Applied Mathematics Degree Program 2009/10

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. We had our first graduate in the Spring of 2008 and we had six more students graduate 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.

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 (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**		

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

IV. 2009-10 Assessment Activities

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

Outcome 2: *Apply mathematics to solve problems* was assessed in Math 421, Applied Partial Differential Equations I, in fall 2009. There are three performance criteria for this PSLO.

a) Write a mathematical description of a physical problem.
b) Correctly solve the relevant ordinary or partial differential system.
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 3 students enrolled in Math 421 this term, so the results from this assessment should be reviewed with caution due to this small sample size. They were each given the same problem. The problem was to determine an appropriate PDE for solving the heat equation over a disc with zero temperature on the boundary. They were asked to solve the PDE using the method of Fourier-Bessel expansion and to give an interpretation of the results.

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
Mathematical description			100%
Correct Solution			100%
Interpretation			100%

Table 2. Assessment results for Outcome 2.

All three students performed with high proficiency. No further action is required at this time.

Outcome 5: *Apply technology tools to solve problems* was assessed in Math 452, Numerical Methods II, in winter 2010. 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 projects and exams. The exam 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 only three math majors in the course.

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
Calculator computations			100%
Analysis of algorithms		66%	34%
Solution validity			100%

Table 3. Assessment results for Outcome 5, exam results

The project results *for only the math majors* are given in Table 4. Percents indicate the percentages of students performing at the given level for each criterion. Again there were three math majors in this (same) course.

	Student Performance		
Criterion	Some/no proficiency	Proficient	High Proficiency
Write code		34%	66%
Document code		66%	34%
Presentation			100%
Solution validity			100%

Table 4 Assessment results for Outcome 5, project results.

Based on this data it seems that our students are pretty good at figuring out code writing and presentation, although it does not seem that they are as strong in their analysis as we would like them to be (this is a reflection on all of Math452, not just the technology component). Also, although in principle the students understand the need to check their solution with an exact solution or with one provided by some other algorithm in Matlab, when an exact solution is not available and their solution does not quite match Matlab's solution, they seem at loss for what to do next (although typically they use each other for confirmation of a proper solution, which is of course a good tool to use). Some students took well to expressing themselves in written form in math, which sometimes can be a struggle. One student used LaTex for his reports, which is encouraged but not (yet) required. This should lead us (the faculty) to stress the importance of verifying solutions whenever possible and further elaborate on possible approaches when no exact solution is available.

Additional Assessment: Ethics and Professionalism ISLO

As an additional assessment, the math faculty participated in the institutional assessment of ethics and professionalism during the 2009-10 academic year.

Ethics

The Ethics ISLO was assessed in the Math 421 class in fall 2009. There were 3 students. They were given the OIT Applied Mathematics Code of Ethics and the assignment and asked to submit their responses by the end of Finals week. No class time was devoted to

ethics. All three students completed the assignment on time and Table 5 summarizes the results.

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

Table 5. Assessment Results for Ethics, fall 2009

Professionalism

The faculty assessed the professionalism of graduating seniors during the spring 2010 term. Because of the low number of graduates in the program, the faculty assessed all graduates to date in the program. There were eight graduates included in the assessment. The results are shown in Table 6.

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	87.5%
Punctuality	Faculty Rating	0-2 scale	80% at 1 or 2	100%
Attendance	Faculty Rating	0-2 scale	80% at 1 or 2	100%
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	Not rated
Knowledge of classroom policies and procedures	Faculty Rating	0-2 scale	80% at 1 or 2	100%
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 6. Assessment results for professionalism, spring 2010.

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 2009-10 academic year. The faculty reviewed the results during a spring 2010 faculty meeting and had the following conclusions.

Outcome 2: Apply mathematics to solve problems.
Students met all performance criteria and no further action is required at this time.

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.

VI. Changes Resulting From Assessment

As a result of the 2008-2009 assessment exercise, several actions were identified as areas of improvement by the faculty involved in the Applied Mathematics Degree Program. The limitations identified in 2008-2009 are listed below as well as the actions taken in 2009-2010 to improve them.

1. Future performance criteria need to be more carefully considered before implementing, in order to design criteria that can pinpoint strengths and weaknesses better.

   The Degree Program developed new criteria for each class as well as the PSLO-Curriculum Matrix.

2. Assessment activities should be integrated into course activities in such a way as to ensure that students put adequate effort into the activities.

   The criteria that were assessed in 2009-2010 were done so in such a way that the student's grades were either directly dependent on the criteria, or the students thought they were.

3. Student loads should be monitored to see if overloading with senior level courses continues to be a problem.

   Extra effort was put into intra-faculty communication as well as faculty-student advising to ensure that every effort was made to keep students within reasonable credit loads.

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

<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
342	A	NA	A	A	NA	E	NA
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