Semester Reports For Math 375

1 Relevant Student Learning Outcomes (SLOs)

In discussion with the faculty, the undergraduate committee created the student learning outcomes for the applied math majors. The following SLOs are pertinent to the course content in Math 375.

1. Use techniques from calculus to design analytical and numerical methods to solve applied problems, and understand the accuracy and limitations of the methods.
2. Effectively perform essential computations in linear algebra, including solving linear systems, computing the eigenvalues of a matrix, and determining linear independence.
3. Use numerical techniques for solving mathematical problems, and judge their accuracy.
4. Communicate well, orally and in writing, in an applied mathematics context.

In Math 375, student performance in these areas is assessed by regular graded homeworks, mid-semester exams, and a final exam.

SLO 1 is assessed by asking students to derive numerical methods to approximate (i) derivatives or (ii) solutions to nonlinear equations (s.a. fixed-point iteration or Newton's method) or (iii) solutions to first order initial value problems (s.a. Euler's method) and, in all cases, use Taylor series approximations to obtain estimates for the approximation error.

SLO 2 is assessed by asking students to (i) write the system of n linear equations determining a numerical approximation in matrix form and implementing it in MATLAB, or (ii) solving a 3x3 linear system using Gauss Elimination and finding the LU, PLU or QR factorization of the associated matrix, or (iii) finding least squares solutions for linear systems and estimating the least squares error.

SLO 3 is assessed by asking students to implement an approximation method and discuss convergence properties and accuracies. Possible methods to choose from include (i) iterative methods to solve first order equations, (ii) methods for numerical integration, (iii) methods to solve differential equations, (iv) methods for interpolation.

SLO 4 is assessed based on the clarity of the presentation of the students work in exams.

Every instructor for Math 375 is asked to complete a "Semester Report", which provides data on the performance of the students in achieving these outcomes. Instructors will be asked to separate the results from different concentrations and majors. To that end, students should be asked to self-identify which major or concentration they have declared, perhaps with a question on the first exam or on a survey administered to the class. Finally, instructors should ask students to self-assess their performance on these SLOs through questions on an electronically administered survey.

2 Rubrics

The purpose of the rubrics is to ensure that assessment occurs independently from the instructor's chosen grading scale. For example, some instructors may view that a student who gets 80-90% of the points to have given a "very good" solution while others may expect 100% credit to be rated at this level, using the "excellent" rating to distinguish exceptional solutions.

2.1 Rubric for SLO 1:

Use techniques from calculus to design analytical and numerical methods to solve applied problems, and understand the accuracy and limitations of the methods.

SLO 1 is assessed by asking students to derive numerical methods to approximate (i) derivatives or (ii) solutions to nonlinear equations (s.a. fixed-point iteration or Newton's method) or (iii) solutions to first order initial value problems (s.a. Euler's method) and, in all cases, use Taylor series approximations to obtain estimates for the approximation error.

Excellent	Exemplary, complete and clear derivation of the method, including explanation of details and special cases. and full justification of each step. The logic of the arguments flows naturally. Exemplary, complete and clear derivation of expressions for the approximation error using Taylor series. Mathematical and English language is highly articulate.
Very Good	Cogent derivation of the numerical method, with most key steps clearly justified. Cogent derivation of expressions for the approximation error using Taylor series, including most steps. Mathematical and English language is easily understandable.
Satisfactory	Comprehensible derivation of the numerical method, with all major steps shown and minor algebra mistakes, but otherwise consistent work. Correct statement of Taylor series or Taylor polynomial approximation. Mathematical and English language is decipherable.
Questionable	Unclear presentation, however outline of the argument is correct. Mathematical and English language is incomplete.
Unacceptable	Sloppy, unclear presentation, incorrect results, inconsistencies in the work. Mathematical and English language is unclear.

2.2 Rubric for SLO 2:

Effectively perform essential computations in linear algebra, including solving linear systems, computing the eigenvalues of a matrix, and determining linear independence.

SLO 2 is assessed by asking students to (i) write the system of n linear equations determining a numerical approximation in matrix form and implementing it in MATLAB, or (ii) solving a 3x3 linear system using Gauss Elimination and finding the LU, PLU or QR factorization of the associated matrix, or (iii) finding least squares solutions for linear systems and estimating the least squares error.

Excellent	Exemplary solutions, clear and well organized work, correct algebra, demonstrating full understanding of all steps taken. Mathematical and English language is highly articulate.
Very Good	Correct solutions, showing all steps in a cogent presentation, demonstrating full understanding of all steps taken. Mathematical and English language is easily understandable.
Satisfactory	Good presentation with most steps shown and minor algebra mistakes, but otherwise consistent work. Mathematical and English language is decipherable.
Questionable	Unclear presentation, algebra mistakes, incorrect results, outline of the argument is correct. Mathematical and English language is incomplete.
Unacceptable	Sloppy, unclear presentation, incorrect results, inconsistencies in the work. Mathematical and English language is unclear.

2.3 Rubric for SLO 3:

Use numerical techniques for solving mathematical problems, and judge their accuracy.

SLO 3 is assessed by asking students to implement an approximation method and discuss convergence properties and accuracies. Possible methods to choose from include (i) iterative methods to solve first order equations, (ii) methods for numerical integration, (iii) methods to solve differential equations, (iv) methods for interpolation.

Excellent	Exemplary use and implementation of the numerical method. Student has a complete understanding of the accuracy of the method. Mathematical and English language is highly articulate.
Very Good	Cogent use and implementation of the numerical method. Student has a good understanding of the accuracy of the method. Mathematical and English language is easily understandable.
Satisfactory	Comprehensible use and implementation of the numerical method. Student gives at least some indication of the accuracy of the method. Mathematical and English language is decipherable.
Questionable	Incomplete use and implementation of the numerical method. Student may show some comprehension of the accuracy of the method. Errors are significant. Mathematical and English language is incomplete.
Unacceptable	Poor use and implementation of the numerical method. Unclear whether or not the student understands the method. Errors are striking. Mathematical and English language is unclear.

2.4 Rubric for SLO 4:

Communicate well, orally and in writing, in an applied mathematics context.

SLO 4 is assessed based on the clarity of the presentation of the students work in exams.

Excellent	Exemplary writeup where the mathematical and English language is highly articulate.
Very Good	Cogent writeup where the mathematical and English language is easily understandable.
Satisfactory	Comprehensible writeup where the mathematical and English language is decipherable.
Questionable	Incomplete writeup where the mathematical and English language is incomplete.
Unacceptable	Poor writeup where the mathematical and English language is unclear.