

Annual Program Report 2022-2023

The report(s) should be inclusive of all levels, degrees (i.e. certificates, bachelor's and master's), modalities and locations.

Department: Mathematics

Department Chair: Peter Staab

Department Assessment Committee Contact: Amy Wehe

This document is to be kept in the department and an electronic file is due to the AVP of Institutional Research and Planning by June 1, 2023.

Section I: Program Assessment (please complete this section for each program in your department)

Program: Mathematics

A. Program Learning Outcomes (PLOs) (Educational Objectives)

I. List of PLOs and the timeline for assessment

PLO #	PLO – Stated in assessable terms	Where are the learning outcomes for this level/program published? (please specify) Include URLs where appropriate.	Timing of assessment (annual, semester, bi-annual, etc.)	When was the last assessment of the PLO completed?
1.	<p>Students should develop effective thinking and communication skills.</p> <p>a) state problems carefully, articulate assumptions, understand the importance of precise definition, and reason logically to conclusions;</p> <p>b) identify and model essential features of a complex situation, modify models as necessary for tractability, and draw useful conclusions;</p> <p>c) deduce general principles from particular instances;</p> <p>d) use and compare analytical, visual, and numerical perspectives in exploring mathematics;</p> <p>e) assess the correctness of solutions, create and explore examples, carry out mathematical experiments, and devise and test conjectures;</p> <p>f) recognize and make mathematically rigorous arguments</p> <p>g) read mathematics with understanding;</p> <p>h) communicate mathematical ideas clearly and coherently both verbally and in writing to audiences of varying mathematical sophistication;</p>	<p>https://www.fitchburgstate.edu/academics/programs/mathematics-babs</p>	<p>(a)(c)(f)(h) – every other year</p> <p>(b)(d)(e)(g) – every other year</p> <p>(i)(j) – every 3 years (with PLO 4)</p>	<p>AY 2022 and AY 2023</p>

	<p>i) approach mathematical problems with curiosity and creativity and persist in the face of difficulties;</p> <p>j) work creatively and self-sufficiently with mathematics.</p>			
2.	<p>Students should learn to link applications and theory.</p> <p>a) Mathematics students should encounter a range of contemporary applications that motivate and illustrate the ideas they are studying</p> <p>b) learn to apply mathematical ideas to problems in those areas.</p> <p>c) Students should come to see mathematical theory as useful and enlightening in both pure and applied contexts.</p>	https://www.fitchburgstate.edu/academics/programs/mathematics-babs	Every three years	AY 2022 and AY 2023
3.	<p>Students should learn to use technological tools.</p> <p>a) Mathematical sciences major programs should teach students to use technology effectively, both as a tool for solving problems</p> <p>b) Mathematical sciences major programs should teach students to use technology effectively, as an aid to exploring mathematical ideas.</p> <p>c) Use of technology should occur with increasing sophistication throughout a major curriculum.</p>	https://www.fitchburgstate.edu/academics/programs/mathematics-babs	Every three years	

4.	<p>Students should develop mathematical independence and experience open-ended inquiry.</p> <p>a) A mathematical sciences major should be structured to move students beyond the carefully choreographed mathematical experiences of the classroom.</p> <p>b) A major curriculum should gradually prepare students to pursue open-ended questions</p> <p>c) to speak and write about mathematics with increasing depth and sophistication.</p>	https://www.fitchburgstate.edu/academics/programs/mathematics-babs	Every three years	
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II. **PLO Assessment** (Please report on the PLOs assessed and/or reviewed this year. Programs should be assessing at least one each year.)

The Assessment Committee collected many student artifacts during AY 2022 which were meant to provide evidence of student learning in Goal 1(a)(c)(f)(h) and Goal 2. The Assessment Committee evaluated some of that work in AY2022, but some artifacts remained to be assessed. The Assessment Committee decided that at least some of AY2023 should be spent evaluating the remaining artifacts submitted in AY 2022. Therefore, Goal 1(a)(c)(f)(h) and Goal 2 were assessed in AY 2023 as well as in AY 2022.

Using the table below, list and briefly describe the **direct method(s)** used to collect information assessing whether students are learning the core sets of knowledge (K), skills (S) and attitudes (A) identified as essential.

PLO # (from above)	Assessment description (exam, observation, national standardized exam, oral presentation with rubric, etc.)	When assessment was administered in student program (internship, 4th year, 1st year, etc.)	To which students were assessments administered (all, only a sample, etc.)	What is the target set for the PLO? (criteria for success)	Reflection on the results: How was the “loop closed”?
1(a)	Homework (Linear Algebra HW06)	Approx 2nd year	All students in Linear Algebra	Judged at the level of the student, the criteria for success is a score of 2 (proficient).	We will contact the professor of the class to discuss different wording of the questions that would encourage more complete answers from students.
1(f)	Homework (Linear Algebra HW06)	Approx 2nd year	All students in Linear Algebra	Judged at the level of the student, the criteria for success is a score of 2 (proficient).	We will contact the professor of the class to discuss different wording of the questions that would encourage more complete answers from students.

1(h)	Homework (Linear Algebra HW06)	Approx 2nd year	All students in Linear Algebra	Judged at the level of the student, the criteria for success is a score of 2 (proficient).	We will contact the professor of the class to discuss different wording of the questions that would encourage more complete answers from students.
2	Homework (Linear Algebra HW06)	Approx 2nd year	All students in Linear Algebra	Judged at the level of the student, the criteria for success is a score of 2 (proficient).	We will contact the professor of the class to discuss different wording of the questions that would encourage more complete answers from students.
1(a)	Project	Approx 3rd year	All students in Math 3003– Advanced Statistics	Judged at the level of the student, the criteria for success is a score of 2 (proficient).	We will discuss the outcomes with the professor of the course.
1(c)	Project	Approx 3rd year	All students in Math 3003– Advanced Statistics	Judged at the level of the student, the criteria for success is a score of 2 (proficient).	We will discuss the outcomes with the professor of the course.

1(f)	Project	Approx 3rd year	All students in Math 3003– Advanced Statistics	Judged at the level of the student, the criteria for success is a score of 2 (proficient).	We will discuss the outcomes with the professor of the course.
1(h)	Project	Approx 3rd year	All students in Math 3003– Advanced Statistics	Judged at the level of the student, the criteria for success is a score of 2 (proficient).	We will discuss the outcomes with the professor of the course.

You may use this comment box to provide any additional information, if applicable:

The homework from Linear Algebra Math 2600 that the assessment committee assessed asked students to solve several linear algebra problems, apply a definition to a particular instance, and prove whether or not a particular matrix or vector space fulfilled certain properties. The assignment provided examples for each of the Goals 1(a)(f)(h). The students accomplished these tasks to varying degrees. Some students misunderstood the concepts and some did not state assumptions clearly or reason logically to conclusions. All students engaged in most of these goals, however, and it appears they are practicing the skills necessary to improve these skills. Many students already demonstrated a proficiency in these skills, and a few demonstrated mastery in certain subcategories of these goals.

The project from Math 3003– Advanced Statistics that the assessment committee assessed asked students to find data, ask a question about that data, use summary statistics and graphs to explore the data, and then perform a statistical test to analyze their data. This project was rich in goals the assessment committee could assess. In particular, we were able to assess Goals 1(a), 1(c), 1(f), and 1(h) through this one assignment. Students demonstrated these goals in their work to

varying degrees. There were four artifacts to assess. One of those students demonstrated all but two of the goals at a level of proficiency or mastery and the remaining two goals at an emerging level. The remaining students struggled to demonstrate these goals at a proficient level. A conversation with the professor of this course would be necessary in order to consider why this may be the case. The number of artifacts in this assignment was very small (4), so it does not make sense to generalize results of this assignment to the entire mathematics program.

The assessment of both of these assignments shows that the mathematics department is requiring students to engage in work that gives them exposure and practice in the goals we assessed this year. We may need to consider how students can get more practice in skills related to these goals so we can be sure they achieve proficiency by the time they graduate with a degree in mathematics.

Summary of Findings: Briefly summarize the results of the PLO assessments reported in Section II above combined with other relevant evidence gathered and show how these are being reviewed/discussed. How are you “closing the loop”?

Reflection Prompt	Narrative Response
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<p>Other than GPA, what data/ evidence is used to determine that graduates have achieved the stated outcomes for the degree? (e.g., capstone course, portfolio review, licensure examination)</p>	<p>Students of mathematics are required to take a seminar or capstone course at the end of their studies at Fitchburg State University. Mathematics students in the Applied Mathematics concentration are required to take a Senior Seminar in Mathematics in which they do research and write a paper combining their major and their minor in another field. All Mathematics majors in the Applied Mathematics concentration must also have a minor or second major in another field. Mathematics students who are in the secondary education concentration take a seminar associated with their practicum teaching seminar in which they reflect on their practicum experience. This reflection involves both the content they teach as well as the pedagogy they use to teach their subject. Mathematics majors with no additional concentration are required to take the Mathematics Seminar, where they engage in mathematical research and read at least one mathematics paper.</p> <p>Students are also required to complete projects and assignments throughout their studies at Fitchburg State University that provide the mathematics department with evidence that students are engaging in skills represented by the PLOs.</p>
<p>Who interprets the evidence? What is the process? (e.g. annually by the curriculum committee)</p>	<p>Each year the Assessment Committee collects evidence from faculty demonstrating student work related to the PLOs to be assessed the following year. Since this student work often includes final semester projects, it is not practical to collect the work and assess it in the same term. To this end, work was collected in Spring 2023 that will be assessed during AY2023-2024. The Assessment Committee assesses this work together in order to ensure inter-rater reliability.</p>

<p>What changes have been made as a result of using the data/evidence? (close the loop)</p>	<p>The Assessment Committee will report their findings to the department either directly to the professor who gave the evidence, to the curriculum committee, or both. In this way, the results of the work the Assessment Committee has done will inform future curriculum changes in the department.</p>
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B. Assessment Plan for Program/Department

I. Insert the program or department Assessment Plan (This is an independent plan from what is reported in this document).

In Spring 2023, the Assessment Committee asked professors in the department for student artifacts representing student work toward Goal1(b)(d)(e)(g) and Goal 3. In AY 2023-2024, the Assessment Committee will create an assessment rubric for Goal 3, assess these artifacts using the new rubric, and will request new artifacts from department faculty for Goal1(a)(c)(f)(h)(i)(j) and Goal 4. If there is time in AY 2023-2024, the Assessment Committee will begin creating the Assessment Rubrics we will use to assess Goal 4. Neither Goal 3 nor Goal 4 have ever been assessed by the department in their current form.

II. Explain any changes in the assessment plan including new or revised PLOs, new assessments that the program/department plans to implement and new targets or goals set for student success.

In AY 2023-2024, the Assessment Committee will create an assessment rubric for Goal 3. If there is time in AY 2023-2024, the Assessment Committee will begin creating an assessment rubric that we will use to assess Goal 4 the following year. Neither Goal 3 nor Goal 4 have ever been assessed by the department in their current form.

III. If you do not have a plan, would you like help in developing one? ___Yes

C. Program Review Action Plan or External action Letter/Report

Annual Reflection/Follow-up on Action Plan from last Program Review or external accreditation (only complete the table that is appropriate for your program)

I. Programs that fall under Program Review:

- i. Date of most recent Review: [AY 2017](#)
- ii. Insert the Action Plan table from your last Program Review and give any progress towards completing the tasks or achieving targets set forth in the plan.

Our last review only had a 5-year plan (we last did the review right before the new Program Review format/timeline). The following is that plan:

In the future, the mathematics department would like to work on its interconnectedness with other departments, local community colleges, and organizations that can provide career opportunities for our students. In addition, we plan to focus on the needs of our students and how we can better meet those needs.

In particular, we are discussing the following:

1. STEM resource center (math and science) -- we are talking with other departments and offices on campus about the possibility of a STEM resource center. This would be similar to the math center, but it would also serve students in science classes, who often face mathematical hurdles in their courses.
2. Math Center-- We are also interested in collaborating more with the Math Center, which often seems disjoint from the department. The math center is located in a beautiful new facility in Hammond, but it is physically and practically detached from our department. One possible solution to help with collaboration is to have a Math Center

Liaison from the department.

3. Careers—We are working on collecting information for career-based advising and internships. Specifically, we are interested in what particular skills and dispositions industry is currently looking for and what careers and jobs are in demand and are well suited for our students. We can use this information to inform advising and curriculum decisions. This work is also part of Mary Ann's sabbatical in Spring 2017.
4. Assessment Plans—Our current assessment plan was written almost 15 years ago. In that time, our department has almost completely turned over. It has become clear that our assessment plan needs to be revisited and revised. Therefore, beginning this year the Assessment Committee is working on a reboot of our Assessment Plan.
5. Math Software—The department currently uses Maple and several other mathematics software programs. We now have many new faculty, some of whom have experience with other software. We will be reevaluating what software we would like to retain and which we would like to remove, replace, or add.
6. QR requirement – The University is currently working on a LAS program. The new requirements may include a quantitative reasoning course. Quantitative reasoning is also gaining attention in the mathematical community and the country as a whole. We will be discussing how to address the need for a quantitative reasoning course. This may involve transforming developmental math into a QR requirement, transforming our current Finite Mathematics into a QR course, or creating a new QR credit-bearing course.
7. Supplemental Instruction—We are currently looking at adjusting and expanding supplemental instruction (SI). This may involve including Supplemental Instruction sections in more of our courses. As SI expands, we will be in need of a Developmental Math and SI coordinator position, which would ideally be a staff position. One possible adjustment to SI is to include longer sessions and/or giving students credit for the extra time spent in class.
8. BHE plans for Developmental Math—Our current SI program is a response to the guidelines from the BHE regarding math placement testing. We are currently using student's high school GPA to place students into courses supported by SI sessions. We will continue to respond to recommendations and requirements dispensed by the BHE.

9. Grad programs in STEM ED—We are in discussions about streamlining graduate programs for in-service teachers for professional licensure. We have eliminated the inactive MAT program that has been lingering on the books for more than 10 years, and are considering replacing it with a program that will service in-service teachers in mathematics and other sciences, such as biology, chemistry or physics.
10. Statistics – Although some faculty in the department have taken some statistics classes, we do not currently have a statistician on the faculty in this department. Since statistics is an area of mathematics that is highly useful in industry, we will be looking for ways to strengthen our department in that area.
11. Collaboration with other Departments—With the inception of the division of Natural and Health Sciences, there have been more opportunities for the mathematics department to communicate with other departments, such as the STEM Summit, which was held in January, and the STEM Working Group, which is an interdisciplinary group tasked with improving the student experience in STEM on this campus. We plan to continue discussions with our cognate fields on things such as what mathematics their students need to know prior to taking their courses, what mathematics courses their students should take to get that material, and other ways to support students in STEM courses to facilitate their success.
12. Collaboration with Mount Wachusett Community College—For the past few years, we have been in greater communication with our colleagues at Mount Wachusett. This communication has been through meetings organized by the chair of the Biology and Chemistry department, work on assessment organized by the director of assessment, and work on the Mass Transfer program organized by the BHE. We would like to continue our connections with our closest community college neighbor and continue to collaborate for student success in transfer between our two colleges.

Much of this work has already been completed and our next self-study is scheduled for next academic year. I want to point on that this year, #7, the assessment committee has continued refining the rubrics for our assessment plan started a few years ago.

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iii. If you do not have an action plan, would you like help in developing one based on your last program review and needs of the program? _____ Yes

Note: we will work on one of these next year with our Program Self Study and Review Scheduled.

II. Programs with external Accreditation:

- i. Professional, specialized, State, or programmatic accreditations currently held by the program/department.
- ii. Date of most recent accreditation action by each listed agency.
- iii. Date and nature of next review and type of review.

List key issues for continuing accreditation identified in accreditation action letter or report.	Key performance indicators as required by agency or selected by program (licensure, board or bar pass rates; employment rates, etc.) (If required.)	Update on fulfilling the action letter/report or on meeting the key performance indicators.

Section II - Departmental Outcomes

A. Departmental Strategic Initiatives

Accomplished Initiatives AY22-23 <small>Add more rows as needed</small>	Corresponding Strategic Plan Goal & Strategy <small>Goal # followed by Strategy # ex: 1.3</small>	Indicate (X) if a Diversity, Equity and Inclusiveness (DEI) Goal
Put a Data Analytics Minor (interdisciplinary) through governance.	1.3, 1.4	
Add an internship program as an option to the Mathematics major.	1.2,1.4, 2.5, 3.6	
Develop marketing videos for mathematics	5.6	

Planned Initiatives for AY 23-24 <small>Add more rows as needed</small>	Associated Strategic Plan Goal & Strategy <small>Goal # followed by Strategy # ex: 1.3</small>	Indicate (X) if a Diversity, Equity and Inclusiveness (DEI) Goal
Advertise for new Data Analytic minor both internally and to potential new students	1.4, 5.6	
Continue working with marketing to promote mathematics programs.	5.6	

B. Departmental Accomplishments and Reflection:

1. *Initiatives that you may be considering for 23-24 academic year that you did not already capture above*
2. *Any other thoughts or information that you would like to share*

Similar to the previous year, the Mathematics Department managed to get a lot accomplished despite the lack of personnel again. Both Sarah Wright and Rachael Norton were granted full-time leaves and the Mathematics Lab Coordinator (Stella Fatah) left the University in August 2022. Including the Lab Coordinator position, we are down four full-time positions from the 2020 academic year.

Despite this fact, we accomplished quite a bit. With respect to the Lab Coordinator position, one of our adjuncts (Susan Eramo) filled in as a part-time basis and performed well running that program. We have just recently hired a full-time replacement for this position.

In terms of curriculum, we proposed two new courses and a new interdisciplinary minor. This was accomplished in large part by Jessica Oehrlein who joined the Department in Fall 2021 and is finishing her second full year at FSU. Jessie's background in Statistics and Data Science has had a significant impact on our Department. She has a strong background in these fields that allowed us to push ahead with these courses (Introduction to Statistical Analysis and Principles of Data Analysis). The former is an introductory statistics course designed for students with a strong mathematical background and the latter is an introduction to data analysis. These are both required courses for a new minor: Data Analytics. This program is interdisciplinary with Computer Science and Earth and Geographic Sciences and all of these have passed through governance thus far and should begin in the Fall.

Also with respect to curriculum, the capstone course in Applied Mathematics has been updated to allow Mathematics majors to more easily take the course. In a separate proposal, a new internship in Mathematics has been proposed. Mary Ann Barbato has been a member of a Natural Sciences group of faculty in developing materials to make it easier for students and faculty to investigate internship possibilities. In addition, a new course for students receiving credit for internships has passed through governance this year. We hope that internships will be common with our majors in the near future.

We had another successful year of seminar series thanks to Ben Levy, who organized the series. We didn't have any fall talks, however there were five talks in the spring. These mostly corresponded to our Freshman Seminar in Mathematics which had underclass students attend mathematics seminars and reflect on each one.

The seminar series also hosted two larger events this spring

- The Alumni Panel had five alumni return to campus and reflect on their time at FSU in the Mathematics Department and their current jobs. There were about 25 people in attendance for this. It was the first in-person alumni panel in four years and highly regarded.
- Pi Mu Epsilon is a mathematical honors society and the Mathematics Department hosted its induction ceremony in April with thanks to Mary Ann Barbato for organizing. The ceremony formally inducted five students and two faculty (even one from the English Department) and William Martin from Worcester Polytechnic Institute presented a talk entitled *You do the math!* about Mathematics all around you. This was the first in-person ceremony since 2019.

Another annual event that we always celebrate is the Elizabeth Haskins Mathematics Contest, and the Mathematics Department hosted about 60 regional high school students here on campus and many thanks to Gerry Higdon for organizing. This event had about the same number of students as the previous year and unfortunately the number of students is far down from the peak of over 500 which occurred about 8 years ago.

Looking toward 2023-2024

The main item on our Departmental agenda for next year is our self-study. We have begun the planning process already. Many of our longer-term goals will be on hold next year as we self-assess and anticipate comments from the external reviewer. The number of initiatives for next year that we listed above is small due to our self-study.