

Institutional Effectiveness Report
Academic Year 2014-15
Department of Mathematics

General Education Report

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May 29, 2015

Program Mission and Goals

- 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 provide them with skills appropriate for their selected majors.
- Equally important, the curriculum provided by the Department leads to baccalaureate degrees in two distinct but overlapping areas: mathematical sciences and teacher certification 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.
- The Department also offers graduate courses in support of the post-baccalaureate program in teacher re-certification.
- The Department provides experiential learning activities for its majors such as travel to local, regional, and national conferences, field trips to local industries, student research and internships, competition in national modeling contests, and employment in labs and recitations. These experiences expand upon the concepts learned in the classroom and add practice and observation components to complete the learning cycle. Participation in these activities better prepares students for careers after graduation.
- To maintain the vitality of the Department and enhance the University's teaching mission, members of the Department undertake new course development, conduct research in discipline or related areas, or pursue other avenues of faculty development.
- The Department serves the regional community by hosting the annual Pee Dee Regional High School Mathematics Contest and the annual Advanced Placement Calculus Practice Exam. The Department serves the mathematics community by hosting the annual Francis Marion Undergraduate Mathematics Conference and by judging the national High School Modeling Competition in Mathematics (HiMCM). The Department faculty members also participate in various workshops, science colloquia, science fairs, and other programs that enrich the educational and cultural experiences of the region.

General Education Requirement in Mathematics

The General Education requirement in mathematics for most Bachelor of Arts students and all Bachelor of Science students is six hours of mathematics. Some Bachelor of Arts students may only take three hours of mathematics plus three hours of Logic (PRS 203). Math 105 and Math 110 count as general elective college credit but not towards the required six hours of mathematics in the General Education requirements. Thus, mathematics courses must be above Math 110 in order to satisfy any of the required six hours in mathematics. Elementary Education and Early Childhood Education students are required to complete Math 170 and Math 270 to fulfill the General Education requirement in mathematics.

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.*

Student Learning Outcomes for General Education Requirement of Mathematics

Goal 1: Every student 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.

Goal 2: Every student will be proficient in the techniques for solving polynomial equations.

Outcome 1: Students will demonstrate competence to solve a polynomial equation by factoring.

Outcome 2: Students will demonstrate competence to solve a quadratic equation using the quadratic formula.

Outcome 3: Students will demonstrate competence to solve a geometric story problem leading to a quadratic equation.

Goal 3: Every student 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 work-rate problem.

Outcome 3: Students will demonstrate competence to solve a story problem involving distance, rate, and time.

Goal 4: Every student will be proficient in the techniques for solving various 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.

Assessment: Instructors of college algebra II courses will provide samples of solutions from students who receive a grade of C or higher to problems or other work that call for students to demonstrate proficiency of basic computational techniques.

College Algebra II (Math 111) is taught in both the self-paced and lecture mode. Each uses a different textbook and a slightly different approach to the content. The self-paced courses give six tests and no comprehensive final. A student must score at least 70% on each test before he or she can move to the next content area. In the lecture sections, a combination of quizzes, projects, tests, and a comprehensive final exam is given to assess student performance. Therefore, it was agreed that a series of *standardized questions* be included in major tests or the final exam of Math 111. These standardized questions are included in the tests of the self-paced sections and typically the final exam of the lecture sections. Scores on these questions would be included in the student test score but may be stored separately for general education mathematics program assessment purposes.

Professors were given some leeway in the exact *form* of the questions, such as whether to use the “iff” construction and how to lay the questions out on the pages of the Final Examinations. The *content* of the questions was the same for all sections.

→ All results are normalized to 100 points. ← Thus, even a five-point problem has its scores multiplied by 20 so as to yield a score out of 100. The column “A,B,C”’s means among those scoring A, B, or C in the course. Similarly are interpreted the other scores.

It is the department’s opinion that the most relevant number is the performance of students performing “A,B,C”. Those scoring a D or F in the course are required to retake Math 111 in order to get a C or higher and thus be eligible to take the second course in mathematics in order to satisfy the General Education requirement in mathematics. This figure is accordingly presented in bold type. The deviations are computed as a “population” deviation, that is, with n rather than $n - 1$ in the formula.

Fall 2014 data

The assessment data for Fall, 2014 were collected from lecture sections from four instructors and from Self-Paced sections. Those students who did not get at least a C were not part of the data collected or analyzed. The statistics are to be interpreted as in years past. Problem 7 is the same as Problem 22 in years past. As always, all figures are scaled to be as of 100 points.

	Sum	PROBLEM NUMBER									
		2	4	6	8	10	12	14	16	18	20
Those making As, Bs, or Cs:											
Count (L + SP):	151	+	38	=	189						
Mean	63.1	85.9	75.0	65.0	68.7	51.4	38.4	52.0	78.9	66.9	55.8
StDeviation	21.7	32.0	41.1	45.0	38.3	43.4	42.2	44.5	34.9	37.8	36.7
Those making As:											
Count (L + SP):	43	+	4	=	47						
Mean	72.6	92.3	85.5	78.3	85.1	46.4	39.4	63.2	88.3	83.1	64.0
StDeviation	16.8	24.6	33.2	37.7	31.6	42.7	41.0	42.7	23.0	26.2	33.6
Those making Bs:											
Count (L + SP):	48	+	26	=	74						
Mean	67.8	87.8	79.3	67.2	67.2	59.1	50.5	56.8	84.1	74.2	60.5
StDeviation	22.0	29.0	38.9	44.0	39.0	44.6	45.8	45.0	30.4	35.7	34.8
Those making Cs:											
Count (L + SP):	60	+	8	=	68						
Mean	51.6	79.3	63.1	53.4	59.0	46.6	24.5	39.2	66.9	47.6	44.9
StDeviation	19.2	38.0	45.2	47.7	38.0	41.4	34.1	42.0	42.2	38.6	38.2

In lecture sections, the assessment problems are folded into the regular final examination. A little over half the final is taken with assessment problems, the remainder of the final is completely at the discretion of the instructor. Self-paced sections found similar problems throughout their curriculum. A description of the assessment problems follows:

- 02 Solve for x by factoring
- 04 Solve for x with the quadratic formula
- 06 Solve for x in a rational equation
- 08 Simple geometric story problem
- 10 Work-rate problem
- 12 Story problem involving distance, rate, and time
- 14 Problem involving money lent at interest
- 16 Function-with-story-attached problem
- 18 Quadratic-function-with-story attached, with max or min value to be reported
- 20 Solving for x in equations involving powers, roots, and logarithms.
- 07 Reading information from the graph of a function

Spring 2015 data

The assessment mechanism for Spring 2015 was collected from lecture sections from four instructors and from self-paced sections from two instructors. Several professors do not submit data on students who get an F; these students are not considered part of the assessment data and the F's tabulated here are only of those that are reported. As always, all figures are scaled to be as of 100 points.

		PROBLEM NUMBER											
	Sum	2	4	6	8	10	12	14	16	18	20	7	
Those making As, Bs, or Cs:													
Count (L+SP)	110.0	=	75		+	35							
Mean	78.8		83.6	75.0	88.0	84.2	72.8	81.6	73.6	82.5	77.8	72.5	77.8
<u>StDeviation</u>	18.5		36.4	37.0	28.0	30.1	40.2	35.9	43.2	34.8	30.2	32.4	29.2
Those making As:													
Count(L+SP)	35.0	=	21		+	14							
Mean	89.7		94.3	82.0	96.6	97.7	86.6	91.4	85.7	88.3	93.3	83.4	87.7
<u>StDeviation</u>	12.2		23.2	33.4	12.2	10.2	30.9	24.5	35.0	29.4	17.2	29.6	18.2
Those making Bs:													
Count(L+SP)	42.0	=	24		+	18							
Mean	82.9		85.7	78.3	87.6	81.4	81.0	91.7	83.2	88.8	83.0	73.0	79.8
<u>StDeviation</u>	13.4		33.2	35.1	27.9	32.0	35.6	26.0	36.3	29.0	23.6	29.0	29.0
Those making Cs:													
Count(L+SP)	33.0	=	30		+	3							
Mean	61.9		69.7	63.2	79.4	73.5	47.9	58.3	48.5	68.5	54.7	60.2	64.8
<u>StDeviation</u>	18.0		46.0	40.0	36.2	35.9	43.0	44.9	48.5	42.0	34.5	35.1	33.7

Results: In consultation with course instructors, the Department Assessment Committee will review and judge the data and make recommendations. The benchmark assessment score of students with a course grade of C or higher is 70 which was achieved in the spring but not fall semester. The 2014-15 year score was 68.9, just below the benchmark.

Assessment Activities

Although any six hours of mathematics above Math 110/110L may be used to satisfy the General Education requirement, the Department of Mathematics will restrict its analysis of understanding of fundamental mathematical principles and the skills to apply them to Math 111 and as well as the Math 170/270/370 sequence for Early Childhood and Elementary Education majors. These courses eventually include a large majority of each entering freshman class. About a third of each entering freshman class is placed in Math 105 and 110/110L, which does not yield general education credit. Those students normally take Math 111 as their next mathematics course.

The Department of Mathematics uses several assessment tools, such as an internal assessment exam, an internal portfolio analysis, the University student and course evaluations, and the external Praxis I (PPST Mathematics) or Praxis Core exam.

Assessment	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Overall quality of Math 111 course as a learning experience ¹	1.81	1.95	1.82	1.89	1.90	1.77	1.80
Overall quality of Math 170 course as a learning experience ¹	2.70	2.72	2.32	1.47	1.50	1.46	1.43
Overall quality of Math 270 course as a learning experience ¹	1.82	1.90	1.41	1.72	2.07	1.49	1.46
Mean assessment score out of 100 points of students who received an A, B, or C in Math 111 ²	70.0	78.2	57.7	63.6	70.2 ³	74.0	68.9
Percentages of elementary and early childhood education majors who passed Praxis I Math <u>given that they have completed</u> the Math 170/270/370 sequence and who passed Praxis I Math <u>given that they have not completed</u> the Math 170/270/370 sequence ²	72.7 and 59.4	82.4 and 69.4	90.9 and 67.4	94.1 and 70.0	81.5 and 75.0	50.0 and 36.8	61.5 and 40.7

1. Data as recorded on University Course and Instructor Evaluations (1-excellent, 2-good, 3-fair, 4-poor, 5-cannot rate).
2. Revised presentation of assessment data. Explanation of assessment described in designated section.
3. Fall 2013 data from Self-Paced classes were not included due to error in communication.

Primary Issues Identified and Actions Taken

Issues of Concern	Actions Taken
<p><i>Validity of Math 111 Assessment Questions</i></p> <p>Math 111 students who have taken their Final Exam seem to be discussing the assessment questions, which are typically used on each Math 111 Final Exam, with Math 111 students who have not taken their Final Exam.</p>	<p>Beginning in the Fall 2010 semester, a departmental Final Exam, which includes the assessment questions, will be given to all Math 111 lecture sections on the last day of Exam Week.</p> <p><i>Spring 2012 Update: Math 111 Final Exams were un-departmentalized in Spring 2012 because of the issue below. Standardized problems, as noted in Math 111 Assessment section, were included in Spring 2012 Final Exams. Assessment scores have returned to the 70s range in Spring 2012.</i></p> <p>RESOLVED</p>
<p><i>Low Math 111 Assessment Scores</i></p> <p>The departmental Math 111 Final Exam required scheduling for the last day of exam. The exam is also offered in the crowded Chapman Auditorium. We believe these two issues contributed to low scores. This claim supported by more typical assessment scores by summer school students.</p>	<p>Math 111 Assessment Questions have been included in tests throughout the semester and the final exam in each specific section.</p> <p><i>Spring 2014 Update: Mean score of assessment problems rebounded above 70 for students who earned a grade of C or higher in 2012-13.</i></p>

<p><i>Proper placement of incoming freshmen based upon high school achievement</i></p> <p>A crucial goal of the Department is to have all incoming freshmen enrolled in an appropriate mathematics course in the fall semester. All freshmen and transfer students needing mathematics general education credits are placed into mathematics courses by the department chair. These placements are based on SAT or ACT scores, high school background, intended major, and any clarifying interviews. While this process seems to have worked well over the past years, it requires a lot of work on the part of the department chair.</p>	<p>Dr. Fitzkee, Chair of Mathematics, has committed to spending numerous hours during the summer placing incoming students in mathematics courses.</p> <p><i>Summer 2013 Update: Dr. Fitzkee has discussed a computer administered Mathematics Placement Test with Hawkes Learning Systems which would provide important information for mathematics placement.</i></p>
Issues of Concern	Actions Taken
<p><i>Consistency of topics covered in non-terminal mathematics courses</i></p>	<p>Department Curriculum Committee has agreed on formative standards.</p> <p>RESOLVED</p>
<p><i>Low percentage of elementary and early childhood education majors that pass Praxis Mathematics.</i></p> <p>In the 2013-14 academic year, the percentage of elementary and early childhood education majors who passed Praxis Mathematics exam given that they have completed the Math 170/270/370 sequence was 50.0%. The percentage who passed Praxis Mathematics exam given that they have not completed the Math 170/270/370 sequence was 36.8%.</p>	<p>Praxis I has been replaced by Praxis Core. Dr. Sharon O’Kelley and Dr. Bill Whitmire will include more Praxis Core sample problems in the Math 170/270/370 course sequence. They will also discuss with the School of Education the timing of elementary and early childhood education majors taking the Praxis Core exam.</p> <p><i>Summer 2015 Update: Percentages have rebounded in 2014-15 but still not as high as years prior to 2013-14.</i></p>

Assessment of Math 170/270/370 Sequence

The results of Praxis I (now replaced by Praxis Core) Mathematics Exam, a national Educational Testing Service exam required for our Elementary and Early Childhood Education majors, are used to validate an understanding of fundamental mathematical principles and the skills to apply them for these two courses, Math 170 and 270. Since the Exam includes topics in geometry covered in Math 370, we had strong consideration of students who successfully complete the mathematics education course sequence of Math 170/270/370 which is the mathematics requirement for students majoring in Elementary and Early Childhood Education.

Eighty-five Elementary and Early Childhood Education students took the Praxis I Exam Mathematics section (May 1, 2014 to April 30, 2015). Their results cross listed with their completion of the Math 170/270/370 sequence are listed below.

	Completion of Math 170/270/370 sequence	Non-completion of Math 170/270/370 sequence	Total
Praxis I Math Passing score	16	24	40
Praxis I Math Non-passing score	10	35	45
Total	26	59	85

Currently this is a 47.1% pass rate of the Mathematics Section of the Praxis I Exam by Elementary and Early Childhood Education majors. Of the 26 students who completed the Math 170/270/370 sequence, 16 students (or 61.5%) earned a passing score on the Exam. Of the 59 students who have not completed the Math 170/270/370 sequence, 24 students (or 40.7%) earned a passing score on the Exam.

The passing percentage for completers (61.5%) is still significantly higher than for non-completers (40.7%) as has been true since 2008-09. The passing rate for completers is an improvement from last year (50.0%). Mathematics content and timing of students' attempts of the Praxis Exams with the School of Education continued to be studied.