Applied Mathematics Degree Program 2008/09

Introduction

The Applied Mathematics Degree was approved by the Oregon University System in the spring of 2006, and the program was implemented beginning in the fall of that year. We have had problems identifying our students because some of them are dual majors and do not need to declare themselves as an Applied Math major or have a math advisor (until two terms before graduating). We had our first graduate in the Spring of 2008 and we anticipate having six more students graduating with the degree during the 2008/2009 academic year. The degree is too new at this point to be able to offer additional information on retention rates, numbers of graduates or employment rates and salaries.

Mission

Graduates with the Applied Mathematics Degree will have knowledge and appreciation of the breadth and depth of mathematics, including the connections between different areas of mathematics, and between mathematics and other disciplines. They will be prepared for immediate participation in the workforce, or for graduate study.

Educational Objectives

Graduates of the Applied Mathematics Program will be able to do the following:

1. Apply mathematics and technology tools to solve problems.
2. Understand the use of mathematical tools and concepts in other fields.
3. Communicate, and work, with people of diverse backgrounds in individual and group settings, in an ethical and professional manner.
4. Adapt to advances in knowledge and technology in the workplace.

Expected Student Learning Outcomes

Upon graduation, students will be able to

1. apply mathematical concepts and principles to perform computations
2. apply mathematics to solve problems
3. create, use and analyze graphical representations of mathematical relationships
4. communicate mathematical knowledge and understanding
5. apply technology tools to solve problems
6. perform abstract mathematical reasoning
7. learn independently

Other Learning Opportunities

In addition to coursework, students can participate in the department's colloquium series, attend regional mathematics conferences and/or compete in the national COMAP competition.

Data Collection/Assessment Schedule

The following table indicates the three year cycle (note that the fourth year is included to show where the cycle begins repeating) for assessing the learning outcomes.

	Academic Year Assessed		
Learning Outcomes	**'08-9**	**'09-10**	**'10-11**
1. Apply mathematical concepts and principles to perform symbolic computations.			**X**
2. Apply mathematics to solve problems.		**X**	
3. Create, use and analyze graphical representations of mathematical relationships.	**X**		
4. Communicate mathematical knowledge and understanding.	**X**		
5. Apply technology tools to solve problems.		**X**	
6. Perform abstract mathematical reasoning.			**X**
7. Learn independently.	**X**		

2008-09 Assessment Activities

Two assessment activities were conducted during this academic year. Outcome four, *communicate mathematical knowledge and understanding* was assessed in Math 255, Multi-variable and Vector Calculus II and Math 422, Applied Partial Differential Equations II, and a general assessment of all majors in all outcomes was performed.

Outcome 4: *Communicate mathematical knowledge and understanding*

Both written and oral communication were assessed in Math 255. Students were instructed to research a problem which used either Green's Theorem, the Divergence Theorem, or Stokes theorem in its solution. The problem typically came from a field other than mathematics. They had to prepare a brief (3-5 page) technical report which included an introduction to the problem, computational techniques to solve the problem, and appropriate conclusions. Students were encouraged to use LaTex to write their report, and each visited with the instructor before selecting their topic. Each student was given 20-30minutes for an in-class presentation of their paper, at the board.

For their paper, each of the students enrolled received a score of very poor, complete or very good in the following four criteria:

1. Describe the problem.
2. Explain solution techniques.
3. Compute and interpret results.
4. Quantitatively evaluate and compare performance of methods.

The results *for only the math majors* are given in the following table. Percents indicate the percentages of students performing at the given level for each criterion.

	Student Performance		
Criterion	Very poor	Complete	Very good
Describe problems	0%	0%	100%
Solution techniques	0%	50%	50%
Compute/interpret results	40%	25%	75%
Evaluate/compare performance	0%	0%	100%

For the in-class presentation of their reports, each student's performance was determined in each of four criteria:

1. Content.
2. Answering questions.
3. Computing and interpreting results.
4. Evaluating and comparing performance.

The following results were obtained:

	Student Performance		
Criterion	Very poor	Complete	Very good
Content	0%	25%	75%
Answering questions	0%	25%	75%
Compute/interpret results	0%	0%	100%
Evaluate/compare performance	0%	25%	75%

Both written and oral communication were also assessed in Math 422. For written communication, students prepared a written report on the analytical solutions and graphical representations of exact solutions to partial differential equations. These projects were required to be in the form of a technical report that includes a description of the problems of interest, a discussion of the proposed solution methods as well as the solution itself, computations (generally via Matlab), and analysis and interpretation of computational and graphical results.

Each of the five students enrolled received a score of very poor, complete or very good in the following four criteria:

1. Describe problems of interest.
2. Explain proposed solution techniques.
3. Compute and interpret numerical results.
4. Quantitatively evaluate and compare performance of methods.

The results are given in the following table. Percents indicate the percentages of students performing at the given level for each criterion.

	Student Performance		
Criterion	Very poor	Complete	Very good
Describe problems	0%	60%	40%
Solution techniques	0%	40%	60%
Compute/interpret results	40%	20%	40%
Evaluate/compare performance	0%	80%	20%

Students also gave in-class presentations where they were expected to lecture on new material that the class needed to cover, or present a detailed solution of a problem that the entire class had been working on.

Their performance was determined in each of four criteria:

1. Content at the board.
2. Ability to field questions
3. Use of board space, readability
4. Voice projection

The following results were obtained:

	Student Performance		
Criterion	Very poor	Complete	Very good
Content	0%	0%	100%
Answering questions	0%	20%	80%
Compute/interpret results	0%	50%	50%
Evaluate/compare performance	0%	50%	50%

General Assessment

Our program has a small number of students, allowing examination of each one individually. A meeting of faculty who teach major courses was held, and the performance of each student was discussed, for all seven program learning outcomes. Although this method potentially lacks the objectivity of criterion-based assessment, it also is more robust in the sense that student performance has been observed for a longer period than a simple "snapshot" in time, and by more people. The results are compiled in the following table. The individual students are identified by the letters A through H, and the numbers in the cells indicate proficiency according to the following scale: 4 = outstanding, 3 = acceptable, 2 = poor, 1 = unacceptable, - no information.

Seniors 2008-09

Learning Outcome	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
1. Computation	3	3	4	3	4	2	4	3
2. Solve Problems	3	3	4	2	4	2	4	3
3. Graphing	4	3	3	3	4	3	4	3
4. Communication	3	3	3	3	4	3	4	3
5. Technology	4	3	4	2	4	2	4	3
6. Abstract Reasoning	3	3	2	2	4	2	-	3
7. Learn Independently	4	3	3	2	4	3	4	4

Analysis of Assessment Results

Before going into a more detailed discussion, it should be noted that the size of our "cohort" is very small, and observations may or may not indicate true strengths or weaknesses in the program.

Communication of Mathematical Knowledge and Understanding

In Math 422 some possible weakness was observed in the area of computing and interpreting results. Unfortunately those two skills were lumped together into one criterion, leaving some uncertainty as to whether students' weaknesses were in computation, in interpretation, or in both.

There is some concern that the grading criteria used in Math 422 might have been such that students were not sufficiently motivated to give their best effort at this assignment. This may have led to the poorer performance in the areas of computation and interpretation.

Also of concern is the fact that one or two of the students enrolled in 422 were carrying a load of three 400 level math courses in the term that assessment took place, and that may have influenced their performance. It is uncertain as to whether this problem is a result of the newness of the program; some students have decided to get an Applied Math Degree at a late time in their OIT careers, resulting in the need or desire to take a heavy load of

challenging math courses all at the same time. It is possible that this problem won't occur when the program is more established.

General Assessment

Our conclusion is that about 75% of the seniors have performed satisfactorily in all areas. The performance of the remaining 25% are not entirely satisfactory, however, these students did perform well in some areas and well enough in all areas to complete the degree. The relatively low scores relating to the abstract reasoning outcome are due to the fact that when compared to the other outcomes, abstract reasoning is not emphasized as much in the program.

Student Learning Improvement Plan

Several actions were identified in a discussion amongst faculty involved in the Applied Mathematics Degree Program.

- Future criteria need to be more carefully considered before implementing, in order to design criteria that can pinpoint strengths and weaknesses better.
- Assessment activities should be integrated into course activities in such a way as to ensure that students put adequate effort into the activities.
- Student loads should be monitored to see if overloading with senior level courses continues to be a problem.

The Math Major Committee is responsible for carrying out these actions.