

University of Maine System
Program Integration
Round Two

Mathematics

Below please find a summary of the key points derived by the UMS Chief Academic Officers from the report provided by the **Mathematics** program integration team. The team's full report follows the CAOs' summary and recommendation.

UMS Chief Academic Officers' **Summary and Recommendations**

Mathematics

Four of the seven University of Maine System campuses offer Bachelor degrees in mathematics (University of Maine, University of Southern Maine, University of Maine at Farmington, and University of Maine at Presque Isle), and all seven institutions offer a minor in mathematics. The University of Maine also offers a Master's degree in mathematics, and the University of Southern Maine offers a Master's degree in statistics. Each mathematics department in the system supports its respective university in the area of general education, and many contribute courses to other majors. The discipline thus plays an important role on each university campus.

The Mathematics Team held two face-to-face meetings and two online meetings between September and November 2015. They divided into four subgroups following the last face-to-face meeting, but follow-through was limited with only two of the subgroups reporting their outcomes and no follow-up meetings to discuss and compile findings. The final report was thus a partial assessment of the potential for program integration with modest recommendations to offer.

Although the Mathematics Program Integration Team proposed two interrelated ideas to improve quality -- to develop summer math workshops and coordinate a set of upper-level undergraduate courses that would rotate among the campuses -- the CAOs believe that, while interesting, those suggestions pose additional challenges and may not yield immediate results. We therefore encourage the Mathematics Team to focus their efforts on the discipline's role in general education and in course sequencing, and pursue their own recommendation to align learning outcomes. Toward that end, we recommend that the Mathematics Team reconvene in sufficient face-to-face meetings over the next several months to adequately address the following:

1. While acknowledging past difficulties, build on the work already underway to craft a set of common learning outcomes and develop common course numbering for College Algebra, Pre-Calculus, Calculus I, Calculus II, and Calculus III to facilitate transferability and online collaborations (by January 2017 for fall 2017 implementation);
2. Pending completion of item #1, begin a broader discussion of how best to serve underprepared students and develop a set of preliminary recommendations (by March 2017 for fall 2017 implementation);
3. Evaluate the potential for and usefulness of convening an annual meeting of all mathematics faculty in the University System.

Given the struggles with some of the subgroups identified in the initial report, the Team should also consider re-evaluating its membership in consultation with administrative leaders on each

campus. Consider who else might be included on the Team and how many meetings there should be.

Report of the University of Maine System Program Integration Mathematics Team

March 1, 2016

REPORT OF THE MATHEMATICS TEAM

Mathematics Team Membership

- Karen Kimball – CAO UMM
- Nicholas Koban (team leader) – UMF
- Paul Dexter – USM
- Robert Franzosa – UM
- Lester French – UMA
- Krishna Kaphle – UMFK
- Gail Lange – UMF
- Zhu-qi Lu – UMPI
- Deb Meehan – UC
- William Otto – UMM
- Cheng Peng – USM
- Nigel Pitt – UM
- Natasha Speer – UM
- Laurie Woodman – USM

Executive Summary

Four of the seven University of Maine System campuses offer Bachelor degrees in mathematics (University of Maine, University of Southern Maine, University of Maine Farmington, and University of Maine Presque Isle), and all seven campuses offer a minor in mathematics. Also, the University of Maine offers a Master's degree in mathematics, and the University of Southern Maine offers a Master's degree in statistics. Each mathematics department in the system offers service to the respective university in the area of general education, and thus, mathematics plays an important role on any university campus.

The mathematics team has two recommendations (which are explained in more detail in this report): a six-to-eight-week summer mathematics workshop located at one of the system campuses and to work toward a set of aligned learning objectives that describe all first-semester calculus courses offered by the University of Maine System campuses

Background

The mathematics team held the following meetings:

- The original meeting on 9/26/15 in Orono
- Online meetings on 10/20/15 and 10/23/15

- Meeting on 11/13/15 in Brewer

During the meeting in Brewer, we divided the team into four subgroups:

- A subgroup to discuss course outcomes and transferability
- A subgroup to discuss opportunities for professional development and summer experience for undergraduates
- A subgroup to discuss distance learning
- A subgroup to discuss students going back for graduate degrees in mathematics and mission differentiation within mathematics throughout the system

At this time, only two of these subgroups have reported their discussions and/or recommendations. Thus, the mathematics team does not have much to report.

Recommendations

To Improve Quality

The team had discussions centered on two interrelated ideas that could be merged to offer a quality experience for math majors throughout the system. The two ideas are a summer math workshops (modeled after Maine Writers Workshop) and summer course offerings of 300-400 level courses at a single campus (that could rotate location from year to year). These ideas are mutually supportive, and a combination of these ideas would be cost-efficient approach to a summer experience. Following that thinking lead to the idea of a six-to-eight-week summer mathematics workshop located at one of the system campuses which would contain an upper level mathematics course along with a research experience for undergraduates. This idea did raise a number of questions/concerns such as:

- Is there enough student interest to spend a majority of the summer at a different campus participating in one of these workshops?
- Is there enough faculty interest in leading (teaching the course or mentoring undergraduate research) one of these workshops?
- If there is some interest from the previous two questions, is it enough to justify an annual workshop? Or should the workshops only occur every two or three years?

After review these ideas and questions, the subgroup determined that summer workshops (or other collaborative meetings) are promising ideas for future consideration. In the medium-to-long term the success of such a program would depend on a critical mass of student and faculty interest, and sufficient funding either from UMS resources or grant funding for Research Experiences for Undergraduates, or similar programs. Perhaps smaller-scale initiatives to promote inter-campus contacts would be helpful in generating this critical mass. An example of such an initiative is funding for week-long visits by faculty from one campus to visit another campus in an effort to promote research contacts and research ideas for undergraduates. Such an initiative may be valuable to the smaller campuses in the University of Maine System.

To Improve Access and Enrollment

A subgroup on distance learning was formed, and at the time of the writing of this report, this subgroup has not reported any discussions or recommendations. As the mathematics team discussed this topic in our earlier meetings, we had the following observations or concerns:

- The preferred method of distance learning for mathematics seemed to be live streaming.
- How will local support be provided for any student taking a math class via live streaming or PolyCom? How will students be offered office hours, tutoring, etc for classes offered via this method?
- Is there a difficulty with registration timelines aligning?
- Is there an obstacle due to different placement testing throughout the system?
- How will the 3 credit vs 4 credit difference in certain courses be handled?

The mathematics team also believes there are many benefits to offering upper-level courses across campus

- The campuses that do not have a mathematics major may not offer the calculus sequence beyond calculus 1, but many of their students may need classes beyond calculus 1
- For the campuses that have math minor but not math major, there is a need for upper-level courses to fulfill the minor requirements
- The University of Maine and University of Southern Maine offer upper-level statistics courses that could be beneficial to other campuses. For example, as a benefit to the actuarial program at the University of Maine Farmington

To Improve Productivity and Financial Sustainability

A subgroup on the subject of students going back for graduate degrees in mathematics and mission differentiation within mathematics throughout the system was formed, and at the time of the writing of this report, this subgroup has not reported any discussions or recommendations.

In addition to the above, the mathematics team was charged with developing a set of recommendations for steps to achieve the following goals.

To Improve Alignment of Learning Outcomes and of Course Name and Numbering

Questions guiding our work

Is there a set of learning objectives that describe all first-semester calculus courses currently offered on University of Maine campuses? If so, what are they? If not, what steps might be taken to determine the feasibility of creating a uniform set of course learning objectives?

What we did

We worked from a set of calculus learning objectives that have been recently generated by Educational Testing Services (ETS) to reflect current views of what should be addressed in calculus. We used this as a reference because the current president of the Mathematical Association of America recommended it as a good starting point and the lack of other available objectives lists.

We created a spreadsheet that included each objective. We chose to work with the “topic-level” description of objectives found in the ETS document. The document includes more general objectives (corresponding roughly to chapters of a textbook) and more specific objectives (sample assessment items). The objectives we worked with correspond roughly to chapter sub-sections. The ETS list also includes some topics that are typically included as part of a second semester calculus course.

Representatives from all campuses indicated whether each objective was something that was addressed (required) or optional in their campus’ calculus curriculum and whether it was part of their first or second semester calculus course.

What we learned

There is a great deal of consistency among the campuses in terms of what is addressed in our first semester calculus courses. There are, however, some topics taught in first semester calculus on some campuses that are taught in second semester calculus on other campuses. These topics are related to integration and applications of the definite integral and well as differential equations. There is quite a bit of agreement that a particular sub-set of the topics are part of a second semester course.

We surveyed the representatives from the campuses and asked whether it would be feasible for their campus to teach first semester calculus based on just the sub-set of objectives that were common among all the campuses.

At this time, that is not feasible for all campuses. This is largely because of the implications such a decision would have for the second semester calculus courses and programs requiring only first semester calculus. Those campuses would need to discuss what the implications of these changes would be for the objectives for the second semester calculus curriculum (at a minimum, second semester calculus instructors would need to adjust the content in their courses and this might also mean that other topics would need to be removed to make spaces). In addition, there might be implication for students in the majors/programs that currently require only first semester calculus (e.g., courses in those programs may have been designed with the expectation that these particular integration topics have been addressed in first semester calculus).

Possible next steps

There are many reasons why it might be valuable for students and faculty for there to be consistent learning objectives among the campuses. There are also a range of ways that this

might be accomplished in the future but because these kinds of changes will require adjustments on some campuses that need to be discussed and agreed to by faculty, further work is needed before we can reach consensus on the set of learning objectives.

