

Institutional Effectiveness Report  
Academic Year 2012-13  
Department of Mathematics

General Education Report

*Dr. George E. Schnibben*  
*(Institutional Effectiveness Coordinator)*

*Dr. Thomas Fitzkee*  
*(Department Chair)*

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### *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.*

### *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 Math 121, as well as the Math 170/270/370 sequence for Early Childhood and Elementary Education majors. These courses eventually include about 90% of each entering freshman class. About 30% of each entering freshman class is placed in Math 105 and 110/110L, which does not yield general education credit. The other main courses such as Math 132, 134, 140, and 150 will be considered service courses as evaluated using service criteria.

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) exam.

Assessment	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Overall quality of Math 111 course as a learning experience <sup>1</sup>	1.91	1.89	1.81	1.95	1.82	1.89	1.90
Overall quality of Math 120 course as a learning experience <sup>1</sup>	1.75	1.78	1.78	2.02	Math 120 deleted	Math 120 deleted	Math 120 deleted
Overall quality of Math 121 course as a learning experience <sup>1</sup>	2.21	2.36	1.97	1.96	2.38	2.00	1.63
Overall quality of Math 170 course as a learning experience <sup>1</sup>	1.47	1.93	2.70	2.72	2.32	1.47	1.50
Overall quality of Math 270 course as a learning experience <sup>1</sup>	1.53	1.37	1.82	1.90	1.41	1.72	2.07
Mean assessment score out of 100 points of students who received an A, B, or C in Math 111 <sup>2</sup>	67.0	73.2	70.0	78.2	57.7	63.6	70.2 <sup>3</sup>
Assessment of Math 120 Portfolios (out of 60 points) <sup>2</sup>	Not evaluated with current numerical assessment method	45.9	43.1	42.1	Math 120 deleted	Math 120 deleted	Math 120 deleted
Assessment of Math 121 Portfolios (out of 60 points) <sup>2</sup>	Not evaluated with current numerical assessment method	47.2	41.3	43.6	40.7	33.7	33.9
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 <sup>2</sup>	Not evaluated with current numerical assessment method	68.0 and 80.6	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

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 During 2006-2013*

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>Spring 2012 Update: Math 111 Final Exams were undepartmentalized 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.</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>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 himself to spending numerous hours during the summer placing incoming students in math courses.</p> <p>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.</p>
<p><i>Consistency of topics covered in non-terminal mathematics courses</i></p>	<p>Our Curriculum Committee has agreed on formative standards.</p>

## *Assessment of Math 111*

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 the 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 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.

## *Data taken in Fall 2012*

### Executive Summary

The assessment mechanism for Fall, 2012 had one very serious failing: no data from the self-paced program were available, and all data are from the lecture sections. In all, 176 data-records were taken, 113 of which were of students who passed the course with a C or higher. The data were put through their usual grinder and the following statistics came out. 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.

	PROBLEM NUMBER											
	Sum	2	4	6	8	10	12	14	16	18	20	7
Those making As, Bs, or Cs:												
Cardinality	113.0											
Means	<b>65.6</b>	<b>89.2</b>	<b>53.6</b>	<b>46.5</b>	<b>79.7</b>	<b>54.8</b>	<b>70.3</b>	<b>70.9</b>	<b>85.4</b>	<b>58.2</b>	<b>66.3</b>	<b>62.5</b>
Deviations	14.6	29.1	38.2	41.9	35.8	42.8	38.3	42.6	34.8	34.7	31.4	34.9
Those making As:												
Cardinality	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Means	80.9	97.0	77.3	57.9	90.6	84.5	88.8	80.9	100.0	72.5	78.3	74.2
Deviations	14.0	17.1	31.6	44.5	25.1	31.8	29.5	36.7	0.0	33.3	32.3	31.6
Those making Bs:												
Cardinality	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0
Means	69.4	94.8	56.2	55.5	87.1	55.7	81.0	71.4	79.8	60.0	72.6	66.4
Deviations	13.1	21.4	39.6	40.5	30.7	47.7	35.0	42.1	41.1	32.8	30.0	35.8
Those making Cs:												
Cardinality	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0
Means	53.9	80.0	38.5	32.2	67.0	37.8	50.4	65.0	82.6	48.7	53.9	52.5
Deviations	16.0	38.7	40.2	41.8	44.2	43.1	45.0	46.0	37.9	37.0	32.3	35.7
Those making Ds:												
Count	31.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0	31.0
Mean	44.9	81.3	33.9	10.6	51.3	50.0	31.3	49.7	79.4	33.5	43.2	53.2
StDeviation	11.6	44.0	40.0	26.5	43.7	44.4	38.3	46.5	39.2	38.1	36.4	34.2
Those making Fs:												
Count	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0	32.0
Mean	23.7	58.8	11.9	8.1	21.9	11.9	13.1	33.8	54.7	15.6	19.5	33.4
StDeviation	11.4	46.1	29.0	17.4	36.8	27.2	29.9	45.1	48.5	30.8	28.1	32.6

### Explanation of the assessment problems

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 being 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

### *Data taken in the Spring 2013*

#### **Executive Summary**

The assessment mechanism for Spring, 2013 went fairly well. Fifteen students' worth of data, all from the Self-Paced Program, could not be used because the course grade was not included; there were in all 130 student's worth of data to work with. The data were put through their usual grinder and the following statistics came out. 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.

	P R O B L E M   N U M B E R											
	Sum	2	4	6	8	10	12	14	16	18	20	7
Those making As, Bs, and Cs:												
Cardinality	100.0											
Means	<b>75.4</b>	<b>97.0</b>	<b>74.3</b>	<b>67.4</b>	<b>79.6</b>	<b>70.6</b>	<b>73.8</b>	<b>77.1</b>	<b>88.4</b>	<b>61.0</b>	<b>81.4</b>	<b>77.4</b>
Deviations	16.4	22.2	37.4	43.3	34.7	41.8	40.3	41.3	31.5	34.4	26.5	29.2
Those making As:												
Cardinality	15.0											
Means	<b>88.5</b>	100.0	80.0	85.3	96.7	83.3	100.0	93.3	93.3	71.1	100.0	84.3
Deviations	6.9	0.0	27.1	28.5	12.5	35.0	0.0	24.9	24.9	26.9	0.0	21.0
Those making Bs:												
Cardinality	52.0											
Means	<b>78.4</b>	96.2	77.7	72.9	79.9	75.2	76.3	85.2	88.5	62.4	81.0	83.8
Deviations	13.6	27.5	37.4	41.5	35.5	40.3	40.4	34.4	31.9	34.4	24.1	29.7
Those making Cs:												
Cardinality	33.0											
Means	<b>64.9</b>	97.0	66.4	50.5	71.4	57.6	57.7	56.8	86.1	54.1	73.6	64.2
Deviations	17.4	17.1	40.0	46.0	37.4	43.7	42.2	49.0	33.1	36.1	31.6	26.9

*Submitted by Dr. Damon Scott, Professor of Mathematics.*



## *Assessment of Math 121*

Portfolios are a required component of Math 121. Assessment involves the collection of representative portfolios from each semester. Examples of excellent (A/B), good (C), and poor (D/F) student portfolios for each section every semester are reviewed. The portfolios contain reflective summaries of what the student learned in the course in addition to copies of all graded work, including tests, projects, and homework. These are examined both in terms of Goal 6 but also in student growth in communications, mathematical analysis, mathematical modeling, and technology. The notebooks of portfolios will be placed on a shelf in L403.

**Data Collection** For this assessment we collected copies of portfolios from all instructors of Math 121. They were asked to provide the portfolio of a successful (A or B) student, an average student (C), and an unsuccessful student (D or F). This should give a cross-section of abilities in courses that represent approximately 60 students fulfilling the mathematics general education requirements. It should be noted that students must attain a grade of C or higher to move on to a higher mathematics course.

Our criteria for this assessment were the goals drafted in Spring 2005:

1. Be able to represent, interpret, and interconnect a function symbolically, verbally, graphically, and numerically.
2. Be able to manipulate functions: to evaluate for a given input, to find  $x$ - and  $y$ -intercepts, to solve equations in one variable, to graph a function from its symbolic form.
3. As a minimum at the end of fulfilling their general education requirements, students should know and understand (have facility to meet the above two goals for) linear, polynomial, exponential, and logarithmic functions.
4. Understand and be able to use the concept of slope as a rate of change.
5. Learn to be confident and aggressive problem-solvers
6. Learn good scholarly habits toward progressive student independence
7. Learn to apply mathematics to real world problems
8. Communicate mathematics through reading and writing [Model English with mathematics; interpret mathematics into English]
9. Learn mathematical modeling as the art of applying mathematics to the real world [Recognize when a quantitative model may be useful]
10. Use the computer and calculator as tools for learning and problem solving [Appreciate the role of machines as aids in learning (exploration and discovery) and doing (tedious calculations, more sophisticated problems, future uses of technology)] [Manipulate and analyze data]

The first four goals should be evidenced in the tests the students took. All ten goals should be evidenced in the four projects that each student submitted. Note that all of these projects were group submissions.

**Format of the Assessment.** As in the Spring 2008 assessments, the following numerical scale was used for each goal:

- 6 – two evidences of success with linear, polynomial, exponential, and logarithmic functions
- 5 – two evidences of success with 3 of the 4 functions, including linear functions
- 4 – two evidences of success with 2 of the 4 functions, including linear functions
- 3 -- two evidences of success with 1 of the 4 functions, only linear functions
- 2 – one evidence of success with 4 of the 4 functions, including linear functions
- 1 -- one evidence of success with at least 2 of the 4 functions, including linear functions
- 0 -- one evidence of success with at least 1 of the 4 functions

Utilizing this scale, a perfect portfolio would have a score of 60.

**Assessment Results** In completing this assessment we received 9 Math 121 portfolios (three portfolios from three sections) from one instructor for the academic year. Please note that copies of tests and projects do not differentiate between red ink, black ink, and pencil. So in some cases it's hard to differentiate between instructor writing and student writing, and sometimes pencil entries are hard to reproduce. Also, colored sheets sometimes were copied as black.

In general, the Math121 students performed well on the exams (skill-based) and less well on interpretation and communicating mathematical understanding (projects). The reflective summaries were included in the portfolios. The portfolios were extremely well organized.

Goals

	1	2	3	4	5	6	7	8	9	10	Total
a	6	6	6	6	5	5	5	6	6	5	56
b	3	3	3	3	3	3	3	2	2	3	28
c	1	1	1	2	1	1	2	2	2	2	15
d	5	5	5	5	5	5	5	6	5	6	52
e	3	3	3	3	2	2	3	3	3	3	28
f	4	2	2	2	1	2	2	2	2	2	21
g	6	6	6	6	6	6	5	6	6	6	59
h	4	2	3	3	3	2	2	3	3	2	27
i	4	5	2	2	1	1	1	1	1	1	19
Average	4.0	3.7	3.4	3.6	3.0	3.0	3.1	3.4	3.3	3.3	33.9

All the averages are at least 3.0. Overall, scores are on average higher this year than last. Although the lowest scores this year are really low. Overall, writing seems to be the main issue for this course.

*Submitted by Dr. David Szurley, Assistant Professor of Mathematics.*

*Assessment of Math 170/270/370 Sequence*

The results of Praxis I (Pre-Professional Skills Test) 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 Praxis I Mathematics Exam includes topics in geometry covered in Math 370, we had strong consideration of students who successfully complete the mathematics education sequence of Math 170/270/370 which is the mathematics requirement for students majoring in Elementary and Early Childhood Education.

Fifty-nine Elementary and Early Childhood Education students took the Praxis I Exam (PPST) Mathematics section (May 1, 2012 to April 30, 2013). 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	22	24	46
Praxis I Math Non-passing score	5	8	13
Total	27	32	59

Currently this is a 78.0% pass rate of the Mathematics Section of the Praxis I Exam by Elementary and Early Childhood Education majors. Of the 27 students who completed the Math 170/270/370 sequence, 22 students (or 81.5%) earned a passing score on the Exam. Of the 32 students who have not completed the Math 170/270/370 sequence, 24 students (or 75.0%) earned a passing score on the Exam.

It is noted that the passing percentages (81.5% for completers and 75.0% for non-completers) are closer than in recent years. However, we feel confident that our Math 170/270/370 sequence is fulfilling Goal 5 of the General Education requirements and well preparing Elementary and Early Childhood Education majors.

*Submitted by Dr. Thomas Fitzkee, Chair and Professor of Mathematics.*