, these situations would be rare enough to warrant ad hoc and equitable solutions agreed upon by both student and instructor.
- During the second meeting, a participant deemed that a project is not absolutely necessary to a general math degree. Benefits are spurious.
- One participant voice concern over how to ensure equitable treatment of harder working team members for group-based assessment. Another participant held the view that seemingly every other Faculty implements some level of group work, and there already exists resources to assist with these problems.
- The group held favourable views towards changes in lecture styles, but many courses are still content focused and "hard" by reputation. There is no net benefit to massive revisions to content focused courses.
- The group held a mixed view of group work for mathematics courses. It is more favourable for some types of courses, like those pertaining to mathematical methods used industrially, for example.
- A participant indicated that some topics lend themselves to independent study and student-based inquiry, but not all of them.
- The idea of introducing a capstone course for General Mathematics students was revisited (first introduced in the focus groups). The group felt that the entire emphasis of the course should be on soft skill development, and less discipline-driven. Reformulating the course to be less work for the instructor (perhaps no weekly meetings; one term instead of two; etc..) was essential due to the number of participants.

- An alternative suggestion to a capstone course was made: recognizing instructors for implementing soft-skills learning in higher level math courses.
- A participant suggested the creation of a 300 level course in mathematical communication as a degree requirement: written, oral and software presentation. The group held mixed views on this.
- Another participant countered the above point: soft skills would be developed through more open-ended and theme based assignments. These skills are much better taught in the context of a mathematical discipline and within a mathematics course.
- One participant definitively rejected the notions of a capstone course for General Mathematics.
- A participant proposed that the department regularly engage in some type of meeting/workshop/panel discussion on classroom practices. The effectiveness of the facilitator would be essential.
- The group held an extremely favourable view of reaching out to guest lectures for courses, particularly at the first year level where applications to the material can seem distant.
- One group member voiced displeasure of the use of some mathematical software. Their desire was to emphasize numerical software used in industry: MATLab, Python, R and Excel instead of symbolic programs like Maple and Mathematica.
- The group discussed evaluation methods in courses at various levels. It was determined that more variation in assessment for larger service courses was currently not practical given resource constraints. For senior level courses, the group was unanimous in support for more diverse evaluation methods.

Additional Comments:

- A group member voiced concern that the General Mathematics program is not a program, but rather just a collection of courses (often from unrelated fields).
- There was some concern over the bloated nature of many first year service courses. Particularly in the calculus streams, many of the courses have such packed syllabi, there is no room to explore the topics through applications. A suggestion was made to interface with stakeholder departments and faculties to see about reducing the syllabi and re-introducing more themed applications. The general themes of calculus courses is focused more on abstract and less so on real problems using calculus. A group member was skeptical about the utility of courses consisting of only "algebra tricks"
- A participant voiced concern over lack of student knowledge in higher level mathematics courses. An idea was presented to introduce the specific prerequisite skills required in the course in the syllabus, in addition to the usual list of prerequisite courses. This would allow students to target weakness in their backgrounds before it becomes a larger impediment.
- A group member pointed out that many instructors do not follow syllabi.

Findings

1. Students currently pursuing a Bachelor of Education, or wishing to pursue one in the future, make up a large percentage of the students enrolled in General Mathematics.
2. Despite having the flexibility to incorporate a second major, the majority of General Mathematics students do not pursue a second field of study. The program, in its current form, should be emphasized as multidisciplinary by nature. Additional advising of students entering this program is essential.
3. Students are generally extremely favorable to the breadth and flexibility of the program, but they express concern about the transferability of the skills they develop.
4. Faculty members express significant concern over the lack of depth and rigour in the program. There is a reputation concern with General Mathematics, especially from within the department.
5. Faculty members are concerned about the lack of any unifying elements in the program, whether it be a capstone course or a project requirement introduced somewhere else. Despite this, there is opposition to the introduction of such things into this well-enrolled program due to resource considerations and other impracticalities.
6. The General Mathematics program is significantly more flexible than other programs currently offered, but less so compared to the new Mathematics program. When the new program is introduced in Fall 2018, there may be attrition to General Mathematics, which would be perceived as an easier version of the new program.
7. Efforts may be required to more thoroughly differentiate the new Mathematics and General Mathematics programs. Student advising plays an important role here as well.
8. Faculty typically do not employ high impact practices in the classroom, nor do they intend to. The two most cited reasons for this are resource considerations and incompatibility with the course content. Increased collaboration with Faculty of Science teaching and learning resources and the Taylor Institute may work to alter this view.
9. Students often gravitate to General Mathematics because of positive experiences in first year service courses. While it is essential that the program recruit students from within the University of Calgary, it is important to note that the majority of the 200 level service courses do not adequately prepare the typical student for more advanced offerings within mathematics. The new Mathematics program addresses this with stricter core course requirements, but General Mathematics does not. Consequently, attrition rates in courses such as Math 335, Pure Math 315, Stat 321 and Math 311 may remain high for General Mathematics students going forward.

Action Plan

Recommendation	Action Item	Who is Responsible?	Due Date
Reach a departmental consensus on whether or not to continue offering a General Mathematics program.	• Examine the redundancy and overlap with the new Mathematics Program. • Monitor student enrolment in both programs. • Monitor course selection by students, particularly those in joint programs with Werklund and also Science double majors. • Ultimately determine if cancellation of the program is the appropriate action. • Alternatively, the department may consider restricting the General mathematics program to students pursuing a combined degree.	General Mathematics program leads; Department UPPC; Department Council; Department Executive; Department Head; Faculty of Science; Dean of Science	2017-2021
Address the lack of soft skills developed over the course of the program; the lack of a unified capstone experience; and the possibility of failing to address several program level outcomes.	• Implement some type of senior project or capstone experience, as resources permit. Alternatively, incorporate soft skill development into many senior offerings to ensure uniformity across the spectrum of course selection. • Address deficiencies and inconsistencies in course outcomes of higher level courses. Ensure that similar courses at a certain level target several outcomes similarly. • Slightly modify program requirements in order to ensure certain skills are developed. • Revisit and revise course outcomes regularly.	Department UPPC; Department Teaching and Learning; Department Executive; Taylor Institute for Teaching and Learning	2017-2021

Developing and encouraging interdisciplinary degrees, collaboration with other departments and faculties	• Continue to interface with Werklund School of Education to ensure that combined degree students are best prepared for a career in primary and secondary mathematics teaching. • Work closely with various advising groups to develop degree paths for students wishing to pursue double degrees in Commerce, Arts, Kinesiology and Engineering.	Department UPPC; Science Advisors; Faculty of Arts; Haskayne School of Business; Werklund School of Education; Schulich School of Engineering	2017-2021
Differentiating the General Mathematics Program from the new Mathematics Program	• Through a combination of course redesigns, program requirement adjustments and program outcome adjustments, ensure that the General Mathematics program is not simply an "easy" version of the new Mathematics program.	Department UPPC; Department Teaching and Learning; Department Executive; Department Council; Department Head	2017-2021

Conclusion

The General Mathematics program currently has a clearly defined roll amongst the other existing programs in the Department of Mathematics and Statistics. It is flexible enough to allow practical entries for students pursuing another major, and lends itself favorably to those wishing to teach mathematics at the primary or secondary school levels. Students generally seem satisfied with the courses offered by the program, and they enjoy the plethora of choice available to them. Faculty members are also generally satisfied with the program, though there are concerns over the mathematical rigour and sophistication offered, in addition to the lack of a capstone experience which will exist in other department programs moving forward.

However, given the implementation of a new program in Mathematics, much of the character of the General Mathematics program is also replicated in the new Mathematics program. These leads to four possibilities:

- General Mathematics is left in its current form.
- General Mathematics is left in its current form, but only allowed for students pursuing a second major.
- General Mathematics is removed, with the new Mathematics program subsuming all incoming students.
- General Mathematics is differentiated more substantially from the new Mathematics program.

The last two possibilities will significantly affect department operations. If the program is deleted, the enrolment in the new Mathematics program will more than double. This poses a significant resource issue, given that all new Mathematics students will be required to take a project-oriented capstone course. On the other hand, a higher enrolment in new Mathematics will greatly support senior course offerings, which typically have very low enrolment.

Commented [CG3]: There are only three things here…

References