Name of Program/Department:	Mathematics Program
Year:	**2018-19**
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Program Mission Statement

A primary purpose of the Department of Mathematics at Francis Marion University is to offer all University students a varied and well-balanced curriculum of undergraduate education in mathematics. In the liberal-arts tradition, the courses in the curriculum teach students to think logically, to analyze problems and solve them appropriately, and to communicate their ideas clearly.

The department also provides a broad range of entry-level courses in order to meet the needs of students with widely varying mathematical backgrounds and to provide them with skills appropriate for their selected majors. The mathematics courses that satisfy the General Education requirement in mathematics are designed to help students achieve *Goal 5: The ability to use fundamental mathematical skills and principles in various applications.*

Equally important, the curriculum provided by the Department leads to baccalaureate degrees in two distinct but overlapping areas: mathematical sciences and teacher licensure in mathematics. These courses prepare students for careers in education, business, industry, and government. They also prepare those students of sufficient interest and ability for further study of mathematics at the graduate level.

Program Learning Outcomes

1. Students should be able to analyze problems involving various applications and solve them using appropriate mathematical skills, principles, and technology.
2. Students should be able to present oral and written solutions in a structured format that can be understood by a general audience.
3. Students should recognize and appreciate the applicability, beauty, and power of mathematics.
4. Students should be confident in their abilities to use mathematics to solve various problems.

Executive Summary

The Department of Mathematics uses several direct and indirect assessments. The direct assessments of Student Learning Outcomes (SLO) 1.0 (Outcomes 1-4), SLO 2.0 (Outcomes 1-2), SLO 3.0 (Outcomes 1-2), and SLO 5.0 (Outcomes 1-2) are evaluated using a calculus performance rubric, an elementary proof performance rubric, a technology usage performance rubric, and a communication performance rubric from student work samples. Values are the percentages of students who met or exceeded faculty expectations based on the rubrics. The indirect assessments of SLO 1.5[†], SLO 2.3, SLO 3.3, SLO 4.1-4.2, and SLO 5.4 are tabulated from student attitude surveys. Values are percentages of students who state that they are confident in their skills and abilities or have an appreciation for the beauty of mathematics as a singular discipline and its applications.

Academic year 2018-19 assessments show targets were achieved in 11 of 17 outcomes. Students are meeting targets in the use of appropriate technology to solve mathematical problems and the effective communication of mathematics in written form and oral presentations. Since assessments of students' effective communication of mathematics in written form and oral presentations have exceeded the target of 70 in four of the last five years, the target for these outcomes (SLO 5.1-5.2) will be increased to 80 in 2019-20.

Targets were not achieved in 6 of 17 assessed outcomes. The three direct assessments of elementary computational techniques in the calculus course sequence (SLO 1.1-1.3) were not as high as desired for a fourth year in a row. Calculus instructors met at the end of the Spring 2019 semester and concluded that assessment problems of Outcomes 1 and 3 did not accurately measure student performance. Instructors felt that while the problems were good cumulative problems, they did not represent the core concepts required to progress through the calculus sequence. These assessments will be revised for 2019-20. The two direct assessments of the ability to understand and construct elementary proofs (SLO 2.1-2.2) decreased significantly from last year. The decrease was disproportionately evident in Math 230. We will continue to watch this assessment measure to determine if this is an anomaly.

† SLO 1.5 is an abbreviation for SLO 1.0 Outcome 5.

Student Learning Outcomes

SLO 1.0: Students in Math 201, 202, 203, 306, and 499 will be proficient in the elementary computational techniques in the calculus course sequence.   Students in Math 499 will respond to a statement concerning their confidence in their computational techniques in the calculus course sequence.

> Outcome 1: Students will demonstrate competence to calculate derivatives and use them in one or more applications, such as optimization or related rates problems (Math 201/499).
> Outcome 2: Students will demonstrate competence to calculate integrals and use them in various applications, such as area, volume, or average value of a function over an interval (Math 202/499).
> Outcome 3: Students will demonstrate competence to calculate convergence of series and use them in various applications, such as polynomials to approximate functions (Math 203/499).
> Outcome 4: Students will demonstrate competence to calculate gradients and partial derivatives and use them in various applications (Math 306/499).
> Outcome 5: Students will respond to a statement concerning their confidence in their computational techniques in the calculus course sequence (Math 499).

SLO 2.0: Students in Math 230 and 311 will develop the ability to understand and construct elementary proofs. Students in Math 499 will respond to a statement concerning their confidence in their ability to understand and construct elementary proofs.

> Outcome 1: Students will be able to read and understand elementary proofs and be able to determine what constitutes a mathematical proof (Math 230/311).
> Outcome 2: Students will be able to write elementary proofs (Math 230/311).
> Outcome 3: Students will respond to a statement concerning their confidence in their ability to understand and construct elementary proofs (Math 499).

SLO 3.0: Students in Math/CS 212 will be able to use appropriate technology to solve mathematical problems. Students in Math 499 will respond to a statement concerning their confidence in their ability to use appropriate technology to solve mathematical problems.

> Outcome 1: Students will be able to read computer programs that model various mathematical applications (Math/CS 212).
> Outcome 2: Students will be able to write computer programs that model various mathematical applications (Math/CS 212).
> Outcome 3: Students will respond to a statement concerning their confidence in their ability to use appropriate technology to solve mathematical problems (Math 499).

SLO 4.0: Students in Math 499 will appreciate the beauty of mathematics as a singular discipline and its applications.

> Outcome 1: Students will respond to a statement concerning their appreciation for the beauty of mathematics as a singular discipline (Math 499).
> Outcome 2: Students will respond to a statement concerning their understanding of the importance of mathematics in real world applications (Math 499).

SLO 5.0: Students in Math 499 and Student Teaching will be able to effectively communicate mathematics in written form and oral presentations.

Outcome 1: Students will communicate mathematics in a written presentation (Math 499).

Outcome 2: Students will communicate mathematics in an oral presentation (Math 499).

Outcome 3: Secondary education students will demonstrate applications of various strategies and tools in the teaching of mathematical concepts (Student Teaching).

Outcome 4: Students will respond to a statement concerning their confidence in their ability to develop and effectively communicate mathematics in written form and oral presentations (Math 499).

Assessment Methods

The direct assessments (SLO 1.1-1.4, SLO 2.1-2.2, SLO 3.1.3.2, and SLO 5.1-5.2) are evaluations of student work samples normally part of the end of course exam using performance rubrics for calculus, elementary proof, technology usage, and communication. The indirect assessments (SLO 1.5, SLO 2.3, SLO 3.3, SLO 4.1-4.2, and SLO 5.4 are tabulated from a senior survey administered in Math 499 at the end of the semester.

SLO 1.0: Students in Math 201, 202, 203, 306, and 499 will be proficient in the elementary computational techniques in the calculus course sequence. Students in Math 499 will respond to a statement concerning their confidence in their computational techniques in the calculus course sequence.

For outcomes 1-4, instructors of Calculus sequence courses (Math 201, 202, 203, 306) and Mathematics Capstone Course (Math 499) will collect samples of student solutions to problems or other work that call for students to demonstrate proficiency of basic computational techniques in the calculus sequence. Student solutions will be evaluated based on a calculus performance rubric (1 = does not meet faculty expectations; 2 = meets faculty expectations; 3 = exceeds faculty expectations). The target is for 70% of students to meet or exceed faculty expectations. For outcome 5, students will complete a senior survey in the Mathematics Capstone Course (Math 499) with responses of disagree, agree, and strongly agree. The target is for 95% of students to agree or strongly agree.

SLO 2.0: Students in Math 230 and 311 will develop the ability to understand and construct elementary proofs. Students in Math 499 will respond to a statement concerning their confidence in their ability to understand and construct elementary proofs.

For outcomes 1-2, instructors of Discrete Mathematics I (Math 230) and Transition to Higher Mathematics (Math 311) will collect samples of student solutions or relevant problems of other work to demonstrate the ability to understand and construct elementary proofs. Student solutions will be evaluated based on a proof performance rubric (1 = does not meet faculty expectations; 2 = meets faculty expectations; 3 = exceeds faculty expectations). The target is for 70% of students to meet or exceed faculty expectations. For outcome 3, students will complete a senior survey in the

Mathematics Capstone Course (Math 499) with responses of disagree, agree, and strongly agree. The target is for 95% of students to agree or strongly agree.

SLO 3.0: Students in Math/CS 212 will be able to use appropriate technology to solve mathematical problems. Students in Math 499 will respond to a statement concerning their confidence in their ability to use appropriate technology to solve mathematical problems.

For outcomes 1-2, instructors of Introduction to FORTRAN (Math/CS 212) will collect samples of student solutions to relevant problems or other work to demonstrate the ability to use appropriate technology to solve mathematical problems. Student solutions will be evaluated based on a programming performance rubric (1 = does not meet faculty expectations; 2 = meets faculty expectations; 3 = exceeds faculty expectations). The target is for 70% of students to meet or exceed faculty expectations. For outcome 3, students will complete a senior survey in the Mathematics Capstone Course (Math 499) with responses of disagree, agree, and strongly agree. The target is for 95% of students to agree or strongly agree.

SLO 4.0: Students in Math 499 will appreciate the beauty of mathematics as a singular discipline and its applications.

Students will complete senior surveys in the Mathematics Capstone Course (Math 499) with responses of disagree, agree, and strongly agree to statements concerning their appreciation for the beauty of mathematics and their understanding of the importance of mathematics. The target is for 95% of students to agree or strongly agree.

SLO 5.0: Students in Math 499 and Student Teaching will be able to effectively communicate mathematics in written form and oral presentations.

For outcomes 1-3, instructors of the Mathematics Capstone Course (Math 499) and supervisors of student teachers will collect samples of student work and will attend presentations that call for students to effectively communicate mathematics. Student work and presentations will be evaluated based on a communication performance rubric (1 = does not meet faculty expectations; 2 = meets faculty expectations; 3 = exceeds faculty expectations). The target is for 70% of students to meet or exceed faculty expectations. For outcome 4, students will complete a senior survey in the Mathematics Capstone Course (Math 499) with responses of disagree, agree, and strongly agree. The target is for 95% of students to agree or strongly agree.

Assessment Results

SLO 1.0: Students in Math 201, 202, 203, 306, and 499 will be proficient in the elementary computational techniques in the calculus course sequence. Students in Math 499 will respond to a statement concerning their confidence in their computational techniques in the calculus course sequence.

Outcome 1: Forty-six of ninety-six (47.9%) students did demonstrate competence to calculate derivatives and use them in one or more applications, such as optimization or related rates problems (Math 201/499). This was a slight increase of 1.8% from last year but still significantly lower than the target of 70%. This target was not achieved.

Outcome 2: Thirty-five of sixty-nine (50.7%) students did demonstrate competence to calculate integrals and use them in various applications, such as area, volume, or average value of a function over an interval (Math 202/499).   This represents a 5.4% decrease from last year. This target was not achieved.

Outcome 3: Twenty-nine of forty-three (67.4%) students did demonstrate competence to calculate convergence of series and use them in various applications, such as polynomials to approximate functions (Math 203/499). This is very close to the target of 70%. and a 16.2% increase from last year. This target was not achieved.

Outcome 4: Thirty-six of thirty-eight (94.7%) students did demonstrate competence to calculate gradients and partial derivatives and use them in various applications (Math 306/499). This is a 6.5% increase from last year and the fourth straight year of an increase. The target was achieved.

Outcome 5: Nine of nine students did respond that they were confident in their computational techniques in the calculus course sequence (Math 499). This is unchanged from last year. This target was achieved.

SLO 1.1 and SLO 1.3 were below the target of 70% but showed improvement.
SLO 1.2 was below the target of 70% and decreased.
SLO 1.4 and SLO 1.5 achieved the targets of 70% and 95% respectively.
SLO 1.0's overall target was not achieved.

SLO 2.0: Students in Math 230 and 311 will develop the ability to understand and construct elementary proofs. Students in Math 499 will respond to a statement concerning their confidence in their ability to understand and construct elementary proofs.

Outcome 1: Sixteen of twenty-eight (57.1%) students did show ability to read and understand elementary proofs and be able to determine what constitutes a mathematical proof (Math 230/311). This is a 19.4% decrease from last year. This target was not achieved.

Outcome 2: Thirteen of twenty-eight (46.4%) students did show ability to write elementary proofs (Math 230/311). This is a significant 36% decrease from last year. This target was not achieved.

Outcome 3: Nine of nine students did respond that they were confident in their ability to understand and construct elementary proofs (Math 499). This is unchanged from last year. This target was achieved.

SLO 2.1 and SLO 2.2 were below the target of 70% and decreased.
SLO 2.3 achieved the target of 95%.
SLO 2.0's overall target was not achieved.

SLO 3.0: Students in Math/CS 212 will be able to use appropriate technology to solve mathematical problems. Students in Math 499 will respond to a statement concerning their confidence in their ability to use appropriate technology to solve mathematical problems.

Outcome 1: Fourteen of sixteen (87.5%) students did show ability to read computer programs that model various mathematical applications (Math/CS 212). This is an 11.0% increase from last year. This target was achieved.

Outcome 2: Fourteen of sixteen (87.5%) students did show ability to write computer programs that model various mathematical applications (Math/CS 212). This is a 16.9% increase from last year. This target was achieved.

Outcome 3: Eight of nine (88.9%) students did respond that they were confident in their ability to use appropriate technology to solve mathematical problems (Math 499). This is a decrease 12.5% from last year. This target was not achieved.

SLO 3.1 and SLO 2.2 achieved the target of 70%.
SLO 3.3 did not achieve the target of 95%.
SLO 3.0's overall target was not achieved.

SLO 4.0: Students in Math 499 will appreciate the beauty of mathematics as a singular discipline and its applications.

Outcome 1: Nine of nine students did respond that they had an appreciation for the beauty of mathematics as a singular discipline (Math 499). This is unchanged from last year. This target was met.

Outcome 2: Nine of nine students did respond that they had an understanding of the importance of mathematics in real world applications (Math 499). This is unchanged from last year. This target was achieved.

SLO 4.0's overall target was achieved.

SLO 5.0: Students in Math 499 and Student Teaching will be able to effectively communicate mathematics in written form and oral presentations.

Outcome 1: Eight of nine (88.9%) students did communicate mathematics effectively in a written presentation (Math 499). This is a 3.2% increase from last year. This target was achieved.

Outcome 2: Eight of nine (88.9%) students did communicate mathematics effectively in an oral presentation (Math 499). This is a 17.5% increase from last year. This target was achieved.

Outcome 3: Two of two students did demonstrate applications of various strategies and tools in the teaching of mathematical concepts (Student Teaching). This target was achieved.

Outcome 4: Nine of nine students did respond that they were confident in their ability to develop and effectively communicate mathematics in written form and oral presentations (Math 499). This is unchanged from last year. This target was achieved.

SLO 5.0's overall target was achieved.

Table 1.0: Assessment Results

Assessment		2015-16[3]	2016-17	2017-18	2018-19
SLO 1.0	Outcome 1	24.5[2]	34.3	46.1	47.9
	Outcome 2	64.3[2]	58.7	56.1	50.7
	Outcome 3	34.5[2]	48.1	51.2	67.4
	Outcome 4	40.0[2]	68.8	88.2	94.7
	Outcome 5	100.0	100.0	100.0	100.0
SLO 2.0	Outcome 1	53.8	86.4	76.5	57.1
	Outcome 2	53.8	63.6	82.4	46.4
	Outcome 3	100.0	100.0	100.0	100.0
SLO 3.0	Outcome 1	75.0	73.9	76.5	87.5
	Outcome 2	50.0	73.9	70.6	87.5
	Outcome 3	100.0	100.0	100.00	88.9
SLO 4.0	Outcome 1	100.0	100.0	100.0	100.0
	Outcome 2	100.0	100.0	100.0	100.0
SLO 5.0	Outcome 1	100.0	81.8	85.7	88.9
	Outcome 2	100.0	81.1	71.4	88.9
	Outcome 3	*1	*1	*1	100.0
	Outcome 4	100.0	100.0	100.0	100.0

*1 No students participated in student teaching during the academic year.
2. Outcomes 1-4 of SLO 1 were mistakenly not assessed in Math 499.
3. Data is only from Spring 2016.

Action Items

SLO 1.0: Students in Math 201, 202, 203, 306, and 499 will be proficient in the elementary computational techniques in the calculus course sequence.   Students in Math 499 will respond to a statement concerning their confidence in their computational techniques in the calculus course sequence.

> Outcome 1: Students will demonstrate competence to calculate derivatives and use them in one or more applications, such as optimization or related rates problems (Math 201/499).
> Outcome 2: Students will demonstrate competence to calculate integrals and use them in various applications, such as area, volume, or average value of a function over an interval (Math 202/499).
> Outcome 3: Students will demonstrate competence to calculate convergence of series and use them in various applications, such as polynomials to approximate functions (Math 203/499).
> Outcome 4: Students will demonstrate competence to calculate gradients and partial derivatives and use them in various applications (Math 306/499).
> Outcome 5: Students will respond to a statement concerning their confidence in their computational techniques in the calculus course sequence (Math 499).

> *The assessment problems of Outcomes 1-3 were not revised as planned in Fall 2018. After review of Outcomes 1-3 at the end of the Spring 2019 semester, calculus instructors concluded that assessment problems of Outcomes 1 and 3 did not accurately measure student performance. Instructors felt that while the problems were good cumulative problems, they did not represent the*

core concepts required to progress through the calculus sequence. The assessment problems for Outcome 3 will be revised similarly by the beginning of the Fall 2019 semester.

SLO 2.0: Students in Math 230 will develop the ability to understand and construct elementary proofs. Students in Math 499 will respond to a statement concerning their confidence in their ability to understand and construct elementary proofs.

> Outcome 1: Students will be able to read and understand elementary proofs and be able to determine what constitutes a mathematical proof (Math 230/311).
> Outcome 2: Students will be able to write elementary proofs (Math 230/311).
> Outcome 3: Students will respond to a statement concerning their confidence in their ability to understand and construct elementary proofs (Math 499).

> *Assessment scores in Outcomes 1-2 decreased significantly from last year. The decrease was disproportionately evident in Math 230. We will continue to watch this assessment measure to determine if this is an anomaly.*

SLO 3.0: Students in Math/CS 212 will be able to use appropriate technology to solve mathematical problems. Students in Math 499 will respond to a statement concerning their confidence in their ability to use appropriate technology to solve mathematical problems.

> Outcome 1: Students will be able to read computer programs that model various mathematical applications (Math/CS 212).
> Outcome 2: Students will be able to write computer programs that model various mathematical applications (Math/CS 212).
> Outcome 3: Students will respond to a statement concerning their confidence in their ability to use appropriate technology to solve mathematical problems (Math 499).

> *Due to achieved targets in Outcomes 1-2, we will continue to watch this assessment measure and consider raising the target next year. While target was not met in Outcome 3, note that this was a small sample. We will continue to watch this assessment measure also.*

SLO 4.0: Students in Math 499 will appreciate the beauty of mathematics as a singular discipline and its applications.

> Outcome 1: Students will respond to a statement concerning their appreciation for the beauty of mathematics as a singular discipline (Math 499).
> Outcome 2: Students will respond to a statement concerning their understanding of the importance of mathematics in real world applications (Math 499).

> *These targets were met and no action is planned.*

SLO 5.0: Students in Math 499 and Student Teaching will be able to effectively communicate mathematics in written form and oral presentations.

> Outcome 1: Students will communicate mathematics in a written presentation (Math 499).
> Outcome 2: Students will communicate mathematics in an oral presentation (Math 499).

Outcome 3: Secondary education students will demonstrate applications of various strategies and tools in the teaching of mathematical concepts (Student Teaching).

Outcome 4: Students will respond to a statement concerning their confidence in their ability to develop and effectively communicate mathematics in written form and oral presentations (Math 499).

Due to achieved targets in Outcomes 1-2, the target will be increased to 80. We are pleased to have assessment data from student teaching for Outcome 3 for the first time. We will continue to watch this assessment measure.