# External Review of the Department of Mathematics Fitchburg State University

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May 19, 2024

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# 1 Introduction

The mission statement of the Mathematics Department at Fitchburg State University (FSU) is provided here:

> *The mission of the Department of Mathematics is to foster our students' self-reliance in mathematics, to produce graduates who can bring together the theory and practice of mathematics, and to create in graduates strengthened ability for critical and logical thinking.*

It is the goal of this report to discuss in both broad and narrow strokes how the department fulfills its mission through the design of its programs, its service to the university, the support of its students, and the hard work of its diverse and accomplished faculty and staff.

As the external reviewer for the department, I had the opportunity to review the Department Self-Study, which is comprehensive and indicative of the commitment of the Department to maintaining a robust cycle of assessment and improvement of its programs. I received the report in March of 2024 and subsequently visited FSU on April 26, 2024. On the day of the visit, I met with Jennifer Hanselman, Ph.D., the Dean of the School of Health and Natural Sciences, the Department Chairperson Peter Staab, Dean of the Library Jacalyn Kremer and Outreach Librarian for Student Success Lori Steckervetz, a group of ten students, the entirety of the full-time faculty (except those on sabbatical), and then ended the day with a closing meeting with Dean Hanselman and Chair Staab. Unfortunately, I did not have the opportunity to meet with Provost and Vice President for Academic Affairs Dr. Patricia Marshall.

## 1.1 Role of the Department at FSU

As noted in the self-study, the Department plays a critical role at FSU in offering service courses for other majors in addition to serving its own mathematics and mathematics education majors. It is the opinion of this reviewer, in line with a considerable amount of research and a number of policy statements, that the role the department plays in offering its service courses situates it uniquely in the college and university, resulting in a special demand for sufficient support in terms of classroom space, assessment efforts, and above all, faculty and staff.

Nearly every student that enters FSU will be required to take a course offered by the Mathematics Department. Students in STEM majors will take Precalculus and Calculus. Students in other majors will take Applied Statistics or Math in Society. The audience of the Mathematics Department consists of nearly the entire student body at FSU. In addition, students from other majors may opt to complete a minor in mathematics or even

to double major in mathematics. The fact that so many students take mathematics courses has implications that will be expanded on throughout this report.

### 1.2 Relationship with Academic Leadership

During my meeting with Dean Hanselman, I had the opportunity to learn about her thoughts on the role of the Mathematics Department. Dean Hanselman is clearly very supportive of the department and its faculty. She recognizes their contributions to the University and their scholarly work. As evidenced by her commissioning of a study of the foundational mathematics placement and follow-up system, she is dedicated to supporting the department in providing the best experiences for students taking service courses through the Mathematics Department, informed by data-driven assessment and response. In addition, she encouraged the department to implement its embedded tutors program. Finally, she is aware of the decline in department FT/TT faculty and has indicated her support for restoring department faculty numbers despite the financial challenges facing FSU.

### 1.3 This Report

In addition to the Mathematics Department faculty, the audience for this report includes the Dean and Vice President of Academic Affairs, as recommended by the MAA's *Guidelines for Program Review in the Mathematical Sciences* [4].

In the sections that follow, I will outline an overview of the Department and its major programs and general coursework, based on my reading of the self-study and observations made during the site visit. I must add the caveat that I am only one person attempting to review the entirety of the workings of a Mathematics Department based on a one-day visit; I will necessarily have an incomplete picture of the department and will attempt to keep this in mind when making any recommendations. A two-day visit would allow for the reviewer (or a team of reviewers) to paint a better picture of the entirety of the department.

**Recommendation 1.1:** For future evaluations, consider having either a team of two reviewers or a two-day visit for an individual reviewer to perform a more thorough visit of the department.

# 2 Overview of Department and Program Strengths

Being a relatively new chairperson of a Department of Mathematics, I must begin this overview by stating how admirable the faculty has worked together over the years since the previous review to respond to the changing needs of FSU students and the expanding career options mathematics majors encounter. The faculty clearly get along and work well together, keeping student opportunity and success at the forefront of what they do. The department is doing inspirational work. Below are some further observations and reflections on the strengths of the department.

## 2.1 Department Programs and Course Offerings

The Mathematics Department offers an extensive array of courses at the 1000-level through 4000-level. As with most mathematics departments, many 1000-level courses are required for other majors, and in the case of FSU, every student takes a Mathematics Department course to satisfy their Quantitative Literacy general education requirement (unless they have transferred in such courses from elsewhere). As noted earlier, this situates the Mathematics Department uniquely among the natural sciences; indeed, it is no exaggeration to say that almost every student at FSU is impacted by the Mathematics Department faculty.

In addition to offering a Mathematics major, the Department offers concentrations in Applied Math and Secondary Education (9-12). There is a minor for Early Childhood, Elementary or Special Education. Particularly exciting is the development of the minor in Data Science, a collaborative effort between the Mathematics Department and two other departments. The department has been attentive to aligning its programs with department goals, which in turn are influenced by the Mathematical Association of America's *CUPM Curriculum Guide to Majors in the Mathematical Sciences* [11].

In the fall semester of 2023, the department had the opportunity to hire Samantha Walters-Sweeney to the position of *Foundational Mathematics Coordinator*. The responsibilities of the position include developing and maintaining the course modules in which students work in the foundational mathematics courses MATH 0300 (Quantitative Preparation) and MATH 0500 (Algebraic Preparation), as well as the MATH 0400/0401 (Math Preparation Lab). This role is critical in supporting students taking early mathematics courses who may be underprepared for college-level mathematics.

## 2.2 Faculty Activity and Accomplishments

One glance at the CVs of the faculty of the Mathematics Department will reveal that each faculty member is highly engaged in scholarly work, much of which is directly connected

to their teaching. The Department is active in outreach activities, curricular work at the state level, and work that has an impact at the national level. So as not to single out some and leave out others, I will refrain from pointing out specifics. I will note that there is a sustained engagement from the faculty in many areas, including mathematics research, pedagogical research, conference presentations, and work around open educational resources (OER). The faculty are also very involved in service opportunities at FSU, sitting on or chairing various committees and working groups.

### 2.3 Department Facilities and Technology

The Mathematics Department is located in Edgerly Hall. Their offices having been somewhat recently renovated, the main office space being shared with the Department of Computer Science. While I didn't have a chance to visit classroom spaces other than the foundational mathematics center, I heard no great complaints from faculty regarding the math spaces. The self-study describes the technology available to instructors and students and appears to be sufficient.

### 2.4 Student Perspectives

During my visit, I had the pleasure of meeting with a group of eight students. Five students are math majors, two of them completing the Data Science Minor. Two students are Computer Science majors, one with a second major in math and the other with a math minor. The remaining student is an Economics major who is minoring in math.

In general, the students spoke very highly of the faculty of the Mathematics Department. Words like "amazing," "car[ing]," and "help[ful]" were used frequently. They noted that faculty are highly available and go out of their way to meet student needs. They each held the perspective that taking more math would open up future opportunities for them, whether minoring or majoring in math. The students spoke highly of the Freshman Seminar, as well as an alumni panel that was recently held.

Some of the more constructive feedback centered on the feeling that the faculty were "spread too thin," and that at times courses students hoped to take were cancelled due to low enrollments. The math majors expressed a wish that there were more math majors overall (a sentiment with which *any* mathematics department would concur).

Overall, when asked if they would recommend mathematics at Fitchburg State University to a peer, they unanimously agreed, citing the affordability, the quality of education they are receiving, and the fact that "if you get a math degree you can go anywhere in STEM."

### 2.5 The Department Self-Study

The Mathematics Department provided to me a comprehensive self-study. Of note is the thoughtful discussion of department goals and curricular choices. The provided student work materials demonstrate the department's facility with assessing learning outcomes, and the work samples show students are meeting these goals. It is clear that the department takes the cycle of assessment, reflection, and adjustment seriously.

I concur with the self-study in that studying completion rates is not appropriate with a department with such a small number of majors. It is promising that despite a general enrollment decline for several years, there seems to be a bit of an increase in declared Mathematics majors in Fall of 2023.

### 2.6 Response to Previous Evaluation

On pages 23 and 24 of the self-study, the Mathematics Department describes the actions they have taken in response to the previous reviewer's recommendations. It is clear that the department took the recommendations seriously, and I concur that some of the recommendations were not feasible to implement. The department presents a five-year action plan with four core goals, and it is clear that the department has already taken steps to meeting their goals.

## 3 Reflections on the Mission of the Mathematics Department

The programs and courses offered by the Mathematics Department enable it to fulfill its mission of fostering self-reliance in its students and to develop their critical and logical thinking. The department's mission statement aligns with that of the School of Health and Natural Sciences and Fitchburg State University as a whole, particularly regarding the development of skills and habits of mind necessary for analysis and fostering lifelong learning.

### 3.1 Access and Success in STEM

An area in which the department may wish to expand its vision and mission is in being more intentional in the recruitment of students from historically underrepresented groups in mathematics, especially women and people of color. This would add a dimension of civic and global responsibility to the department's mission, and establishes the mathematics department as having an awareness that mathematics, despite its focus on the seemingly

objective endeavors of logical rigor and problem-solving, is not immune to the pernicious and pervasive impacts of inequity in U.S. society.

Indeed, the 2020 Massachusetts Department of Higher Education Vision Statement [5] proposes the following:

> *Significantly raise the enrollment, attainment and long-term success outcomes among underrepresented student populations.*

Given the number of students that the Mathematics Department reaches, it is important for the department to consider its role in the Commonwealth's progress towards attaining this vision, and to make it a core part of its mission.

In the executive summary of its January 2023 report, the National Center for Science and Engineering Statistics (NCSES) [9] states that

> *Hispanic, Black, and American Indian or Alaska Native persons collectively account for 37% of the U.S. population ages 18–34 years in 2021 and 26% of S&E (Science and Engineering) bachelors, 24% of S&E masters, and 16% of S&E doctoral degrees earned by U.S. citizens and permanent residents in 2020.*

and

> *In 2020, women were underrepresented among degree recipients at all degree levels in physical and earth sciences, mathematics and computer sciences, and engineering.*

Since early mathematics courses can be a roadblock for students entering STEM fields (see [9]), the Mathematics Department should be provided the resources necessary to more thoroughly assess student outcomes in early math courses and foundational mathematics, given the unfortunate role of such courses being considered "gateway" courses for STEM careers.

Lastly, to add context, the 2023 Fitchburg State University Institutional Factbook indicates that around thirty percent of undergraduate students at FSU identify as non-white while more than fifty percent identify as female.

**Recommendation 3.2:** The Mathematics Department should revisit its mission statement and consider its role in attaining the Department of Higher Education's Vision Statement regarding increasing the success of underrepresented student populations, particularly in mathematics and other STEM fields.

# 4 Reflections on Programs and Curriculum

The course offerings of the Mathematics Department are comprehensive in scope and depth. There are a number of service courses, discussed in the self-study and more fully below, as well as upper division courses that span the range of abstract and applied mathematics. In this section, I will offer some observations and recommendations regarding the Mathematics and Mathematics Education majors.

Particularly commendable is the 1-credit Freshman Seminar in Mathematics (MATH 1850), in which students can learn about careers in mathematics and the demands of being a math major. Several of the students in the focus group commented on the usefulness of the Freshman Seminar. This appears to be an effective course for developing student interest in the major and retaining majors.

## 4.1 The Applied Mathematics Concentration and Data Science Minor

I wish to note two interesting offerings of the Mathematics Department that illustrate a response to the changing landscape of careers that mathematics students may encounter upon graduation. More than ever, mathematics majors can find jobs in a number of fields that will require their analytical and problem solving skills. The two programs below reflect an effort to very directly address these skills.

- The Department offers a robust Applied Mathematics Concentration, in which students around their late second and third years begin to specialize in courses of a more applied nature, such as Methods of Applied Mathematics (MATH 3500) and Mathematical Modeling (MATH 4450). The Capstone in Mathematics (MATH 4600) is a particularly strong offering, as students have the opportunity to complete a senior project, which involves reviewing literature, formulating a problem and collecting data, and producing a research paper and presentation. The Applied Mathematics concentration strongly supports the Department Learning Outcomes, as described on page 33 of the self-study.

- The Department recently created a Data Analytics Minor. This collaborative effort was spearheaded by new faculty member Dr. Jessie Oehrlien, and represents an example of the department's efforts to work collaboratively in being innovative and responsive to student needs. The creation of this minor involved working with the Computer Science and Environmental, Geographic and Public Health Sciences Department.

## 4.2 The Mathematics Education Major

Dr. Nermin Bayazit is the primary Mathematics Education faculty member of the department, overseeing the Initial Licensure programs in Mathematics 9-12 and Mathematics 5-8 at FSU. Additionally, she is the Chair of the Program Area for Secondary and Middle Level Education (PASM). Along with members of the Department, she maintains alignment of the Mathematics Education major with the various and sometimes changing requirements of the Massachusetts Department of Elementary and Secondary Education (DESE).

In particular, prospective middle and high school mathematics teachers must develop proficiency in the Subject Matter Knowledge (SMK) requirements that DESE stipulates, which can be described as deep knowledge of the mathematics a candidate wishes to teach–including two grade levels above and two grade levels below. Thus, for instance, a 9-12 teacher candidate should have expertise in Grades 7 and 8 mathematics and the first two years of undergraduate mathematics; hence the recommendation by many governing bodies that such teachers obtain a full mathematics major (cf. [2]).

However, the 5-8 teaching candidates are in a challenging position as a full mathematics major may be out of reach. This leaves the challenge of crafting a major that is suitable for such students, so they may satisfactorily complete the FSU initial licensure program and attain the requisite SMKs. To that end, a recommendation for the department is to work in concert with Dr. Bayazit in investigating a pathway for 5-8 students to complete a degree that contains the SMKs but which also allows them to complete their initial licensure program. For example, there may be a way to create an interdisciplinary major that contains the SMKs, or even a mathematics major that is specifically geared towards these students.

Students in initial licensure programs are critical given the persistent need in the region and the Commonwealth for secondary mathematics teachers.

**Recommendation 4.3:** The Mathematics Department should prioritize investigating options for prospective 5-8 mathematics teachers to flexibly complete their initial licensure program without necessarily requiring a full mathematics major. Consult resources such as the CBMS report "Mathematical Education of Teachers II" [2] to creatively craft a pathway for such students.

## 4.3 The Mathematics Major

The Mathematics major features a foundation in Calculus, Linear Algebra, and argumentation and the writing of proofs, all necessary for introducing students to the mathematical rigor required of advanced undergraduate mathematics. There is a required course in Ab-

stract Algebra (MATH 4300) as well as a course in mathematical computing (MATH 2550). In addition to a few other required courses, there are

- a 1-credit Mathematics Seminar (MATH 3900), and
- fifteen additional credits of advanced mathematics (9 of which are at the 4000 level).

The intention of the major is that later in their program students have the opportunity to choose an area of mathematics on which to focus, depending on their future plans (e.g. a student wishing to go to graduate school in mathematics may choose to take a course in real analysis). While noble in intent, it seems that maintaining the major as described has been challenging, especially with the small number of mathematics majors.

The unfortunate reality may be that having such a wide variety of course offerings and so much opportunity for students to select their path may be unfeasible in the current environment. As the self-study indicates, an already stretched-thin faculty are being asked to teach directed studies to fulfill students' plans of study, or as students in the focus group lamented, courses are sometimes cancelled due to low enrollments. For these practical reasons, it may be prudent to streamline the mathematics major to ensure that courses run and faculty resources are able to handle the teaching load demanded by the major. The department already seems to be discussing options for addressing this and related concerns.

A concrete option for revising the major, which aligns with what the department is already considering, is to expand the Capstone in Mathematics (MATH 4600) course to include all Mathematics majors. The capstone can offer students a further opportunity to delve more deeply into a given area through studying accessible papers and/or texts and reporting on their findings, in line with the Senior Project that Applied Math students complete.

In addition–and this is *solely* the opinion of this reviewer–I believe it is imperative that students completing a Mathematics major have exposure to the fundamental concepts of the real number system found in a course like Real Variable Theory (MATH 4000). Perhaps in practice most students take this course; however, the department might consider making it a requirement for the major.

Finally, as a way to better address the department's Learning Outcome 2[1] for all majors, including a course such as Mathematical Modeling (MATH 4550) in the Mathematics major should be considered. The self-study indicates that this PLO is met through the Calculus sequence, but unless students are truly investigating novel modeling situations in these courses, it is more likely the applications come in the form of exercises in applying a given technique to standard real-world problems.

[1] PLO 2: Students should learn to link applications and theory.

A consequence of altering the Mathematics major in this way may likely be a reduction in the number of major electives, but this may have the added effect of reducing directed studies and thus limiting the cancellation of low-enrolled courses.

**Recommendation 4.4:** The Mathematics Department should continue to pursue ways to revise the mathematics major to make offering courses more feasible and better address the department's stated cognitive goals, while maintaining the ability for students to study a particular area in depth.

**Recommendation 4.5:** The Mathematics Department should consider requiring MATH 4600 in the Mathematics major, as well as a course that includes substantial applications like MATH 4450.

### 4.4 Role of the Library

During the site visit, I had a very lively and interesting conversation with Dean of the Library Jacalyn Kremer and Outreach Librarian for Student Success Lori Steckervetz. We discussed some of the ways the Library has supported the Mathematics Department; of note was a recent collaboration on an applied statistics course that focused on social justice topics. The two emphasized that the Library can assist the department in finding data sets and helping students learn to properly manage data. The department should seek opportunities to utilize the expertise of library staff as it continues to offer and grow its Data Science Minor. The Library may also act as a resource in helping students find topics for their Capstone course projects.

## 5 Reflections on Service Courses and Foundational Mathematics

### 5.1 Foundational Mathematics

One of the recurring themes of this report is the importance of the service courses the Mathematics Department offers. As stated in the self-study (p.58):

> *Our foundational mathematics program and introductory mathematics courses are a sizable portion of what we do, an overall strength of our department, and a considerable service to the university and collective student body.*

The report goes on to note that collecting important data and drawing conclusions about student success remains a challenge given the time and resources needed to do this effectively. The report also mentions an internal Student Success Initiative proposal to study

the foundational math program that was not awarded. The recent support offered by Dean Hanselman to study placement and follow-up is a step in the right direction, however, it seems that a major roadblock was that the placement assessment (Accuplacer) lacks sufficient fine-grained student performance data that would provide more information. Alternative tools that have such a student performance breakdown exist but may be more costly to implement (such as McGraw Hill's ALEKS PPL program, which places students up through Calculus I and provides a detailed breakdown of student knowledge based on a number of subcategories).

The upshot is that the department is aware of this need and has sought out the resources to undertake better assessment of foundational mathematics, but has not been entirely successful in obtaining that support. The National Academies of Sciences, Engineering, and Medicine states in its document "Barriers and Opportunities for 2-Year and 4-Year STEM Degrees: Systemic Change to Support Students' Diverse Pathways" [9]:

> *Data collection systems should be adjusted to collect information to help departments and institutions better understand the nature of the student populations they serve and the pathways these students take to complete science, technology, engineering, and mathematics degrees. (p.162)*

Thus, it is imperative that FSU support the creation and implementation of a robust system of assessment of incoming students' mathematical knowledge and skills and their performance in foundational support courses and subsequent coursework.

**Recommendation 5.6:** University leadership should provide the needed resources for the Mathematics Department to better assess the effectiveness of placement and follow-up support for students in need of foundational mathematics.

A small step towards improving the support students receive in foundational and 1000-level mathematics courses is to incentivize students to attend the extra 1-hour sessions. It is my understanding that at the time of writing this report, the Mathematics Department is surveying students and faculty regarding the effectiveness of the extra 1-hour sections and is considering ways to increase participation in extra sessions.

**Recommendation 5.7:** Students should be incentivized to attend additional sessions when enrolled in service courses and in need of extra support.

## 5.2 Service Courses

The DFW rates presented in the self-study for 1000-level courses are quite high. There are many possible reasons for this. Keeping in mind that the DFW rate is only one data

point intending to measure student success in a given course, the Mathematics Department should continue to investigate how to better ensure students are prepared for the mathematics courses they take, receive the just-in-time support they may need, and have every opportunity to be successful, through intentional course design, communication of expectations, and appropriate level of rigor.

The self-study indicates the department is aware of this need, however, there is only so much an already stretched thin department can do. On pp. 52-53, the self-study describes challenges the department faces in staffing its MATH 1300 (Precalculus) course with full-time faculty members and the resulting effect on DFW rates. I will not speculate as to the cause of these effects and leave it up to the department to further investigate this pattern. Whatever the reasons, there is evidently a benefit to having full-time faculty members teaching courses like MATH 1300 and other 1000-level courses. While the self-study notes that MATH 1300 is a pathway into the Mathematics major, the table on pp. 18-19 indicates that MATH 1300 is suggested or required for the following majors: Biology, Chemistry, CIS and Computer Science, Environmental and Earth Science, and Engineering Technology. The impact on STEM majors of having full-time faculty teaching MATH 1300 cannot be overstated. A similar conclusion can be drawn about MATH 1700, 1800, and other mathematics courses required by other majors.

One attempt to address the disparities among sections is better course coordination, i.e., regular discussions among full-time and part-time faculty about learning outcomes, texts and resources, technology, and assignments and assessments.

**Recommendation 5.8:** The Department should increase efforts to staff service courses with full-time faculty, and take steps towards better course coordination so that students taking the same course have the opportunity to attain the same learning outcomes.

# 6 Reflections on Faculty and Staff

In its report, "The Importance of Mathematical Sciences at Colleges and Universities in the 21st Century," [8] the MAA comments on the role of Mathematics Departments in higher education (p. 7):

> *The size and constitution of the faculty in a mathematical sciences department can vary greatly with the size and mission of the institution. The foremost consideration is the presence of sufficient permanent (i.e., tenure- track or long-term contract) full-time faculty to enable the development, implementation, assessment, and ongoing modernization of a curriculum in alignment with the*

*educational needs of a diverse student body in both STEM and non-STEM disciplines within the context of the institution's mission.*

Further, it goes on to cite the following (p. 8):

> *Ultimately, "a central task for mathematics faculty at institutions of higher education, and more broadly, the mathematical sciences community as a whole, is to create a coherent, intriguing introduction to collegiate mathematics for* ***all*** *students. (Saxe & Braddy, 2015, p.2)"*

Again, a mathematics department is rather unique among the natural sciences, and the Mathematics Department as FSU is no different in this regard. One of the main responsibilities of the Mathematics Department at FSU is to create mathematics experiences for all students. Thus there is a need for sufficient faculty to teach major courses and to staff the significant number of 1000-level course sections that are required for other majors or general education.

The department self-study provides data on DFW rates that suggests that having more full-time, tenure-track faculty teaching 1000-level courses can increase student success. Therefore, it is incumbent upon Fitchburg State University leadership to provide the Mathematics Department the opportunity to increase its FT/TT ranks to a level sufficient for staffing a larger proportion of these courses with full-time faculty.

The self-study indicates that three requests for replacement hires have been denied in the time since the previous evaluation. In that time, the department hired Dr. Oherlien; however news was spreading on the day of my site visit that another FT faculty member was leaving the department. This means that the department has seen a loss of at least three full-time tenure track faculty members in a short period of time, yet, the demands on department faculty are arguably greater given what has been outlined in this report. Fully realizing that throughout the Commonwealth pulbic universities are facing financial challenges, having an adequately staffed mathematics department is paramount to the success of students in STEM majors and beyond.

University leadership should consider the ramifications of the declining number of Mathematics faculty, particularly its impact on students taking entry-level mathematics courses and their subsequent success in STEM Majors.

**Recommendation 6.9:** The Mathematics Department should be authorized to hire, at minimum, two full-time tenure-track faculty.

# 7 In Conclusion

Visiting Fitchburg State University and its Mathematics Department was a pleasure. Clearly, this is a group of faculty that are dedicated, accomplished, and student-focused. They have worked hard to respond to the changing needs of their students, and are continually seeking ways to do so. Their self-study provides evidence of their commitment to a cycle of assessment and improvement.

The number of faculty has declined in the face of a growing need for better assessment and support of students who take mathematics courses–nearly every student at Fitchburg State. This decline presents a critical need for more full-time Mathematics faculty, given the impact not just on the department, but on the entire university.

# A References


1. Bressoud, David M. *Attracting and Retaining Students to Complete Two- and Four-Year Undergraduate Degrees in STEM: The Role of Undergraduate Mathematics Education.* Retrieved from

   https://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse_088835.pdf

2. Conference Board of the Mathematical Sciences (2011). *The Mathematical Education of Teachers 2.* American Mathematical Society.

3. Fitchburg State University Office of Institutional Research and Planning (2023). *Fitchburg State University Institutional Factbook.* Retrieved from

   https://www.fitchburgstate.edu/sites/default/files/documents/2023-02/FactBook_2022_23.pdf

4. Gillman, A. G., Herzig, A., and Deirdre Longacher Smeltzer (2024). *Guidelines for Program Review in the Mathematical Sciences.* Mathematical Association of America.

5. Massachusetts Department of Higher Education (2020). *A New Direction for Enhancing Economic Growth and Social Mobility in Massachusetts: An Equity-focused Strategic Framework for Public Higher Education.* Retrieved from

   https://www.mass.edu/strategic/equity.asp

6. Mathematical Association of America (MAA) (2003) *Guidelines for Programs and Departments in Undergraduate Mathematical Sciences.* Retrieved from

   https://maa.org/sites/default/files/pdf/guidelines/Dept-Guidelines-Feb2003.pdf

7. MAA (2010) Guidelines for Serving as a Consultant in the Mathematical Sciences. Retrieved from

   https://maa.org/sites/default/files/pdf/ProgramReview/ConsultantManual.pdf

8. MAA (2018). *The Importance of Mathematical Sciences at Colleges and Universities in the 21st Century.* MAA Task Force report retrieved from

   https://maa.org/programs-and-communities/curriculum-resources/survey-and-reports/task-force-reports#Importance%20to%20Departments

9. National Academies of Sciences, Engineering, and Medicine (2016). *Barriers and Opportunities for 2-Year and 4-Year STEM Degrees: Systemic Change to Support Students' Diverse Pathways.* Washington, DC: The National Academies Press.

   https://doi.org/10.17226/21739.

10. National Center for Science and Engineering Statistics (NCSES) Directorate for Social, Behavioral and Economic Sciences (2023). *Diversity and STEM: Women, Minorities, and Persons with Disabilities.* National Science Foundation, Alexandria, VA, NSF 23-315.

11. Schumacher, C. S. and Siegel, M. J. Co-Chairs, Zorn, P. Editor MAA (2015) *CUPM Curriculum Guide to Majors in the Mathematical Sciences.*

# B List of Recommendations

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