
Section 1 – Program Mission

- **Program Mission:**

The mission of the Applied Mathematics degree program is to prepare students for immediate participation in the workforce, or for graduate study. Employment opportunities include pharmaceutical companies, government agencies (like the National Security Agency), insurance companies (as actuaries), publishing companies (as editors of technical publications) and public K-12 and higher education. Graduates 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.

The mission, objectives, and student learning outcomes for the Applied Mathematics program are reviewed annually by the department during Fall convocation.

- **Mission Alignment:**

The applied mathematics degree program mission provides students with strong quantitative reasoning and computational skills which are applicable in a broad variety of careers. The program also incorporates projects in a number of upper level courses. In these ways the Applied Mathematics degree program mission aligns with the university mission.

- **Changes to the Mission:**

There were no changes made to the mission of the Applied Mathematics Department in the past year.

Section 2 – Program Student Learning Outcomes

- **PSLOs:**

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

Section 3 – Curriculum Map

This curriculum map is for the 2024-25 catalog, for the Applied Mathematics BS degree.

Semester	Course	Credits	PSLO's							ISLO's					
			1	2	3	4	5	6	7	Com	IA	Eth	QL	TW	DivP
Freshman - Fall	MATH 251	4	F	F	F	F							F		
	COM 111Z	4								F					
	WRI 121Z	4								F					
	Social Science Elective	3										F			
Freshman - Winter	MATH 252	4	F	F	F	F									
	STAT 201	4			F		F				F	F	F		
	PHY 221 & lab	4	F	F	F						F				
	Social Science Elective	3									F				
Freshman - Spring	MATH 253	4	F	F	F	F									
	PHY 222	4	F	F	F	F									
	Humanities Elective	3													F
	Social Science Elective	3													
Sophomore - Fall	MATH 254	4	F	F	F	F									
	MATH 321	4	P	P	P	P				P				P	
	PHY 223	4	F	F	F										
	General Elective	3													
Sophomore - Winter	MATH 341	4	F	F	F	F	F	F							
	MATH 354	4	P	P	P	F			F						
	General Elective	4													
	Humanities Elective	3													F
Sophomore - Spring	MATH 361	4			F							P			
	General Elective	3													
	General Elective	3													
	General Elective	3													
	Humanities Elective	3													
Junior - Fall	MATH 310	4	F			F		F		F					
	SPE 321	3								P				P	
	Focused Elective	3			F										
	Upper Division Elective	4													
Junior – Winter	MATH 346	4				P		P	P						
	WRI 122Z or 227Z	4								P					
	Focused Elective	3	P	P	P	P	P								
	Upper Division Elective	3													
	General Elective	3													
Junior - Spring	MATH 322	4	P	P	P	P									
	MATH 451	4	P	P	P	P									
	Focused Elective	3	P	P	P	P									
	Math/Physics Elective	3	P	P	P	P									
	General Elective	2													
Senior - Fall	MATH 421	4	C	C	C	C	P	P	C						
	Focused Elective	4	P	P	P	P	P								
	Math/Physics Elective	4	P	P	P	P	P								
	General Elective	3													
Senior - Winter	Upper Division Math Core	4	C	C	C	C	C	C	C						
	Focused Elective	3	P	P	P	P	P								
	Social Science Elective	3													P
	General Elective	3													
	General Elective	3													
Senior - Spring	Upper Division Math Core	4	C	C	C	C	C	C	C						
	WRI 327 or 350	3								P					
	General Elective	3													
	General Elective	3													
Total Credits		181													

KEY : F = Foundation, P = Practicing, C = Capstone, Com = Communication, TW = Teamwork, Eth = Ethical Reasoning, IA = Inquiry and Analysis, QL = Quantitative Literacy, DivP = Diverse Perspectives.

Section 4 – Assessment Cycle

The Applied Mathematics department evaluates our Program Specific Learning Outcomes on a 3-year rotating schedule, as shown below.

Program Student Learning Outcomes	Academic Year Assessed		
	2024-25	2025-26	2026-27
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

The specific courses used to assess the PSLO's and the ISLO's are indicated in the table below

ISLO	PSLO	Act	Collect	Plan
		2023-2024	2024-2025	2025-2026
	PSLO 1			MATH 354
	PSLO 2		MATH 321/322	
	PSLO 3	MATH 422		
	PSLO 4		MATH 354	
	PSLO 5			MATH 452
	PSLO 6	MATH 346		
	PSLO 7	MATH 354		
Com			MATH 354	
TW			**	
Eth				STAT 201
IA		PHY 222		
QL		MATH 361		
DivP				MATH 315

The years each PSLO/ISLO will be in the act/assess/plan phase are given in the table below.

Applied Mathematics B.S. Cycle for PSLO's and ISLO's			
Outcome	2024-25	2025-26	2026-27
PSLO 1	Plan	Assess	Act
PSLO 2	Assess	Act	Plan
PSLO 3	Act	Plan	Assess
PSLO 4	Assess	Act	Plan
PSLO 5	Plan	Assess	Act
PSLO 6	Act	Plan	Assess
PSLO 7	Act	Plan	Assess
ISLO : Com	Assess	Act	Plan
ISLO : TW	Assess	Act	Plan
ISLO : Eth	Plan	Assess	Act
ISLO : IA	Act	Plan	Assess
ISLO : QL	Act	Plan	Assess
ISLO : DivP	Plan	Assess	Act

Section 5 – Assessment Data Collection Processes

This year we collected data to assess two PSLO's (2 and 4) and a single ISLO (Com). These were assessed by using an assignment from a single course as indicated in section 4. The Com ISLO was assessed concurrently with PSLO 4, using

the same criteria. The assessment data were collected and scored by the instructors for each course. Historically, the mathematics department has considered a rate of 70% for high proficiency or proficiency to be the minimum acceptable standard, this threshold was used as the performance target for evaluating the PSLO's and ISLO's. The evaluations of each PSLO and ISLO were based on both direct and indirect measures, the exact number and character of each measure varied from course to course and is detailed in Section 6. These measures were determined by the individual faculty teaching the courses, but were discussed in advance by the entire department.

Section 6 – Assessment Data and Interpretations

PSLO-2 “Apply mathematics to solve problems”

This PSLO was assessed in MATH 322 (Differential Equations II) during the Spring 2025 term with Professor Pake Melland. In MATH 322, students produced a report that applies course techniques to an area of interest. Students were strongly encouraged to a project from:

- The FitzHugh-Nagumo model for neuron dynamics.
- Lotka-Volterra equations with > 2 species or novel nonlinear terms.
- The SIR model for disease outbreak.
- The Kuramoto model for oscillations.

They were asked to augment the “standard form” (e.g., base equations presented in a Wikipedia page) of a differential equation and apply techniques from class to their augmented model. The students were required to interpret their results in the context of their application. For example, if the mathematical analysis shows that a species dies out under certain model conditions, students had to relate those conditions to a real-world interpretation.

The class contained eight students, six of which were math majors. One major only attended a few classes before withdrawing, and one major did not complete the final report. They are excluded from this analysis, leaving a total of four math majors. From the suggested topics, three chose to augment the Lotka-Volterra equations and one chose the Kuramoto model. Student completed a final technical report detailing how they used mathematical techniques to understand the real-world problem they attempted to model. Students were also required to perform a peer-review for one other report and assess it for mathematical accuracy, relevancy, and its overall findings. The report and review serve as strong artifacts for students’ ability to apply mathematics to solve problems and critically evaluate mathematical approaches to problems.

PSLO-2 was assessed according to the following criteria:

1. Ability to modify an existing mathematical principle to study a new problem of interest.

This criterion focuses on the students’ ability to conceptualize a problem and propose a mathematical approach towards that problem. Prior to the reports, students had to submit a 1-page “project proposal” outlining their problem and proposed approach. Students were allowed to ask me for feedback prior to their proposal. The majority of the feedback “reigned in” their ideas to a more tractable idea. That is to say, most students were eager to use math to solve their problem. But that eagerness would have led them down a path of intractable mathematics. As the majority of the proposals were brainstormed with me prior to submission, this criterion was assessed on a “yes/no” basis: Yes—the students submitted a proposal with a clearly defined modification of a mathematical model and a proposed approach. No—no proposal was submitted or an inadequate (too simple) modification was suggested.

Three students proposed a modification of the Lotka-Volterra equations (two introduced a hierarchy of three interacting species; one introduced a “satiation” non-linearity for predators). These three students proposed analyses of equilibrium, nullclines, and numerical simulations as mathematical tools to study their systems. One student did not complete a proposal, but ultimately completed a final report. Due to this single student’s inability to produce an explicit outline of a problem and mathematical approach, this criterion had a 75 % success rate.

2. Ability to apply mathematical techniques to novel problems

This criterion focuses on the students’ ability to use mathematical techniques in the context of a problem. This criterion was evaluated according to the following rubric (half-points allowed):

- 4/4: All mathematics presented is well-motivated, clear, correct, and applicable. Minimal typos are the only errors. Sufficient detail is provided so that a student finishing Differential Equations I can read and follow all steps with reasonable effort.
- 3/4: The mathematics supports the problem but lacks detail or total-correctness.

- 2/4: The mathematics contains major errors that reflect a lack of understanding.
- 1/4: The mathematics is generally incoherent.
- 0/4: No math is used to solve the problem.

Under this rubric, one student earned a 4/4, two students earned a 3/4, and one student earned a 2/4. If 3/4 is considered a success, then three students earned a rubric score of 3/4 or higher, and this criterion had a 75 % success rate. Some of the mistake included miss-classification of equilibria, miss-calculation of eigenvalues, and, in one case, a general deficiency in the level of mathematical detail presented.

3. Ability to interpret mathematical findings in a problem-based context

This criterion assesses how well students can give meaning to the results of a mathematical analysis. This criterion was assessed according to the following rubric (half-points allowed):

- 4/4: The major findings of the mathematics are summarized and placed in a broader context. Their implications are shortcomings are discussed.
- 3/4: The major findings are summarized with no interpretation or discussion.
- 2/4: The findings are improperly summarized or mischaracterized.
- 1/4: The mathematical findings are not clearly stated and their context is not provided.
- 0/4: No discussion of the “answer” to the research question is provided.

Under this rubric, three students earned a 4/4 and one earned a 3/4. The major deduction was due to a limited discussion/explanation of the findings. They were presented as, “This is what the math said.” But there was no discussion of “This is what the math meant.” If 3/4 on the rubric score is considered a success, then this criterion has a 100 % success rate.

4. Ability to critically evaluate mathematical approaches used in a problem-based setting.

This criterion assesses the students ability to discern appropriate mathematical techniques and gauge the appropriateness of the findings within the context of a problem. This criterion was assessed through the “peer-review” portion of the project. Students read one other reports and responded to various prompts. One of the prompts asked the student to evaluate a report according to the rubric in Criterion 2. The instructor also evaluated the report according to this same rubric. These two scores were then used to assign a numeric value between 0 and 4 to the reviewer:

- Calculate the difference between the instructor and peer reviewer assigned rubric score.
- Take the absolute value.
- Round down to the nearest whole number.

So, if the instructor assigned a 3.5/4 and the peer assigned a 4/4, the difference (in absolute value) is $|3.5 - 4| = 0.5$. This number is rounded down, to assign the reviewer a 0.

However, if the instructor had instead assigned a 3/4, the difference is $|3 - 4| = 1$, and the reviewer receives a 1. Much like golf, a low score is desirable (indicating a similar assessment of the mathematics as the instructor).

For the math majors, three received a 0, and one student received a 1. If we view earning a 1 or less as a success, then this criterion had a 100 % success rate.

Summary for PSLO 2:

As a whole, the students were successful in proposing a problem and using mathematics to solve their proposed problem. In one case, the student did not adequately formulate this proposed problem (see Criterion 1). In another case, a student did not fully interpret a conclusion based on their mathematics, but their conclusion was still sufficient (see Criterion 3). In order to promote student success in the project, an initial list of systems-to-modify was provided to the students. In lieu of this list, the student may have had more difficulty in conceptualizing the problem.

PSLO-4 “Communicate Mathematical Knowledge and Understanding” (and ISLO Com)

For the purpose of this assessment report, the ISLO Com and the PSLO-4 were considered to be the same learning outcome, and were assessed jointly. This learning outcome was assessed in MATH 354 (Vector Calculus II) during the Winter 2025 term with Professor Pake Melland. Eleven students completed the course, **five** were math majors.

In MATH 354, students formulate and present a project that applies course content to their interests. Students typically choose one of the “big” integral theorems (Green’s, Stokes’, Gauss’s), but are free to choose from any topic presented during the term. For the project completion, all students were required to create and submit a technical report and present or demonstrate the findings during the final exam time. Students completed the project in pairs, but were assigned individual assessments for the presentation portion of the project. A terminal component of the project asked students to reflect on their perception of the project progress and contribution towards that project by each member. Four of the five math majors were paired into groups of two. The

fifth major is a double-major and was paired with another student in their shared degree program (Electrical Engineering). A final report and presentation in Vector Calculus II is a suitable artifact of students' ability to communicate mathematical knowledge and understanding because it requires them to present technical mathematics in an accessible, yet precise, manner.

PSLO 4 was assessed using the following criteria:

1. Ability to communicate, through writing, well-motivated and cohesive mathematical problems and their solutions.

This was assessed through the technical report prepared by the students according to the following rubric (half points allowed):

- 4/4: All mathematics presents is well-motivated, clear, correct, and applicable. Minimal typos are the only errors. Sufficient detail is provided so that a student finishing Vector Calculus I can read and follow all steps with reasonable effort.
- 3/4: The mathematics supports the problems and its findings but lacks detail or total-correctness.
- 2/4: The mathematics contains major errors that reflect a lack of understanding.
- 1/4: The mathematics is present, but is otherwise incoherent.
- 0/4: No mathematics is presented.

For this criterion, all five math majors earned 4/4. Since students were paired into groups, the individual assessment of this criterion is challenging. It is possible that one provided a more substantial contribution to the final product, but this cannot be discerned from the report alone. As an attempt to assess individual students, each group member was asked to reflect on various prompts related to the completion of the technical section of the report. Upon reading these peer-assessment one math major had only minimal contribution to the creation of the report artifact. This student is considered to have NOT met the criterion, and thus 4/5 of 80 % of students successfully met this criterion.

2. Ability to motivate and provide sufficient background knowledge to understand a mathematical idea.

Effective communication in mathematics requires sufficient detail and background knowledge to fully understand a problem and place it in a broader context. This was assessed again through the technical report according to the following criteria (half points were allowed):

- 4/4: The purpose of the project is clearly defined. Adequate background knowledge is provided to understand the posed problem. Any other science major can read the introduction and understand the posed problem.
- 3/4: The purpose of the project is defined, but the background information is deficient.
- 2/4: The purpose of the paper is not clearly defined, and the background information is deficient.
- 1/4: Only minimal background and motivating information is given.
- 0/4: No background or motivation is provided.

For this criterion, all five math majors earned 4/4 as a score. As with the previous criterion, the group component makes this criterion challenging to assess on the individual level. Once again, a review of the peer-assessment showed that one math major had only minimal contribution to the creation of the introductory material for the report. This student is considered to have NOT met the criterion, and thus 4/5 of 80 % of students successfully met this criterion.

3. Ability to communicate, through an oral presentation, well-motivated and cohesive mathematical problems and their solutions.

This criterion was assessed during the presentations during the final exam time. Each member was assessed according the same rubric as criterion 1. The groups were free to choose their presentation modality: one group did a "chalk talk", one group did a "demonstration" (with some accompanying calculations on the board), and one group did a presentation with slides. Four out of five students earned a rubric score of 4/4, with one student earning a 1/4. If 3/4 and above is considered a success, 80 % of students successfully met this criterion.

Summary of PSLO-4 (and ISLO Com)

From a small sample-size it is challenging to draw a substantial conclusion from this assessment, especially factoring in the group aspect of the report and presentation. A few comments are worth making:

- One group completed their report in LaTeX (the standard typesetting software for mathematics). This showed remarkable initiative as the software was self-taught (zero percent of instructional time is dedicated to learning this software). Using LaTeX is also related to effective mathematical communication; proper typesetting in an industry-standard format significantly improves the readability of any document. The department might consider incorporating LaTeX basics into the curriculum.
- The outlined rubric was drafted as a class (with strong guidance by the instructor during drafting discussions). The clearly defined expectations created as a classroom community likely contributed to a large proportion of students meeting successfully meeting each criterion.
- Other aspects related to communicating mathematics (like diagrams and illustrations) were also assessed in the reports and presentations. These were not ultimately included in the assessment of PSLO-4 due to the high degree of variability in diagrams and illustrations required for the different reports.

Objective	Criterion	# of students assessed	Success rate	Departmental target met
PSLO 2	Ability to modify an existing mathematical principle to study a new problem of interest.	4	75%	Yes
	Ability to apply mathematical techniques to novel problems	4	75%	Yes
	Ability to interpret mathematical findings in a problem-based context	4	100%	Yes
	Ability to critically evaluate mathematical approaches used in a problem-based setting.	4	100%	Yes
PSLO 4 / ISLO Com	Ability to communicate, through writing, well-motivated and cohesive mathematical problems and their solutions	5	80%	Yes
	Ability to motivate and provide sufficient background knowledge to understand a mathematical idea.	5	80%	Yes
	Ability to communicate, through an oral presentation, well-motivated and cohesive mathematical problems and their solutions.	5	80%	Yes
ISLO TW	Not assessed			

Table: Summary of all assessment results

Section 7 – Data-driven Action Plans:

The assessment results for PSLO 2 and PSLO4 / ISLO Com are very positive, as the departmental target was met for all criteria used to assess these objectives. No specific action is indicated to address deficiencies revealed by assessment. One issue that did emerge from the PLSO-4 / ISLO Com assessment process is the utility of including instruction on using the LaTeX typesetting software for mathematical writing. This emerged as one group did use LaTeX successfully, despite being self taught. Following discussions within the mathematics department reviewing the assessment results, we agreed as a department to include teaching use of LaTeX as part of STAT 201, which is a required course for the applied mathematics degree.

We did not assess the ISLO Teamwork, as there are no courses within the Applied Math degree that are a good fit for this ISLO. This may imply a weakness within the Applied Math curriculum, and the mathematics department will discuss how the Teamwork ISLO could be included in a natural way within our curriculum.

Section 8 – Closing the Loop: Reflection on previous work

This year the Applied Math Department is continuing to monitor how the introduction of multiple “tracks” for our major (Computational Mathematics, Physics, and Statistics) is impacting our students. One focus of our department will be to see how many students choose each of these tracks, and whether this structural change has effects on our overall enrollment.

Another area of focus for our department is in reducing DWFI rates for lower division courses (especially Math 111/112), as we know that students who succeed in getting to Math 251 are much less likely to withdraw from the university. We have had many active discussions within our department on various ways of reducing the DWFI rates.

Another significant change in our lower division curriculum has been the introduction of Math 105/Math 110 as a non-calculus pathway for students who do not need to take Math 251 as part of their degree program. These classes have been recently introduced, as a department we are hoping that separating students who do not need to take calculus from those that do can both decrease DWFI rates overall, as well as allow for a more rigorous experience for students who are on the standard precalculus track (Math 111/112).

Program Assessment Report Feedback Rubric

2024-25 Assessment Report

Program:

Department Chair:

Program Assessment Report Author:

Rubric Measure	Well Developed, Progressing or Not included.
Program mission is aligned to University Mission	
Educational Objectives Wording is Actionable	
PSLO's are justified by Professional Standards	
PSLO'S are aligned to ISLO	
Curriculum Map: Scaffolding indicates Foundational, Practice, and Capstone Assessments by course	
Assessment Cycle is three years or less to cover all PSLO and ISLO	
During collection year, courses/assignments are specified that align to PSLO and ISLO	
Rubric: Criteria for grading the assignment is described (may include as an appendix)	
Sample: Number of samples reviewed is specified	
Accountability: Reviewer(s) of the assessments are specified	
Assessment data is collected across all locations and modalities	
Performance Targets of acceptability are indicated	
Reported data include: Graduation, Retention, Post Grad Success, PSLO, ISLO	
Interpretation: Current results are compared against performance targets	
Interpretation: Current results are compared against previous assessment	
Reports include actions planned for the next academic year.	
Action drivers: Items not meeting performance targets have actions planned	
Action drivers: Additional action plans for overall department improvement are indicated	
Action plans: Specifics of accountability and timelines are indicated	
Action plans: Actions are linked to identification of resources needed	
Close the Loop: Faculty discuss previous action plan success given new data	
Faculty discuss the assessment process and make any improvements necessary	

Directions: Please provide comments on any item that is not graded as well developed.