Detailed Assessment Report
As of: 10/05/2012 09:41 AM EST
2011-2012 Mathematics MS

Mission / Purpose

The primary mission of the graduate mathematics program is to • Develop mathematical thinking and communication skills • Communicate the breadth and interconnections of the mathematical sciences • Require study in depth • Prepare students for teaching careers in the secondary school and community college setting, for employment outside academia, or for further graduate study. • Provide students with the necessary background in applied and computational mathematics for the department's computational sciences doctoral program.

Student Learning Outcomes/Objectives, with Any Associations and Related Measures, Targets, Findings, and Action Plans

SLO 1:Ability to work with research level topics in mathematics

Students will have the ability to work with relevant specific research topics in their field of emphasis in mathematics.

Related Measures:

M 1:Prospectus presentation

The prospectus presentation provides the graduate candidate the opportunity to present their proposed thesis work, fully outlining the goals and objectives of the study. As such, it constitutes a formal research proposal to the student's Graduate Committee, and thus constitutes the first formal measure of the student's progress toward mastery of working with a research topic in a specialized field of study. The student's Graduate Committee is charged with determining whether the student: 1) is ready for the proposed study based on the student's colloquium presentation of the Prospectus, and based on oral questioning of the student in regard to the proposed work, as well as background questioning in the student's area of mathematical specialization.

Source of Evidence: Presentation, either individual or group

Target:
90% of all full-time students doing a thesis will have completed the Prospectus presentation by the end of the third semester.

Findings (2011-2012) - Target: Met
100% (4 out of 4) of all full-time students doing a thesis completed a prospectus presentation by the end of the third semester.

M 2:Thesis defense

The defense of the thesis is the culmination of the student's work with the research topic, and presents an opportunity to fully examine the student's ability to be able to examine and develop research quality issues associated with the topic. The student's Graduate Committee provides this assessment based on the review of the dissertation, the students oral summary presentation of the material, and a line of questioning of the student constituting an oral exam which is designed to determine the merits of the student's research.

Source of Evidence: Presentation, either individual or group

Target:
90% of students complete and have their theses approved.

Findings (2011-2012) - Target: Met
Of the three students who exited the MS program during the 2011-12 cycle, three (100%) graduated with their theses approved.

M 3:Publication
The importance of being engaged in ongoing research, and the ability to participate in this is measured through the student's ability to produce technical papers which outline progress toward a more substantive refereed publication. Thus, student publication in non-refereed venues, e.g., proceedings articles, transactions articles, etc., provide a direct measure of student involvement and progress in research.

Source of Evidence: Academic direct measure of learning - other

Target:
50% of students will achieve some measure of publication success, as a student article, or as an unrefereed publication, within one year after having graduated from the program.

Findings (2011-2012) - Target: Not Reported This Cycle
The updated target will be implemented beginning with the Fall 2012 cohort.

Related Action Plans (by Established cycle, then alpha):
For full information, see the *Details of Action Plans* section of this report.

Encouragement to publish work
Established in Cycle: 2010-2011
Beginning in Fall 2011, new MS students will be encouraged to work toward publication of their research beginning at orientation...

SLO 2:Ability to teach effectively
Students will have the ability to teach effectively.

Related Measures:

M 4:Student satisfaction with teaching
Students will have the ability to teach effectively so as to be prepared for teaching roles at the Community College, College, or entry level at a University as instructors.

Source of Evidence: Student course evaluations on learning gains made

Target:
Classroom teaching student evaluations will be commensurate with the Department of Mathematics mean (1-5 scale, with 5 being the highest score). The overall results on these student evaluations for experienced faculty in the Department is a score of 3.0 or higher, thus a measure of 50% of the PhD Graduate Teaching Assistants (GTAs) earning an average student evaluation score of 3.0, or higher is required.

Findings (2011-2012) - Target: Met
Of the five GTAs in the MS program who taught courses during the 2011-12 cycle, four (80%) earned an average score of above 3.0 (3.50, 3.87, 4.02, 4.55) on their student evaluations, averaged across all courses that they taught.

M 5:Faculty observation of teaching
Students who are GTAs are required to have one semester of MAT-500. This class is designed to prepare students for teaching, and involves several opportunities for observational assessment of teaching to a lesson plan. Save

Source of Evidence: Presentation, either individual or group

Target:
100% of GTAs will receive a faculty assessment of 3 out of 5 on their faculty teaching evaluations in MAT-500. 50% will achieve a rating of 4 out of 5 or higher. The rating scale is 1 to 5 with the highest score being a 5. The scores measures a composite assessing the students presentation skills, ability to cover the material in a timely well paced fashion, and the ability to interact well with student questions.

Findings (2011-2012) - Target: Not Reported This Cycle
No MS students took MAT 500 during Spring 2012.

M 6:Diversified teaching experience

Masters students must have a diversified teaching experience covering a range of introductory undergraduate courses. This diversity contributed to their capacity to teach various types of students as well as providing a broader measure of their teaching abilities for those interested in careers in academia. This diversity is measured by the number of different teaching preparations a graduate teaching assistant has in each year, and overall while completing thier degree requirements. Each student is provided one point for each new preparation.

Source of Evidence: Academic direct measure of learning - other

Target:
50% of Graduate Teaching Assistants teach at least two different classes in their second year, i.e., achieve at least two points in teaching diversity each year (this excludes those on Research Assistantships).

Findings (2011-2012) - Target: Met
Of the four graduate teaching assistants who were qualified to teach during the entire 2011-12 cycle, all four (100%) taught two different courses during the cycle.

SLO 3:Mastery of mathematics

Students will have mastery of foundational topics in mathematics at the graduate in analysis, algebra, and linear algebra.

Related Measures:

M 7:Mathematics Comprehensive Exam

The Mathematics Comprehensive Exam is designed to assess student attainment in having developed a mastery of fundamental concepts in mathematics, e.g., in analysis and algebra, which are needed for further specialization and study in mathematics.

Source of Evidence: Comprehensive/end-of-program subject matter exam

Target:
80% of students pass the Comprehensive Exam on their first try, 90% pass on the second attempt.

Findings (2011-2012) - Target: Not Reported This Cycle
No students attempted the comprehensive exam during the 2011-12 cycle.

M 8:National standardized comparison

Students will take the ETS Major Field Test in Mathematics in their final semester of graduate study to provide a national basis for assessing student performance in key specialization areas in mathematics.

Source of Evidence: Standardized test of subject matter knowledge

Target:
70% of students score above the national mean score for Seniors taking the exam.

> **Findings (2011-2012) - Target: <u>Not Reported This Cycle</u>**
> No graduate students took the ETS major field test during this cycle.

M 9:Students continuing on to a PhD

While the purpose of the MS degree is not solely to enable students to go on to further study in mathematics by seeking the PhD degree, the number of students who do so at research intensive institutions is a measure of the quality of the students who graduate with an MS from the program.

Source of Evidence: Academic indirect indicator of learning - other

> **Target:**
> 50% of students will go on to seek a PhD at a research intensive university.

> **Findings (2011-2012) - Target: <u>Not Met</u>**
> Of the three students who graduated during the 2011-12 cycle, none (0%) went on to a PhD program.

> > **Related Action Plans (by Established cycle, then alpha):**
> > For full information, see the *Details of Action Plans* section of this report.

> > **Feeding the doctoral program**
> > *Established in Cycle:* 2011-2012
> > During the 2011-12 cycle, the MS students that graduated all completed theses, but were primarily interested in teaching at the ...

SLO 4:Oral and written skills in a professional setting

Students will have effective oral and written communication skills.

Related Measures:

M 10:Professional publication skills

Students will show competence at writing professional mathematics, suitable for publication.

Source of Evidence: Senior thesis or culminating major project

> **Target:**
> 70% of all students will have an accepted thesis, or published work.

> **Findings (2011-2012) - Target: <u>Met</u>**
> Of the three students who graduated from the program during the 2011-12 cycle, three (100%) had an accepted thesis.

M 11:Seminars and colloquia

Students will have given at least one seminar during the term of study for the MS degree.

Source of Evidence: Presentation, either individual or group

> **Target:**
> 70% of students achieve a satisfactory or higher evaluation on at least one seminar during their term of study for the MS degree. The seminars are evaluated by a committee of three faculty and are rated from 1 to 5 (highest). A satisfactory score constitutes a 3.5 average out of 5 points.

Of the three students who graduated during the 2011-12 cycle, three (100%) earned a satisfactory score on a seminar presentation (their thesis defense).

SLO 5:Ability to work with mathematical technology

Students will learn how to effectively utilize technology appropriate to the discipline, including but not limited to software for writing mathematical articles such as LaTeX, and software for performing numerical or symbolic computation such as MATLAB, Maple, and Mathematica.

Related Measures:

M 12:Software Utilization for Mathematical Writing

With the aid of their faculty advisers, students will master the techniques and tools required for professional presentation and publication in mathematics, including using LaTeX, generating figures, plots and data for use in various journal formats.

Source of Evidence: Senior thesis or culminating major project

Target:
100% of students will be able to utilize LaTeX to write their thesis or a professional article as demonstrated by student's utilizing the Department's Dissertation and publication package, or by having an article accepted for publication done in LaTeX.

Findings (2011-2012) - Target: <u>Met</u>
Of the three students who graduated from the MS program during the 2011-12 cycle, three (100%) used LaTeX and the department's dissertation package to prepare their theses.

M 13:Software Utilization for Mathematical Presentation

Students will master software tools, such as LaTeX's beamer package or Powerpoint, required for professional presentation of research in mathematics.

Source of Evidence: Presentation, either individual or group

Target:
100% of students will be able to utilize LaTeX beamer, Powerpoint, or similar software to create their prospectus presentation and thesis defense presentation.

Findings (2011-2012) - Target: <u>Met</u>
Of the three students who graduated from the MS program during the 2011-12 cycle, three (100%) successfully created their prospectus and defense presentations using appropriate software.

M 14:Software Utilization for Computation

Students participating in research in applied or computational mathematics demonstrate proficiency in the use of software used for numerical or symbolic computation, such as MATLAB, Octave, Maple, Mathematica, Sage, and other similar packages.

Source of Evidence: Senior thesis or culminating major project

Target:
80% of students will demonstrate proficiency in mathematically-oriented software, including, but not limited to, tools such as MATLAB, Mathematica, and Maple, through code that implements problem-solving techniques that are appropriate to the research for their thesis, except when the subject matter is deemed by the student's faculty adviser to be entirely theoretical. Such code must either be included in the thesis, or separately made available to the student's comprehensive exam

committee for examination. A figure of merit, on a scale of 1 to 5 (highest), will be assigned based on correctness, efficiency and robustness of the code. A score of 4 or 5 will be considered proficient.

Findings (2011-2012) - Target: Not Reported This Cycle
This rubric will be introduced in comprehensive exams to be administered beginning in Spring 2013, which will be the first exams given to students entering the MS program in Fall 2011. Incoming MS students are being advised of the grading criteria as of Fall 2011 orientation.

Details of Action Plans for This Cycle (by Established cycle, then alpha)

Encouragement to publish work
Beginning in Fall 2011, new MS students will be encouraged to work toward publication of their research beginning at orientation, and graduate faculty will be advised of this achievement target. The intent is that their (required) thesis serve as the basis for publications, whether refereed or non-refereed. The emphasis on the importance of publication will be reaffirmed at the presentation of each student's prospectus. Added in 2011-12 cycle: Experience from the 2011-12 cycle showed that due to the intense pressure of deadlines while completing the MS thesis, and the fact that such projects are short-term anyway, it is unrealistic to expect that a student will also produce a publication based on the thesis *before* graduation, but once the thesis is completed, especially if the student may continue on to a PhD program, it is important and reasonable to convert the thesis into a viable publication within one year *after* graduation. This priority will be imparted to all new MS students during the Fall 2012 orientation and annually to all faculty advisers of MS students.

Established in Cycle: 2010-2011
Implementation Status: In-Progress
Priority: High

Relationships (Measure | Outcome/Objective):
   Measure: Publication | **Outcome/Objective:** Ability to work with research level topics in mathematics

Implementation Description: See description.
Responsible Person/Group: Graduate director (James Lambers), members of the graduate faculty
Additional Resources Requested: N/A
Budget Amount Requested: $0.00 (no request)

Feeding the doctoral program
During the 2011-12 cycle, the MS students that graduated all completed theses, but were primarily interested in teaching at the community college level after graduation. As recent recruiting efforts have increased the size of our applicant pool and allowed greater selectivity, we can exploit that by using applications to determine the future interests of our applicants and admit a cohort that is balanced between students that are inclined to pursue a PhD and those who are not. During their time in the program, it is also important that faculty advisers discuss a variety of possible career paths and include discussion of the option of joining the PhD program so that they can make an informed decision. Students who show promise in research should especially be so informed to maximize their earning potential and quality of work post-graduation.

Established in Cycle: 2011-2012
Implementation Status: Planned
Priority: High

Relationships (Measure | Outcome/Objective):
   Measure: Students continuing on to a PhD | **Outcome/Objective:** Mastery of mathematics

Implementation Description: The graduate admissions committee will make it a priority to screen applicants' statements of purpose to ascertain career objectives to include as an admission criterion. Graduate faculty will be advised and regularly reminded to include the PhD program as a viable option when discussing post-graduation plans for their MS advisees.
Responsible Person/Group: Graduate director (James Lambers), graduate admissions committee (James

Lambers, C.S. Chen and Jiu Ding), members of the graduate faculty
Additional Resources Requested: N/A

Analysis Questions and Analysis Answers

What specifically did your assessments show regarding proven strengths or progress you made on outcomes/objectives?

Proven strengths shown by our assessments include: 1. Effectiveness at teacher training. In spite of their lack of experience, Graduate Teaching Assistants consistently earned ratings from student evaluations that are comparable to average ratings earned by faculty. 2. Training in mathematical software. Students completed the MS program with the knowledge of software needed to create mathematical articles and presentations. 3. Creating a stimulating research environment. To date we have offered our MS students a thesis option and non-thesis option, but recently students have almost unanimously chosen the thesis option, and furthermore, a majority have opted to either continue with the pursuit of a PhD, or at least consider continuing.

What specifically did your assessments show regarding any outcomes/objectives that will require continued attention?

One objective that will require continued attention is that students do more to get their research published. This needs to be made a higher priority, as our MS program is also a doctoral feeder program. As such, it is important for their preparation to learn about what is needed to successfully produce work that is suitable for publication while they are in the MS program. Considering that they are producing quality research and learning the software tools they need, the foundation is established for such dissemination of their work, so what remains is to encourage them to follow through and use their background to produce not only a successful thesis but a successful journal publication. Success in this endeavor will require a greater degree of engagement by the graduate faculty who serve as thesis advisers, not only through the completion of the thesis but also after the thesis to ensure the work is submitted for publication. It is also important at the opposite end of the pipeline, the admissions process, to ensure that each year we admit a cohort that includes a balance between students who are research-minded and those whose interests are focused elsewhere, such as teaching.

Annual Report Section Responses

Program Summary

The Department of Mathematics has traditionally run an MS program with about six students in the program at any one time. The introduction of the Computational Sciences PhD with and emphasis in Mathematics offered through the College of Science and Technology, but administered through the Department of Mathematics for doctoral students pursuing the PhD in Applied and Computational Mathematics has posed growing pains, and has introduced complexities into the administration and oversight of the graduate programs managed by the Department. While this year we now have 12 graduate assistantships to offer, and will have 17 for 2012-13 with 3 externally supported GTAs, these are split between the MS and the PhD programs. Since the MS program is also a feeder for the PhD, the MS program has proven effective at increasing the number of PhD candidates who are presently enrolled in our program; however, this comes at the expense of being able to bring on enough MS candidates for the next cycle (an MS student completes the degree in 2 years, while the PhD is of indeterminate length, although the objective is to have the student finish in about three years after the MS degree). In addition we have had only limited success at getting our PhD students onto externally funded grants. Taken together, the growth of the PhD program (5 new candidates entering in Fall 2011 and 2 more in Fall 2012, in addition to 4 current candidates) comes at the expense of the MS program. As only 2 PhD students will be graduating in 2012-13, we will not be able to admit the desired number of MS students without an increase in our allocation of assistantships. In the long run it will be important to maintain a balance between the number of MS and PhD students in the program that accounts for the difference in completion times. Overall, the level of scholarship and achievement has improved in the program, as measured by the number of students involved in research, with a growing number of MS students wanting to do a masters thesis and successfully completing the thesis, and desiring to continue on to the PhD program.

Continuous Improvement Initiatives

Overall, the level of scholarship and achievement has improved in the program, as measured by the number of students involved in research, with a growing number of MS students wanting to do a masters thesis, as well as wanting to continue further in their careers in mathematics by going on to do a PhD. We have serious issues with critical mass, i.e., the number of students in involved in the MS program as a result of the limited number of assistantships and graduate tuition waivers. This problem is exacerbated by the fact that the MS and PhD program share these assistantship resources. It is obvious that we need to develop external funding sources for the PhD program to allow more of our graduate assistantships to be allocated to the MS program. We have had one or two PhD students fully funded by external grants or awards, however this clearly not enough. Beginning in 2012-13 we are reallocating funds used to pay adjuncts to fund stipends for some additional MS students, which is allowing us to increase our total number of GTAs (in both MS and PhD) from 12 to 17. With the inclusion of 3 externally supported MS GTAs, our MS program is experiencing the same substantial growth, doubling from 5 to 10 between 2011-12 and 2012-13. The MS program along with the PhD is being reviewed to streamline and improve the curriculum. The initial review process was begun in June, 2011, and it is expected to take about one more year to get any proposed curriculum changes through faculty review, College review, and review by Graduate Council at the University level. The improvements are needed to: 1) improve coordination between the MS and PhD programs, 2) strengthen the curriculum of the students doing the MS degree, and 3) improve the research orientation of the program. Specifically, we propose to introduce a Comprehensive Exam for all MS students based on a common core in analysis and algebra. The majority of our MS students are choosing to write a thesis, and with the recent substantial growth in the program, a higher level of engagement on the part of the entire graduate faculty will be required, as all of these students will need advisers. This is tenable since we have hired 7 new tenure-line faculty in the past 6 years, providing us a large base of faculty willing to work with graduate students on the MS thesis. As part of this effort to make the program more research-oriented, students will also be strongly encouraged to work with their advisers to publish the results of their research.

Closing the Loop

The Outcomes, Measures and Attainment Targets designed during the previous cycle, that are based on direct measures of student performance in areas that measure teaching and research effectiveness, have made it possible for us to focus our improvement efforts where they are truly needed. Our MS students have demonstrated that they are effective teachers who graduate with a varied teaching background, and they have also proven to be capable of research output and effective at the utilization of technology, but more needs to be done in the area of dissemination of research through conferences and publications, not only to improve the research productivity of the program but also so that the MS program can fulfill one of its essential roles as a feeder to the PhD program in Computational Science. The additional programmatic changes being considered for the MS program also reflect an awareness by the faculty of the need to align and streamline the program to so that its overall productivity is increased. The next few cycles will reveal to us whether our focus on these areas has the effect of addressing them.