Assessment Report: B.S. in Mathematics-Applied Math Option

M450-451: AY 2017--2018

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AY 2017-2018 Assessment Results for the M450-451 sequence.

Following the Applied Mathematics Program Learning Outcomes and Assessment guidelines, students majoring in the Applied Mathematics option were assessed for Outcomes 3 and 4. In Fall 2017, six applied students attended M450. In Spring 2018, three applied students continued in M451. All were assessed using the protocols described below.

Description of Assessment Protocols:

Fall 2017: For M450, two problems selected from a midterm exam (given by both instructors) were used in the assessment. Student performance on the first question was used to assess outcome 3, and student performance on second question was used to assess outcome. The first question involved a dimensional analysis and subsequent interpretation of relationships among relevant physical quantities given in the problem. The second question asked students to identify dimensions relevant to the given problem, and then they were asked to non-dimensionalize the given differential equation so that the resulting dimensionless equation had a certain form.

Spring 2018: For M451, two problems from the final exam were used for the assessment. The second question on the final required eigenfunction calculations while the sixth question required solving partial differential equations similar to those in physics. In as much was possible, assessment questions were chosen to match outcomes.

Assessment Results:

We used Outcome 3 and Outcome 4 in the appended Program Learning Outcomes below:

		Excellent	Acceptable	Marginal	Unacceptable
M450	Outcome 3	4	2	0	0
	Outcome 4	2	1	2	1
M451	Outcome 3	0	1	0	2
	Outcome 4	1	1	1	0

The performance threshold below was met though just barely in M451. This may not be as serious given that the course content of M451 does not readily match either Outcome 3 or 4.

Recommendations:

Outcomes 3 and 4 make reference to “mathematical models”. This is a vague or at least ill-defined concept. If by “mathematical models” we mean a model of some physical, biological or chemical system then neither M450-451 contain much of such material. Currently M430 Math. Biology is a better fit for these outcomes (and M386R depending on how it is taught). As M450-451 has (for a decade or more) been primarily a math techniques course, different courses would provide better measures of the program learning outcomes, or different program outcomes should be specified.

Program Learning Outcomes

Students demonstrate the ability to:

1) Derive numerical methods for approximating the solution of problems of continuous mathematics (M 441, M 442).
2) Implement a variety of numerical algorithms using appropriate technology (M 441, M 442).
3) Set up mathematical models and critically interpret their results (M 450, M451).
4) Select and implement an appropriate mathematical technique needed to analyze and validate mathematical models (M 450, M 451).

Curriculum Map and Assessment Schedule

	Outcomes					Assessment Schedule
	1	2	3	4		
M 441, Numerical Linear Algebra and Optimization	X	X				Even Fall Semesters
M 442, Numerical Solution of Differential Equations	X	X				Odd Spring Semesters
M 450, Applied Mathematics I			X	X		Odd Fall Semesters
M 451, Applied Mathematics II			X	X		Even Spring Semesters

Threshold

At least half of the majors in each of the courses are assessed as "excellent" or "acceptable" for all the learning outcomes.

Rubric

Learning Outcome	Unacceptable	Marginal	Acceptable	Excellent
1) *Derive numerical methods for approximating the solution of problems of continuous mathematics.*	The work is not correct and complete because either concepts are used improperly or key ideas are missing or the organization is unlikely to work even if a few more ideas were inserted.	The work is not correct and complete because one or two significant ideas are missing, but the terms are properly defined and the work shows a type of organization that might well work if the right ideas were inserted in the proper places. Also, the work is "marginal" if most of the work is leading toward a correct argument, but a false statement is inserted.	The work is almost correct with relevant concepts used and ideas that could work, but not well-organized, for example, with some steps out of order, or with something relatively minor incomplete.	The work is fully correct and complete, with the relevant concepts properly employed and ideas that work, and the steps well-organized into a proper sequence
2) *Implement a variety of numerical algorithms using appropriate technology.*	The work is not correct and complete because either there are fundamental gaps in understanding of the underlying mathematical assumptions or in the understanding of the appropriate technique and its implementation.	The work is not correct and complete because one or two significant components of the analysis or of the implementation are missing, but the majority of the ingredients are present.	The work is almost correct with relevant assumptions addressed and the correct algorithm chosen with an implementation that could work, but is implemented with a minor misunderstanding of a technique or a minor error in other elements of the computations.	The work is fully correct and complete, with a full understanding of the underlying mathematical assumptions that deem a particular mathematical technique applicable to a given model and with an appropriate knowledge of the main principles and techniques related to the implementation of a particular form of analysis, mathematical or numerical.
3) *Set up mathematical models and critically interpret their results.*	If the work is not correct and complete because either there are fundamental gaps in understanding of the underlying scientific principles or in the understanding of the appropriate technique and its implementation.	The work is not correct and complete because one or two significant ideas are missing, but the majority of the ingredients are present.	The work is almost correct with relevant scientific concepts and mathematical techniques that could work, but not well-organized, with a minor omission, misunderstanding, or inadequate choice of mathematical technique.	The work is fully correct and complete, with the complete understanding of the scientific principles of the modeled problem and with employment of the appropriate mathematical techniques.
4) *Select and implement an appropriate mathematical technique needed to analyze and validate a mathematical models.*	The work is not correct and complete because either there are fundamental gaps in understanding of the underlying mathematical assumptions or in the understanding of the appropriate technique and its implementation.	The work is not correct and complete because one or two significant components of the analysis or of the implementation are missing, but the majority of the ingredients are present.	The work is almost correct with relevant assumptions addressed and the correct algorithm chosen with an implementation that could work, but is implemented with a minor misunderstanding of a technique or a minor error in other elements of the computations.	The work is fully correct and complete, with a full understanding of the underlying mathematical assumptions that deem a particular mathematical technique applicable to a given model and with an appropriate knowledge of the main principles and techniques related to the implementation of a particular form of analysis, mathematical or numerical.