Applied Mathematics Degree Program Assessment Report 2010/11

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, and there are six students graduating this year (2010/2011). 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 2009 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	**'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**		

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

IV. 2010-11 Assessment Activities

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

Outcome 1: *Apply mathematical concepts and principles to perform symbolic computations* was assessed in Math 354 Multi-variable and Vector Calculus II, in the Winter of 2011. There are three performance criteria for this PSLO.

a) Set up and evaluate a multi-variable integral.
b) Apply a form of Stokes' theorem to convert between integrals.
c) Solve a problem related to conservative vector fields

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 5 math majors enrolled in Math 354 this term. They were each given the same three problems on a final exam. Jim Fischer has a pdf copy of the problems given to the students and the data used to complete Table 2. Here is a description of the three problems.

Problem 1: Set up a triple integral in cylindrical coordinates that gives the volume of material removed by an offset drill thru a sphere.

Problem 2: Use the divergence theorem to compute a flux integral by computing the corresponding volume integral.

Problem 3: Verify that a vector field is conservative and compute a line integral by recognizing it as a difference in potential values.

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
(a)	20%		80%
(b)			100%
(c)			100%

Table 2. Assessment results for Outcome 1.

The students in Math 354 performed strongly in the area of symbolic computation. The low score of 80% for criteria (a) resulted because one out of the five students could not complete the problem. The data suggests that our Junior/Senior students are performing at a remarkably high level in the area of symbolic computation.

Outcome 6: *Perform abstract mathematical reasoning* was assessed in Math 327, Discrete Mathematics, in the spring of 2011. There are three performance criteria for this PSLO.

a) Construct the contra-positive, converse, and negation of an if-then-statement.
b) Apply the principle of induction to prove a given statement.
c) Determine if a given function is a bijection (provide support).

These criteria were measured by exam problems. The results *for only the math majors* are given in Table 3. Percents indicate the percentages of students performing at the given level for each criterion. There were originally five math majors in the course; however, by the time of examination on the second two concepts there were four remaining.

Proficiency is determined by the correct formation of results based on exam questions. For the construction of logical statements, two of the three exactly correctly formed statements was considered proficient whereas all three formed correctly was considered highly proficient.

For the principal of induction, students were asked to solve a recursion equation (second order, linear, homogeneous) and then to use mathematical induction to demonstrate that the solution was correct. To demonstrate high proficiency, students had to correctly formulate a base case, state the inductive hypothesis and set up a goal of what they had to show, and algebraically simplify the statement applying the inductive hypothesis where necessary to demonstrate a correct proof.

The final of the three problems was to provide support of whether or not a function was bijective. The students were given three functions and asked to classify them as injective, surjective, and bijective providing support for each of the answers (i.e. proof or counterexample). High proficiency was reached by correctly applying the definitions to each of the three functions and determining that only one was bijective. (After which they were asked to provide the inverse function, but this was outside of the assessment.)

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
Constructing Logical Statements	20%	20%	60%
Principal of Induction			100%
Analyzing Functions			100%

Table 3. Assessment results for Outcome 6 results

Additional Assessment: Communication and Lifelong Learning ISLOs

As an additional assessment, the math faculty participated in the institutional assessment of both communication and lifelong learning during the 2010-11 academic year.

Communication and Lifelong-Learning

The Communication and Lifelong-Learning ISLOs were assessed in the Math 421 class in Fall 2010. There were 6 students in the class. For the lifelong-learning portion and the written part of the communication portion, they were given the university-wide assignment and the grading rubrics. They were asked to submit their essays by the beginning of the 10th week. Five students completed the assignment on time and Tables 5 and 6 summarize the results.

Performance Criteria for Written Communication	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Purpose and Ideas	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	60%
Organization	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	80%
Support	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	40%
Style	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	100%
Conventions	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	80%
Documentation	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	40%

Table 5. Assessment Results for written communication, Fall 2010

Performance Criteria for Lifelong-Learning	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Lifelong-Learning	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	100%
Professional societies and organizations	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	80%
Credentials	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	80%
Continuing Education	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	100%
Short- and long-term career plans	Rubric-scored assignment	1 to 4 proficiency scale	80% score at 3 or 4	80%

Table 6. Assessment results for lifelong-learning, Fall 2010.

For the oral part of the communication portion, the students were to give a 20 to 30 minute talk in class. Each student had chosen a project having to do with partial differential equations, and were to write a report as well as give a talk on their findings. All six students completed the assignment, and the results of these oral presentations are given in Table 7.

Performance Criteria for Oral Communication	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Content	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	83%
Organization	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	67%
Style	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	50%
Delivery	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	50%
Visuals	Rubric-scored assignment	1 to 4 proficiency scale	60% score at 3 or 4	67%

Table 7. Assessment results for oral communication, Fall 2010.

V. Summary of Student Learning

The faculty assessed two program student learning outcomes and two institutional student learning outcome during the 2010-11 academic year. The faculty reviewed the results during a spring 2011 faculty meeting and had the following conclusions.

Outcome 1: Apply mathematical concepts and principles to perform symbolic computations.

Students met all performance criteria and no further action is required at this time.

Outcome 6: Perform abstract mathematical reasoning.

Students met all performance criteria and no further action is required at this time.

Institutional Outcome 1: Effective oral, written and visual communication.

Results were mixed. Going forward we will ask students to submit an abstract and two drafts prior to submission of the final written report. Students will be given a rubric outlining the areas to be assessed in the oral presentation.

Institutional Outcome 5: Career development and lifelong learning.

Students met all performance criteria and no further action is required at this time.

VI. Changes Resulting From Assessment

Based on last year's assessment activities, no changes were needed this year.

<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