| 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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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.

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

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

Analysis of Student Survey Data

- 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

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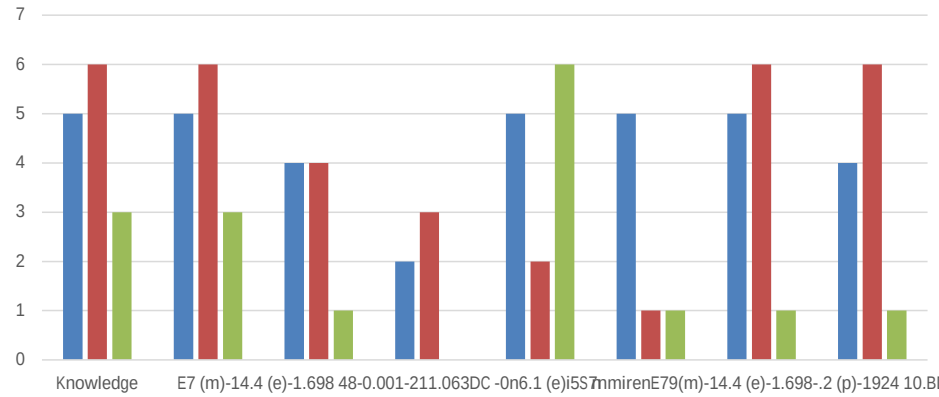
thus are not required by general mathematics students. It would be extremely easy for a general mathematics student to completely avoid these 27 courses.

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:

    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.

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.



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

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.
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- 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

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