Applied Mathematics Degree Program Assessment Report 2012/13

I. 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. The program graduated its first student in the Spring of 2008, six more students graduated in 2008/2009, an additional student graduated during the 2009/2010 year, five students graduated during (2010/2011), and four graduated during the year (2011/2012). There are six students that should graduate this year (2012/2013). 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.

II. Mission, Program Educational Objectives, and Expected Student Learning Outcomes

The program faculty reviewed the mission, objectives, and student learning outcomes for the program in Fall 2012 and made no changes.

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 prepared to do the following in the first few years after graduation.

1) Apply critical thinking and communication skills to solve applied problems.
2) Use knowledge and skills necessary for immediate employment or acceptance into a graduate program.
3) Maintain a core of mathematical and technical knowledge that is adaptable to changing technologies and provides a solid foundation for future learning.

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.

III. Data Collection/Assessment Schedule

Table 1 indicates the three year cycle for assessing the learning outcomes.

	Academic Year Assessed		
Learning Outcomes	**'11-12**	**'12-13**	**'13-14**
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**		

Table 1. Three-year cycle for assessment of Applied Math learning outcomes.

IV. 2012-13 Assessment Activities

Assessment of two learning outcomes was conducted during this academic year.

Outcome 2: *Apply mathematics to solve problems* was assessed in math 354, in winter 2013. There are three performance criteria for this PSLO.

a) Write a mathematical description of a physical problem.
b) Correctly solve the higher dimensional integral.
c) Interpret results.

These criteria were measured by exams and the results *for only the math majors* are given in Table 2. Percents indicate the percentages of students performing at the given level for each criterion.

There were 14 math majors enrolled in Math 354 this term. They were each given the same problem which had three parts. In the first part they were given a solid shape and asked to set up and evaluate an integral over that shape, describing the shape mathematically along the way. In the second part they were asked to calculate the flux of a vector field through the bottom of the shape. In the third part they had to understand how to use their answers to the first two parts and Gauss' Theorem to find the flux out of the shape.

For the first criterion the instructor checked whether the student set up the integral in the first part correctly. For the second criterion the instructor checked to see if they had actually calculated the first and second parts correctly. For the third criterion the instructor checked to see if they understood that Gauss' Theorem applied, and what roles the first two answers played in the calculation.

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
Mathematical description	29%	14%	57%
Correct Solution	14%	29%	57%
Interpretation	36%	29%	36%

Table 2. Assessment results for Outcome 2.

Given that this was quite a difficult problem in an advanced class, the results for the first two parts were reasonable. The outcome for the third criterion was somewhat disappointing even though synthesis and interpretation are predictably the most difficult concepts in a mathematics class. It's also possible that these sorts of ideas were not covered as closely earlier in the class because earlier exams were in-class and thus, given the length of typical problems, were more computation based. This is as opposed to the final which was a three hour, open-book exam. Faculty should look at this third criterion more closely in the future.

Outcome 5: *Apply technology tools to solve problems* was assessed in Math 422, Applied Partial Differential Equations II, in Winter 2013. There are four performance criteria for this PSLO.

a) Write appropriate code.
b) Provide proper documentation of code.
c) Presentation and output of results.
d) Validity of solutions via comparison or other means.

These criteria were measured by several assignments that used the MATLAB software. The results are given in Table 3. Percents indicate the percentages of students performing at the given level for each criterion. There were five math majors in the course.

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
Write code		20%	80%
Document code		40%	60%
Presentation		40%	60%
Solution validity		20%	80%

Table 3 Assessment results for Outcome 5.

Based on this data it seems that our students are pretty good at figuring out code writing. Although it does not seem that they are as strong in their presentation and documentation as we would like them to be. Some presentation issues were a consequence of students not following the directions provided with the assignment(s).

Additional Assessment: Ethics and Professionalism ISLO

As an additional assessment, the math faculty participated in the institutional assessment of ethics and professionalism during the 2012-13 academic year.

Ethics

The Ethics ISLO was assessed in the Math 421 class in Fall 2013. There were five students in the class.

The students were given the Oregon Tech Applied Mathematics Code of Ethics and the assignment and asked to submit their responses by the end of the seventh week of the term. Although the assignment was worth twice as much as any other assignment in the class, only two students submitted their work. Both students completed the assignment on time and Table 4 summarizes the results. With such a low number of participants, these numbers should not be considered statistically significant. The Ethics assignment did not reflect work done in the course and since there does not exist a generally accepted Applied Mathematics Code of Ethics, the department might want to reconsider doing this assessment in the future.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Knowledge of Code	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	100%
Describes ethical issues	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	50%
Describes Parties involved	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	100%
Describes Alternative approaches	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	100%
Benefits/risks of Choice	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	100%

Table 4. Assessment Results for Ethics, Fall 2012

Professionalism

The faculty assessed the professionalism of eight graduating seniors during the spring 2013 term. The results are shown in Table 5.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Timeliness of work	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Quality of work (course expectations)	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Quality of work (work product)	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Attitude toward feedback	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Attitude toward assigned tasks	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Punctuality	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Attendance	Faculty Rating	0-2 scale	80% at 1 or 2	90%
Academic Integrity	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Interpersonal skills	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Knowledge of classroom policies and procedures	Faculty Rating	0-2 scale	80% at 1 or 2	Not rated
Work ethic	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Appearance	Faculty Rating	0-2 scale	80% at 1 or 2	Not rated

Table 5. Assessment results for professionalism, spring 2013.

All students did well on the professionalism and ethics assessment and met all performance criteria.

V. Summary of Student Learning

The faculty assessed two program student learning outcomes and one institutional student learning outcome during the 2012-13 academic year. The faculty reviewed the results during a spring 2013 faculty meeting and had the following conclusions.

Outcome 2: Apply mathematics to solve problems.
Students met all performance criteria and the only further action recommended is that we revist the third criteria (interpretation) prior to our next assessment of this outcome.

Outcome 5: Apply technology tools to solve problems
Students met all performance criteria and no further action is required at this time.

Institutional Outcome 3: Ethics and professionalism
Students met all performance criteria and no further action is required at this time.

<u>Appendix A</u>: Student Learning Outcomes/Curriculum Matrix

In the following table, an E indicates that outcome is emphasized in the course, an A means that it is addressed, and N/A indicates that the outcome is not addressed in the course.

Course	Student Learning Outcome						
	Computation	Graphing	Application	Communication	Technology	Abstract Reasoning	Independent Learning
322	E	A	E	A	NA	A	NA
327	A	NA	A	E	NA	E	A
354	E	NA	A	E	NA	A	E
421	E	E	A	E	A	A	A
422	E	E	A	E	A	A	A
423	E	E	A	E	A	A	A
452	A	E	E	E	E	A	E
453	A	E	E	E	E	A	A