# Institutional Effectiveness Report
# Academic Year 2014-15
# Department of Mathematics

# Mathematics Program Report

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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 area, 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 Mathematical Competition in Modeling (HiMCM). The Department faculty members also participate in various workshops, science colloquiums, science fairs, and other programs that enrich the educational and cultural experiences of the region.

*Student Learning Outcomes for Mathematics Program*

Goal 1: Every student will be proficient in the elementary computational techniques in the calculus course sequence.
> Outcome 1: Students will demonstrate competence to calculate derivatives and use them in various 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).

Assessment: Instructors of Calculus sequence courses and Mathematics Capstone course will provide 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 the Likert-scale (1 = does not meet faculty expectations; 2 = meets faculty expectations; 3 = exceeds faculty expectations). The benchmark goal is for 60% of students to meet or exceed faculty expectations.

Goal 2: Every student will develop the ability to understand and construct elementary proofs.
> Outcome 1: Students will be able to read and understand elementary proofs (Math 230/311).
> Outcome 2: Students will be able to determine what constitutes a mathematical proof (Math 230/311).
> Outcome 3: Students will be able to write elementary proofs (Math 230/311).

Assessment: Instructors of Discrete Mathematics and Transitions to Higher Mathematics course will provide 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 the Likert-scale (1 = does not meet faculty expectations; 2 = meets faculty expectations; 3 = exceeds faculty expectations). The benchmark goal is for 60% of students to meet or exceed faculty expectations.

Goal 3: Students will be able to use appropriate technology to solve mathematical problems.
> Outcome 1: Students will be able to read computer programs to model various mathematical applications (Math/CS 212 or 226).
> Outcome 2: Students will be able to write computer programs to model various mathematical applications (Math/CS 212 or 226).

Assessment: Instructors of computer programming courses will provide samples of student solutions to relevant problems of other work to demonstrate the ability to use appropriate technology to solve mathematical problems. Student solutions will be evaluated based on the Likert-scale (1 = does not meet faculty expectations; 2 = meets faculty expectations; 3 = exceeds faculty expectations). The benchmark goal is for 60% of students to meet or exceed faculty expectations.

Goal 4: Students will develop an appreciation for the beauty of mathematics as a singular discipline and its application in other subject areas.
> Outcome 1: Students will be able to demonstrate appreciation for the beauty of mathematics.
> Outcome 2: Students will be able to understand the importance of mathematics in related subject areas.

Assessment: Students will complete senior surveys and Ready to Experience Applied Learning (REAL) surveys based upon participation in REAL and Science Symposiums.  The benchmark is for 75% of students to demonstrate an appreciation for mathematics and its relevance in other subject areas.

Goal 5: Students will develop and 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 mathematical concepts (Student Teaching).

Assessment: Instructors of the Mathematics Capstone course and student teacher supervisors will provide samples of student work and attend presentations that call for students to effectively communicate mathematics.  Student work and presentations will be evaluated based on the Likert-scale (1 = does not meet faculty expectations; 2 = meets faculty expectations; 3 = exceeds faculty expectations).  The benchmark goal is for 60% of students to meet or exceed faculty expectations.

## *Assessment Activities*

The Department of Mathematics uses several assessment tools, such as an internal Exit Exam, an internal Senior Survey, the University student and course evaluations, and the external Praxis II mathematics test. Faculty service and scholarship are assessed using faculty annual reports.

| Assessment | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | | 2014-15 |
|---|---|---|---|---|---|---|---|---|
| Mean Exit Exam score on required portion[1] | 62 | 34 | 72 | 52 | Not administered[10] | Not administered[10] | | 78 |
| Percentage of graduating students known to be accepted to Graduate School or offered Position in Teaching, Business, Industry, or Gov't[2] | 62.5% | 50% | 0%[9] | 50% | 50% | 50% | | 60% |
| Happiness in majoring in mathematics[3,8] | 1.36 | 1.3 | 1.7 | 1.75 | 1.3 | 1.4 | | 1.2 |
| Helpfulness in mathematics courses[3,8] | 1.55 | 1.7 | 1.7 | 1.75 | 1.6 | 1.6 | | 1.7 |
| Effectiveness on mathematics instructors[3,8] | 1.73 | 1.6 | 1.7 | 1.625 | 1.7 | 1.5 | | 1.4 |
| Quality of the mathematics program[8] | 1.915[5] | 1.705[5] | 2.3[5] | 2.0[5] | 1.6[5] | 1.5[5] | | 1.3[5] |
| Quality of instruction[6] | 1.79 | 1.55 | 1.91 | 1.65 | 1.67 | 1.44 | | 1.49 |
| Availability of instructor outside the classroom[7] | 1.52 | 1.37 | 1.66 | 1.39 | 1.45 | 1.12 | | 1.31 |
| Overall quality of course as a learning experience[6] | 1.79 | 1.58 | 1.94 | 1.64 | 1.79 | 1.46 | | 1.53 |
| Percentage of students who passed the Praxis II Math Content Knowledge score[8] | 100% | 100% | 100% | NA | 100% | - | 50%[11] | 100%[11] |
| Percentage of students who passed the Praxis II Math Proofs and Models score[8] | 100% | 100% | 100% | NA | 50% | 100% | | |
| Number of scholarly activities by math faculty[8] | 24 | 28 | 22 | 33 | 32 | 29 | | 36 |
| Mean number of experiential learning activities for each Math 499 student | 4.0 | 1.9 | 2.0 | 3.75 | 4.1 | 4.1 | | 3.1 |

1. Exit Exams scores are out of 100 points and were introduced in Spring 2008, but scores were not been recorded until Fall 2008.
2. Percentage success as stated during Exit Interview which began in Spring 2008.
3. Data recorded from Senior Survey based upon a four point scale (1-strongly agree, 2-agree, 3-disagree, 4-strongly disagree).
4. Data recorded from Senior Survey based upon a five point scale (1-excellent, 2-good, 3-adequate, 4-fair, 5-poor).
5. Data recorded from Senior Survey based upon a revised four point scale (1-excellent, 2-good, 3-fair, 4-poor). See Appendix for Senior Surveys.
6. Data recorded on University Course and Instructor Evaluations in 300-level and 400-level math courses (1-excellent, 2-good, 3-fair, 4-poor, 5-cannot rate).
7. Data as recorded on University Course and Instructor Evaluations in 300-level and 400-level math courses (1-very satisfied, 2-satisfied 3-dissatisfied, 4-very dissatisfied).
8. See Appendix for data.
9. Of the three students completing the Senior Survey, one student is completing his student teaching in the fall. We are very confident that he will be offered a teaching position when he graduates in December which will result in a change from 0.0% to 33.3%.
10. The ETS Major Fields Exam was administered instead of the Exit Exam in an attempt to obtain national percentiles of participants.
11. Praxis II Mathematics Content Knowledge Test (0061) and Proofs and Models Test (0063) were replaced by Mathematics Content Knowledge Test (5161) in 2013.

| Issues of Concern | Actions Taken |
|---|---|
| *Number of mathematics majors* | Establishment of the Allen Mathematics Scholarship awarded to an outstanding mathematics major. *Number of graduates in mathematics has fluctuated from eight graduates in May 2014 to thirteen graduates in Math 2015.* |
| *Success of students in calculus courses* | Proposal approved for lab section of Calculus I (Math 201L) to be offered in Fall 2010. *However, sufficient enrollment is still a concern.* |
| *Low enrollment in Math 201L* | Identify incoming calculus-eligible students during the summer. |

## *Appendices*

## Summary of Selected Student Responses from Mathematics Senior Survey

| | | | | | |
|---|---|---|---|---|---|
| 2 | I am glad that I majored in mathematics. | *strongly disagree* | *disagree* | *agree* | *strongly agree* |
| | | | | 1 | 7 |
| 3 | I feel the overall quality of the library resources in mathematics are: | *poor* | *fair* | *good* | *excellent* |
| | | | 1 | 5 | 2 |
| 4 | I would rate use of technology (graphing calculators or computers) with the Mathematics Program as: | *poor* | *fair* | *good* | *excellent* |
| | | | | 1 | 7 |
| 5 | The projects/homework assignments in my courses were beneficial in helping me gain knowledge of the material presented in class. | *strongly disagree* | *disagree* | *agree* | *strongly agree* |
| | | | | 2 | 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | The quantity (number) of projects/homework assignments in your mathematics courses in terms of how many you feel were necessary for you to learn the material was on the average: | *far too few* | *slightly too few* | *about right* | *slightly too many* | *far too many* |
| | | | | 7 | 1 | |
| 7 | The variety and complexity of the projects/homework assignments in your mathematics courses in terms of how much you feel was necessary for you to learn the material were on the average: | *far too simple* | *slightly too simple* | *about right* | *slightly too complex* | *far too complex* |
| | | | | 6 | 2 | |

| | | |
|---|---|---|
| 8 | The number of mathematical experiential learning activities, such as employment, field trips, or any other outside the classroom activity, which you participated in during your studies at FMU: | *1, 3, 4, 4, 1, 1, 0, 10* |

| | | |
|---|---|---|
| 8 | I found these mathematics courses to be most profitable: | *311, 201, 407* |
| | | *NR (No response)* |
| | | *NR* |
| | | *All the Calculus Courses* |
| | | *230, 301, 304, 420, 425, Useful to Computational Physics* |
| | | *304, 306, 318* |
| | | *203, 306, 420, 301* |
| | | *420, 405, 306, 304, 320* |
| 9 | I found these mathematics courses to be least profitable: | *425* |
| | | *NR* |
| | | *NR* |
| | | *Linear Algebra* |
| | | *"I found the courses I took useful" (?)* |
| | | *NR* |

| | | |
|---|---|---|
| | | *499* |
| | | *FORTRAN* |

| | | |
|---|---|---|
| 10 | List any courses/subject areas in mathematics you feel you should have had but were not offered. | *Graph Theory* |
| | | *NR* |
| | | *NR* |
| | | *NR* |
| | | *Abstract Algebra* |
| | | *NR* |
| | | *Partial Differential Equations* |
| | | *NR* |

| | | *far too severe* | *somewhat severe* | *adequately demanding* | *somewhat easy* | *far too easy* |
|---|---|---|---|---|---|---|
| 11 | Overall, I feel the requirements in the courses in my major were: | | | 7 | 1 | |

| | | *strongly disagree* | *disagree* | *agree* | *strongly agree* |
|---|---|---|---|---|---|
| 12 | Overall, the mathematics courses I took were profitable. | | | 5 | 3 |

| | | *strongly disagree* | *disagree* | *agree* | *strongly agree* |
|---|---|---|---|---|---|
| 13 | Overall, the mathematics instructors I had were effective. | | | 3 | 5 |

| | | *strongly disagree* | *disagree* | *agree* | *strongly agree* |
|---|---|---|---|---|---|
| 14 | I was advised effectively by the mathematics faculty. | | | 4 | 4 |

| | | |
|---|---|---|
| 15 | I found these mathematics instructors to be most effective: | *Ramey, Buck, Scott* |
| | | *Scott, Buck* |
| | | *Ramey, Buck, O'Kelly* |
| | | *Buck, Scott, Schnibben* |
| | | *Scott, Ramey, Bartz* |
| | | *Scott, Buck, O'Kelly, Schnibben* |
| | | *Ramey, Scott, Newman* |
| | | *Ramey, Scott* |

| | | |
|---|---|---|
| 16 | a) I had these problems with the operation of the Mathematics Program: | Scheduling Problems  1 |
| | | Advising Problems  0 |
| | | Individual Instructors  1 |
| | | Course Content  1 |
| | | None  5 |
| | | Other (Specify below) |

| | | *strongly disagree* | *disagree* | *agree* | *strongly agree* | *Not answered* |
|---|---|---|---|---|---|---|
| 17 | The problems I experienced were handled effectively by the mathematics faculty. | | | 4 | 3 | 1 |

| | | |
|---|---|---|
| 18 | What do you consider to be strong points, if any, of the program in mathematics at FMU? | *Professors very thoughtful* |
| | | *Attend conferences; good professors; small class size* |
| | | *Professors work with students inside and outside class* |
| | | *Flexibility in courses for double majors* |

| | | |
|---|---|---|
| | | *NR* |
| | | *Professors very helpful outside class* |
| | | *One on one coaching; small class size* |
| | | *Faculty members well prepared* |
| 19 | What do you consider to be weak points, if any, of the program in mathematics at FMU? | *NR* |
| | | *Attendance in extracurricular math event; research opportunities esp. Math Physics* |
| | | *No graduate opportunities* |
| | | *The availability of courses (due to small university)* |
| | | *NR* |
| | | *NR* |
| | | *Waivers for taking the GRE Test wasn't offered* |
| | | *Moderate amount of outside activities* |
| 20 | What would you suggest for correcting any weaknesses (listed in 19) or improving the strong points (listed in 18)? | *NR* |
| | | *Encouragement to engage in research activities* |
| | | *NR* |
| | | *Not much; FMU needs more math majors* |
| | | *NR* |
| | | *More office hours* |
| | | *Assist students going to graduate school by helping them afford GRE Test* |
| | | *More trips to other colleges* |
| 21 | I would like to see these changes made in the Mathematics Program: | *NR* |
| | | *NR* |
| | | *NR* |
| | | *I am pleased with the Math Dept.* |
| | | *NR* |
| | | *NR* |
| | | *NR* |
| | | *Research program with the Dept.* |

| | | poor | fair | good | excellent | |
|---|---|---|---|---|---|---|
| 22 | I would rate the overall quality of the Mathematics Program at Francis Marion as: | | | *2* | *6* | |

| | | |
|---|---|---|
| 23 | Which person(s), if any, at FMU do you feel contributed the most to your education and why? | *Ramey* |
| | | *Scott, his eccentric levity encourages fun attitude to math* |
| | | *Scott, Buck, O'Kelly, Schnibben* |
| | | *Scott, Ramey, Bartz* |
| | | *NR* |
| | | *Ramey* |
| | | *Scott, Buck* |
| | | *Ramey, Fitzkee* |
| 24 | What are your immediate plans after graduation? | *Masters of Medical Physics at Duke University* |
| | | *See what field of physics I want to pursue then graduate school* |
| | | *Grad school; teaching and tutoring at FDTC* |

| | | |
|---|---|---|
| | | *Auburn University for PhD in physics* |
| | | *Finding a job* |
| | | *Finding a job in my career path; go to graduate school* |
| | | *Seek employment* |
| | | *Getting a job* |
| 25 | Have you been accepted to a Graduate School or offered a Position in Teaching, Business, Industry, or Gov't? | *Grad School Duke* |
| | | *No* |
| | | *In process; waiting to hear* |
| | | *Yes* |
| | | *Not yet* |
| | | *No* |
| | | *Yes* |
| 26 | Are your immediate related to your major? Explain. | *Math skills to master's degree* |
| | | *Yes see # 24 entry 2* |
| | | *Yes; Grad school; teaching and tutoring at FDTC* |
| | | *Yes, grad school in physics* |
| | | *Yes/no; I plan a financial field with a mathematical approach* |
| | | *Yes, if it goes along with my career path* |
| | | *N/A* |
| | | *No, will be working on my second major* |
| 27 | Do you feel that your undergraduate degree has adequately prepared you for your first job and/or graduate school?  If not, in what areas do you feel your background was inadequate? | *Yes, except numerical analysis* |
| | | *Yes* |
| | | *Yes* |
| | | *I believe the degree has adequately prepared me* |
| | | *Yes* |
| | | *Yes* |
| | | *NR* |
| | | *Yes* |
| 28 | What comments would you like to make about the mathematics program at FMU? (The comments could concern courses, curricula, faculty, facilities, etc.) | *NR* |
| | | *Wish students in self-paced could be helped more* |
| | | *NR* |
| | | *The math program provided good opportunities to its students* |
| | | *NR* |
| | | *NR* |
| | | *N/A* |
| | | *None, I enjoyed the great education from the Math Dept.* |

**Praxis II Mathematics Exam Scores**
**March 2014 through March 2015**

Student ID ***16
8April2014     5161 Mathematics Content Knowledge
               Score 168      Required State Score  160


Student ID ***32
18Sept2014     5161 Mathematics Content Knowledge
               Score 163      Required State Score  160


Student ID ***74
17Sept2014     5161 Mathematics Content Knowledge
               Score 160      Required State Score  160

# Faculty Scholarly Activities

Presented "Unique Perceptions of Limits in Calculus" at the NCTM 2015 Annual Meeting & Exposition in Boston on April 15-18, 2015.

Submitted an article to the online journal Investigations in Mathematical Learning as well as to the Journal of Mathematics Education: East and West Teaching and Learning, Theory and Practice.

Submitted a grant proposal to the National Science Foundation in Applied Mathematics Research in the fall of 2014. The title of the grant proposal is "A Fast and Robust Generalized l1 Greedy Algorithm for Image/Signal Reconstruction".

Coauthored "Error Analysis of Reweighted $l\_1$ Greedy Algorithm for Noisy Reconstruction", with J. Zhu, X. Li and E. Arroyo, accepted for publication by Journal of Computational and Applied Mathematics, February 2015.

Coauthored "The Convergence of the Block Cyclic Projection with an Overrelaxation Parameter for Compressed Sensing Based Tomography", with E. Arroyo, X. Li and J. Zhu, to appear in Journal of Computational and Applied Mathematics, 280, pp. 59-67, May 2015.

Coauthored "L0 Fidelity-Based Two-Phase Method for Image Deblurring Corrupted by Salt-and-Pepper Noise", with J. Sun, submitted for publication to Journal of Mathematical Imaging and Vision, February 2015.

Co-authored a paper with S. Yuzvinsky entitled "Multinets in P^2" which was published in Bridging Algebra, Geometry, and Topology, Spring Proceedings in Mathematics and Statistics, vol. 96, 2014.

Presented a poster entitled "Induced Multinets in P^2" at Configuration Spaces: Geometry, Topology and Representation Theory, Istituto Nazionale di Alta Matematica (INdAM) in Cortona, Italy, in September 2014.

Presented a talk entitled "Problems on Complete Multinets" at the Open Problem Session at the Perspectives in Lie Theory Conference in Pisa, Italy, in February 2015.

Presented a talk entitled "Exact Values of Trigonometric functions" at MAA MathFest in Portland, Oregon, in August 2014.

Presented a poster entitled "Multinets in P^2" at the Project NExT/Young Mathematician's Network Poster Session.

Presented a talk entitled "Bounds on Induced Multinets" at the Joint Mathematics Meetings in San Antonio in January 2015.

Presented a talk entitled "Equations in Roots of Unity and Multinets" at the Palmetto Number Theory Series at South Carolina State University in September 2014.

Presented a talk entitled "Factoring Multivariate Polynomials" at the Kennesaw Mountain Undergraduate Conference in October 2014.

Presented a talk entitled "Complete Multinets" at the AMS Spring Southeastern Sectional Meeting at the University of Alabama in Huntsville in March 2015.

Presented a poster entitled, "Breaking the Two-hour Marathon Barrier" at the Carolinas Sports Analytics Meeting at Furman University in April 2015.

Presented a talk entitled "Sports Analytics: Gaining Competitive Advantages through Advanced Statistics" in the FMU Science Symposium in October 2014.

Presented a talk entitled "Designing Security Systems" for the FMU Math Club also in October 2014.

Acknowledged for his remarks in the paper "Simple and Synergystic ways to understand the Boltzmann distribution function" by Engelhardt, Lopez del Puerto, and Chonacky which will appear in the American Journal of Physics.

Presented "Z-Stability for Certain Crossed Product C*-Algebras." Great Plains Operator Theory Symposium at Kansas State University in Manhattan, KS, in May 2014.

Presented "Large Subalgebras of C*-Algebras" at the Workshop on C*-Algebras and Dynamical Systems at the Fields Institute at University of Toronto in June 2014.

Presented "Designing a Successful Capstone Course" at MAA MathFest in Portland, OR, in August 2014.

Submitted a paper "Smallness and comparison properties for minimal dynamical systems" to the Journal of Ergodic Theory and Dynamical Systems.

Submitted a paper "Crossed products by automorphisms with the tracial quasi-Rokhlin property" has been submitted to Rocky Mountain Journal of Mathematics.

Awarded an AP Summer Teacher Institute grant from the South Carolina Department of Education, which will allow FM to offer AP Calculus BC Certification for Teachers course in Summer 2015.

Served as an AP Calculus Reader for College Board to grade AP Calculus exams in Kansas City (3-9Jun). AP Readers evaluate and score AP students' free-responses ensuring that students receive AP grades that accurately reflect college-level achievement in each discipline.

Submission in preparation "The Use of Words in the Mathematics Classroom" for submission to MathMate, the journal of the South Carolina Council of Teachers of Mathematics.

Presented a talk "Writing in Mathematics: Finding a Voice" at the annual meeting of the Association of Teacher Educators in Phoenix in February 2015.

Presented a talk "Fostering a Favorable Disposition Toward Mathematics Through the Common Core" at the Regional Conference and Exposition of the National Council of Teachers of Mathematics in Richmond, Virginia, in November 2014.

Presented "More Learning Problems in Classrooms and in Popular Culture As Seen Through the Lens of Comic Strips" at the 2015 Popular Culture/American Culture Associations National Conference in New Orleans in April 2015.

Presented a talk entitled "More About Secondary- and College-Level Math Topics with Comic Strips" at the 2014 South Carolina Council of Teachers of Mathematics (SCCTM) Fall Conference held in Myrtle Beach in November 2014.

Presented "Some of My Favorite Trigonometry Problems" at the annual meeting of the South Carolina Council of Teachers of Mathematics (SCCTM) in Myrtle Beach on November 6.

Presented "The Calendar: Science, Mathematics and History" at the Francis Marion Science Colloquium on March 26.

Presented "How to Create Use-Friendly, Flowing Syntax for the Mathematics You Teach and Study" at the Regional Conference of the Southeastern Section of the Mathematics Association of America in March 2015.

Conducted a workshop entitled "Teaching Fractions and decimals, An Interactive Approach" at the annual South Carolina Council of Teachers of Mathematics (SCCTM) in Myrtle Beach in November 2014.

Reviewed articles for the University of Georgia's The Mathematics Educator.