Name of Program/Department:	Mathematics General Education
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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 4: 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 use fundamental mathematics skills and principles in various applications.
2. Student should be confident in their abilities to use mathematics to solve various problems.

Executive Summary

A primary goal of the Department of Mathematics at Francis Marion University is to offer a well-balanced curriculum of undergraduate education in mathematics. One of the core courses of the department that is also representative of the standards for undergraduate mathematics education is Math 111 College Algebra II. In this course students are assessed on four overall student learning outcomes divided into fifteen measureable outcomes.

Based on research of student enrollment, most students, 73.4% of students enrolled in Fall 2015, have taken or will take Math 111 to satisfy a General Education Requirement in mathematics. The course is taught in both the structured-learning and lecture modes.

The Department of Mathematics uses several direct and indirect assessments. The direct assessments of Student Learning Outcome (SLO) 1.0 (Outcomes 1-3), SLO 2.0 (Outcomes 1-3), SLO 3.0 (Outcomes 1-2), and SLO 4.0 (Outcomes 1-3) are scaled 0-100 based on the algebra performance rubric. The indirect assessments of SLO 1.0 (Outcome 4), SLO 2.0 (Outcome 4), SLO 3.0 (Outcome 3), and SLO 4.0 (Outcomes 4) are tabulated from online student surveys.

Academic year 2021-22 assessments show targets were achieved in 7 of 15 outcomes. Direct assessment SLO 1.1† achieved its target for the first time. SLO 1.3 has consistently achieved its target. SLO 2.1 achieved its target but was lower than previous years. Based on additional requested fields, the number of students completing the indirect assessments (SLO 1.4, SLO 2.4, SLO 3.3, and SLO 4.4) increased dramatically from 50 or less in previous years to almost 200 students. These indirect assessments continued to achieve their targets implying that students are confident in their mathematical abilities.

Targets were not achieved in 8 of 15 outcomes (SLO 1.2, SLO 2.2, SLO 2.3, SLO 3.1, SLO 3.2, SLO 4.1, SLO 4.2, and SLO 4.3). Instructors of Math 111 sections were assigned specific assessment problems to examine student work samples from their classes. The examination identified specific errors and allowed reviewers to make detailed recommendations for instructional improvements as listed in the Action Items section.

† SLO 1.1 is an abbreviated notation for SLO 1.0 Outcome 1.

Student Learning Outcomes

SLO 1.0: Students will be proficient in the techniques for evaluating functions and graphs.
Outcome 1: Students will demonstrate competence to evaluate a function from its graphical representation.
Outcome 2: Students will demonstrate competence to evaluate an exponential function.
Outcome 3: Students will demonstrate competence to evaluate a rational function.
Outcome 4: Students will respond to a statement concerning their confidence in their ability to evaluate functions and graphs.

SLO 2.0: Students will be proficient in the techniques for solving polynomial equations.
Outcome 1: Students will demonstrate competence to solve a polynomial equation with rational solution(s).
Outcome 2: Students will demonstrate competence to solve a quadratic equation with irrational solutions.
Outcome 3: Students will demonstrate competence to solve a geometric word problem leading to a quadratic equation.
Outcome 4: Students will respond to a statement concerning their confidence in their ability to solve polynomial equations, predominantly quadratic equations.

SLO 3.0: Students will be proficient in the techniques for solving rational equations.
Outcome 1: Students will demonstrate competence to solve a rational equation.
Outcome 2: Students will demonstrate competence to solve a word problem involving distance, rate, and time.
Outcome 3: Students will respond to a statement concerning their confidence in their ability to solve rational equations.

SLO 4.0: Students will be proficient in the techniques for solving exponential, radical, and logarithmic equations.
Outcome 1: Students will demonstrate competence to solve an exponential equation.
Outcome 2: Students will demonstrate competence to solve a radical equation.
Outcome 3: Students will demonstrate competence to solve a logarithmic equation.
Outcome 4: Students will respond to a statement concerning their confidence in their ability to solve exponential, radical, and logarithmic equations.

Assessment Methods

SLO 1.0: Students will be proficient in the techniques for evaluating functions and graphs.
SLO 2.0: Students will be proficient in the techniques for solving polynomial equations.
SLO 3.0: Students will be proficient in the techniques for solving rational equations.
SLO 4.0: Students will be proficient in the techniques for solving exponential, radical, and logarithmic equations.

For direct assessments, instructors of College Algebra II (Math 111) will collect student work samples of various graded assignments throughout the semester to assess problems that call for students to demonstrate proficiency in basic computational techniques listed in SLO 1.1 - SLO 1.3, SLO 2.1 – SLO 2.3, SLO 3.1 – SLO 3.2, and SLO 4.1 – SLO 4.3. Student samples will be evaluated based on an algebra performance rubric on a scale from 0 – 100 for each outcome. The target is a mean score of 70 of all direct student assessments.

For indirect assessments of SLO 1.4, SLO 2.4, SLO 3.3, and SLO 4.4 students will have the opportunity to complete a survey on which they will state their confidence (1 = not confident, 2 = confident, and 3 = very confident) in their ability to evaluate or solve the listed equation type(s). The surveys are completed at the end of the semester but before course grades are calculated. The target is mean score of 2.0 of all student responses.

Assessment Results

Direct assessment results were calculated from 485 student work samples in 2021-22. Indirect assessments were calculated from 193 survey responses in 2021-22.

Results are listed in Table 1.0.

SLO 1.0: Students will be proficient in the techniques for evaluating functions and graphs.
      Outcome 1: Students will demonstrate competence to evaluate a function from its graphical representation.
      Outcome 2: Students will demonstrate competence to evaluate an exponential function.
      Outcome 3: Students will demonstrate competence to evaluate a rational function.
      Outcome 4: Students will respond to a statement concerning their confidence in their ability to evaluate functions and graphs.

      Outcome 1 did achieve the benchmark.
      Outcome 2 did not achieve the benchmark.
      Outcome 3 did achieve the benchmark.
      Outcome 4 did achieve the benchmark.
      SLO 1.0's overall benchmark was not achieved.

SLO 2.0: Students will be proficient in the techniques for solving polynomial equations.
      Outcome 1: Students will demonstrate competence to solve a polynomial equation with rational solution(s).

Outcome 2: Students will demonstrate competence to solve a quadratic equation with irrational solutions.
Outcome 3: Students will demonstrate competence to solve a geometric word problem leading to a quadratic equation.
Outcome 4: Students will respond to a statement concerning their confidence in their ability to solve polynomial equations, predominantly quadratic equations.

Outcome 1 did achieve the benchmark.
Outcome 2 did not achieve the benchmark.
Outcome 3 did not achieve the benchmark.
Outcome 4 did achieve the benchmark.
SLO 2.0's overall benchmark was not achieved.

SLO 3.0: Students will be proficient in the techniques for solving rational equations.
Outcome 1: Students will demonstrate competence to solve a rational equation.
Outcome 2: Students will demonstrate competence to solve a word problem involving distance, rate, and time.
Outcome 3: Students will respond to a statement concerning their confidence in their ability to solve rational equations.

Outcome 1 did not achieve the benchmark.
Outcome 2 did not achieve the benchmark.
Outcome 3 did achieve the benchmark.
SLO 3.0's overall benchmark was not achieved.

SLO 4.0: Students will be proficient in the techniques for solving exponential, radical, and logarithmic equations.
Outcome 1: Students will demonstrate competence to solve an exponential equation.
Outcome 2: Students will demonstrate competence to solve a radical equation.
Outcome 3: Students will demonstrate competence to solve a logarithmic equation.
Outcome 4: Students will respond to a statement concerning their confidence in their ability to solve exponential, radical, and logarithmic equations.

Outcome 1 did not achieve the benchmark.
Outcome 2 did not achieve the benchmark.
Outcome 3 did not achieve the benchmark.
Outcome 4 did achieve the benchmark.
SLO 4.0's overall benchmark was not achieved.

Table 1.0: Assessment Results

Assessment Problem	2018-19	2019-20	2020-21	2021-22
Goal 1.0 Outcome 1	67.3	65.1	68.3	73.4
Outcome 2	64.4	59.7	68.1	58.4
Outcome 3	84.6	88.3	86.6	86.8
Outcome 4	2.06	2.14	2.30	2.06
Goal 2.0 Outcome 1	74.8	82.0	80.4	72.8
Outcome 2	57.9	67.7	74.6	63.9
Outcome 3	54.7	54.3	59.1	61.8
Outcome 4	2.33	2.34	2.32	2.23
Goal 3.0 Outcome 1	64.1	70.1	79.4	68.1
Outcome 2	50.5	57.4	65.1	60.2
Outcome 3	2.15	2.24	2.34	2.22
Goal 4.0 Outcome 1	53.3	66.9	67.8	55.9
Outcome 2	54.1	73.9	74.4	59.9
Outcome 3	50.9	70.0	71.1	59.8
Outcome 4	2.02	2.15	2.33	2.08

Action Items

Instructors of Math 111 sections were assigned specific assessment problems to examine student work samples to identify errors students made and suggest tactics to reduce errors.

SLO 1.0: Students will be proficient in the techniques for evaluating functions and graphs.
Outcome 1: Students will demonstrate competence to evaluate a function from its graphical representation.
Outcome 2: Students will demonstrate competence to evaluate an exponential function.
Outcome 3: Students will demonstrate competence to evaluate a rational function.
Outcome 4: Students will respond to a statement concerning their confidence in their ability to evaluate functions and graphs.

Outcome 1: No suggestions recommended.
Outcome 2: The most common error in student work samples was incorrectly identifying the values of A (future value) and P (principal value. Instruction should include practice to quickly identify this type of word problem and use the correct values of A and P.
Outcome 3: No suggestions recommended.

SLO 2.0: Students will be proficient in the techniques for solving polynomial equations.
Outcome 1: Students will demonstrate competence to solve a polynomial equation with rational solution(s).
Outcome 2: Students will demonstrate competence to solve a quadratic equation with irrational solutions.

Outcome 3: Students will demonstrate competence to solve a geometric word problem leading to a quadratic equation.
Outcome 4: Students will respond to a statement concerning their confidence in their ability to solve polynomial equations, predominantly quadratic equations.

Outcome 1: A quarter of the student work samples correctly factored the expression but did not solve the equation. Instruction should stress difference between expressions which are simplified and equations which are solved. More practice factoring expressions should also be included.
Outcome 2: The most common error in student work samples was a sign error in evaluating the discriminant. Instruction should include practice of basic operations with signed numbers and review of simplifying radical expressions
Outcome 3: The most common error in student work samples was no attempt. Instruction should include practice drawing a figure to represent a geometric problem and labelling it according to problem specifications.

SLO 3.0: Students will be proficient in the techniques for solving rational equations.
Outcome 1: Students will demonstrate competence to solve a rational equation.
Outcome 2: Students will demonstrate competence to solve a word problem involving distance, rate, and time.
Outcome 3: Students will respond to a statement concerning their confidence in their ability to solve rational equations.

Outcome 1: The most common errors were incorrectly determining the least common denominator, distributive property mistakes, and arithmetic miscalculation. Instruction should reinforce understanding of LCD by explicitly labeling this as a step in the solution process..
Outcome 2: Instruction for these type of problems directs students to make a Distance, Rate), and Time (DRT) table. The two most common errors were incorrectly stating an expression in the time column and attempting to add/subtract/multiply expressions for time. Instruction should assign a problem for students to work through in class and practice filling in the columns, writing down the DRT equation, and using this relationship in the solution. Also, instruction should emphasize that the resulting equation is a rational equation and should to be approached using the same problem-solving methods learned in section 6.4.

SLO 4.0: Students will be proficient in the techniques for solving exponential, radical, and logarithmic equations.
Outcome 1: Students will demonstrate competence to solve an exponential equation.
Outcome 2: Students will demonstrate competence to solve a radical equation.
Outcome 3: Students will demonstrate competence to solve a logarithmic equation.
Outcome 4: Students will respond to a statement concerning their confidence in their ability to solve exponential, radical, and logarithmic equations.

Outcomes 1-3: The most common errors in student work samples were incorrectly applying arithmetic operations to an equation. Instruction should emphasize the valid things to do to an

equation, such as do the same thing to both sides, switch the equation (if A = B, conclude B = A), and re-express one side and keep the other side going (if A = B and B = C, then conclude A = C).