# Assessment Report: Applied Mathematics Learning Outcomes
## Fall 2017

**Fall 2017 Assessment Results**

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According to the below description of Applied Mathematics Program Learning Outcomes and Assessment, all six students majoring in the Applied Mathematics option who are currently enrolled in either section of M 450 were assessed for Outcomes 3 and 4.

**Description of Assignment Assessed**
One assignment was used in this assessment. Two problems selected from a midterm exam given by both instructors. 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.

**Assessment Results**
**Outcome 3**: *Students demonstrate the ability to set up mathematical models and critically interpret their results.* Of the six students assessed, four indicated excellent performance and two indicated acceptable performance.

**Outcome 4**: *Students select and implement an appropriate mathematical technique needed to analyze and validate mathematical models.* Of the six students assessed, two showed excellent performance, one showed an acceptable performance, two gave a marginal performance and one performance was unacceptable.

The threshold given below for overall performance was met. In the case of outcome 3, the threshold was easily satisfied, and the students' performance on outcome 4 met but did not exceed the threshold.

**Recommendations:**
We have no recommendations at this time.

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## 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. |