Academic Program Review
Mathematics & Applied Mathematics
Undergraduate Program
Institutional Self-Study Report
Academic Years 2010-2014

Department of Mathematics
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1 Preface/History

The University of Tennessee at Chattanooga is a metropolitan university located in the southeastern corner of the state of Tennessee. Chattanooga’s metro area has a population of approximately 500,000 people that includes not only Chattanooga, but also portions of North Georgia and Northeastern Alabama.

The University of Tennessee at Chattanooga was founded in 1886 as Chattanooga University by an agency of the Methodist Episcopal Church. In 1907, the university changed its name to University of Chattanooga. In 1969, the university merged with Zion College, which was established in 1949 and became Chattanooga City College in 1964, to form The University of Tennessee at Chattanooga as part of the UT System, which consists of four major campuses located in Knoxville, Chattanooga, Martin, and Memphis. Governance is provided through a UT System President, Chancellors on each campus, and a UT Board of Trustees. The Governor of the State appoints Board members and also serves as Chairman of the Board.

At the time of the merger, the University of Chattanooga’s student population was slightly more than 2,200. Beginning as a public institution in 2013, The University of Tennessee at Chattanooga now serves more than 11,000 students. Approximately 85% of the university’s students are enrolled in undergraduate programs. Overall, the university’s students represent not only Tennessee (coming from 70 Tennessee counties), but they also come from more than 40 states and 40 foreign countries.

The undergraduate programs at The University of Tennessee at Chattanooga emphasize a traditional liberal arts education with strong foundations in coursework designed to foster critical thinking skills while providing a breadth and depth of training in mathematics. The undergraduate programs of study provide a core set of courses and experiences that complement applied experiences provided by the departmental faculty.

The Department of Mathematics is a unit of the College of Arts and Sciences at The University of Tennessee at Chattanooga. The emphasis in the department’s undergraduate program is to provide first for a liberal arts education with a concern to develop adequate employment abilities and training for students. The curriculum is designed to promote the development of analytical abilities. The primary objective of the mathematics program is to develop the abilities of students to think critically and logically.

Mathematics majors choose our Bachelor of Science in Applied Mathematics degree program and a concentration in one of three areas, and non-Mathematics majors can pursue a mathematics minor:

- Bachelor of Science in Applied Mathematics: Actuarial Science
- Bachelor of Science in Applied Mathematics: General Mathematics
- Bachelor of Science in Applied Mathematics: STEM Education
- Mathematics Minor (Interdisciplinary Program)

The Bachelor of Science in Applied Mathematics is designed for students who want a career using mathematics in business, government, or industry. Students pursuing this degree must select one of three concentrations: Concentration in Actuarial Science, Concentration in General Mathematics, or Concentration in STEM (Science, Technology, Engineering and Mathematics) Education.

The Bachelor of Science in Applied Mathematics, Concentration in Actuarial Science is designed for students who want to become actuaries and for students who want a program that integrates business, economics, and mathematics. Actuaries are trained to analyze risk and are typically employed by insurance companies, banks, the government, and companies that handle retirement funds. Actuaries use their broad knowledge of statistics, finance, and business, to help design insurance policies, pension plans, and other financial strategies in a manner which will help ensure that they are maintained on a sound financial basis.

The Bachelor of Science in Applied Mathematics, Concentration in General Mathematics is our most flexible degree and is an excellent choice for students planning to go on to graduate school in mathematics and students who wish to work in the research and development area of industry. Mathematicians often work at research and development laboratories in interdisciplinary teams that may include economists, engineers, computer scientists, physicists, technicians, and others. In private industry, candidates for mathematician jobs typically need a Ph.D., although there may be opportunities for those with a masters degree. Mathematicians use theories and techniques, such as mathematical modeling and computational methods, to
formulate and solve problems. Many mathematicians are employed as university faculty, dividing their time between teaching and conducting research.

The Bachelor of Science in Applied Mathematics, Concentration in STEM Education is designed for aspiring high school mathematics teachers, as its curriculum encompasses subject areas which satisfy that mathematics subject matter required by the credential program.

The Mathematics Minor is valuable to students majoring in science, computer science, engineering, business, and the social sciences, as it provides an understanding of important concepts that have applications in those subject areas. Students majoring in physics, computer science, and engineering can use support courses in the major toward a mathematics minor. Many students in those programs choose to complete a mathematics minor.

In the spring term of 2014, the department deactivated the Bachelor of Arts in Mathematics degree program and began to encourage freshman and transfer students to pursue the Bachelor of Science in Applied Mathematics degree program. All departmental effort is currently focused on this degree program.

1.1 Previous Review
The previous program review, conducted during the 2009-2010 academic year, had several main recommendations. The primary recommendation was that the department “should make a concerted effort to increase its undergraduate majors, especially as measured by the number of degrees granted”. Since that time, the number of majors has increased from 49 in Fall 2009 to 88 in Fall 2013, with much of the growth in the Concentration in STEM Education for the Bachelor of Science in Applied Mathematics. However, the number of degrees awarded has lagged this growth in enrolled majors. It was not until the 2013-2014 academic year that the number of graduates spiked to 12, up from annual rate of 6 to 7 degrees in the previous academic years. Based on enrollment and student progress, we anticipate approximately 10 graduates for the 2014-2015 academic year.

Other recommendations and the changes since the review:

- The previous review noted a shift toward one-year positions, such as lecturers and visiting assistant professors, in the hiring process. Since that time the number of tenured and tenure-track faculty has increased from 17 to 20 while the number of lecturers has increased from 3 to 9.

- The previous review also cited a desire for “more concrete information about departmental procedures”. This desire was largely addressed by a revised and expanded set of bylaws adopted by the Department in April 2014.

- Large enrollments and student dissatisfaction with Business Calculus (MATH 1830) were cited by the reviewer. While demand for MATH 1830 remains high (now nearing 1000 students per academic year) student success has improved in the class.

- Finally, the reviewer noted that a department of this size should have additional administrative assistance, especially for the upkeep of the department’s web presence. Regrettably, no permanent additional support has been forthcoming.

2 Learning Objectives
2.1 Departmental/Program Goals Statements
The vision of the department is to create a community of innovative thinkers who can facilitate the adaptation to the rapidly changing conditions of our global society.

The mission of the department is to offer undergraduate degrees and graduate degrees in mathematics that prepare students to pursue continuing graduate study, to work in industry, and to teach in secondary schools or community colleges. The department aspires to become a significant entity in the state of Tennessee in the preparation of diverse and highly qualified professionals for successful careers as mathematicians, mathematics educators, engineers, scientists, financial analysts, economists, and business entrepreneurs.

The department has a strong interest in teaching students to communicate mathematical ideas effectively and to use basic computational skills, mathematical models and technology to solve practical problems. In
addition to its own degree program, the department provides extensive support for other programs, notably engineering, science, and business, requiring mathematics courses and for the university’s General Education requirements.

The department is committed to excellence in teaching and research mentoring, attracting and supporting outstanding students, maintaining high standards for student performance, and keeping its curriculum up to date. The department also takes pride in a faculty that is active in scholarship and research, which includes the encouragement and supervision of student research in undergraduates student projects and honors theses, as well as graduate student projects and theses.

The department will continue to seek external funding sources to support its programs in teaching and research, build and nurture a sense of community among the department’s faculty and students, and engage in active outreach efforts with community partners in education and industry.

2.2 Course Syllabi

The department is working to obtain greater course-level assessment of learning objectives related to program-level goals. Existing syllabi for undergraduate courses clearly articulate learning objectives and how they will be assessed. There is a need for the department to develop a plan that outlines how student-learning measures will be assessed and how the results of the assessment will be used to modify the curriculum.

The department uses the course syllabus format provided by the Office of the Associate Provost for Student Learning Outcomes, Assessment and Accreditation. The format specifies the order of content. For example, each syllabus should identify the semester, course number and section/CRN, title, credit, faculty contact information, course meeting day(s), time(s), and location(s), prerequisites and corequisites, course description, course learning outcomes, and evaluation/assessment.

It is important to give students information about the basis for the final course grade. It is usually included here the percentage weight for the final grade for each component and the grading scale describing approximately how the course grades will assigned. For clarity, we specify the criteria for required course elements in the syllabus, in addition to specific details for each assignment: Name of the assignment, what is expected, when it is due, how and where to submit. Some faculty members use a rubric to grade the assignment and post that as well. We include when the assignment will be graded and how that information will be presented back to the student. Furthermore, we include information from the Undergraduate Catalog for assigning an Incomplete grade.

Other information in the syllabus include class participation and attendance policy, late assignment submission and make-up policy, required textbook and resources, modes of communication with the students, accommodation statement, counseling center statement, course schedule and topical outline, teaching and learning strategies, and the honor code pledge (from the university’s student handbook).

Course syllabi from courses taught from Fall 2010 to Fall 2014 are included on a CD.

2.3 SACS Outcomes Goals/Data

Students in the department participate in a learning environment characterized by exemplary teaching, innovative scholarship, creative expression, undergraduate research, engaged service, and practical experience. Below is the list of six Student Learning Outcomes for our mathematics majors.

- **Conceptual Understanding.** Students are able to assimilate and consolidate abstract and novel ideas within the core areas of mathematics (including geometry, algebra, analysis, discrete mathematics, numerical analysis, and statistics), to develop a functional grasp of the fundamental concepts and methods of solution, and are able to critique and write clear logical arguments using standard notation in various proof techniques.

- **Computational Skills.** Students are able to correctly and efficiently perform the basic computations and algebraic manipulations within the core areas of mathematics.

- **Modeling and Applications.** Students are able to rigorously apply mathematical principles to advanced problems within the core areas of mathematics and use mathematical modeling to extend these studies to interdisciplinary explorations in the sciences, engineering, business and finance, social sciences, and the health sciences.
• **Disciplinary Values.** Students are able to apply the axiomatic method in their mathematical thought process, to reason accurately without any preconceptions or unnecessary biases enhancing their power of concentration, while developing the patience, persistence and inventive faculties required for independent critical thinking.

• **Written Communication Skills.** Students are able to read and understand the conventions for writing mathematics using the proper mathematical notation, including equations, charts, graphs, and tables, to generate and communicate their ideas and findings clearly, effectively and unambiguously, thereby building a deeper conceptual understanding and appreciation of mathematics.

• **Oral Communication Skills.** Students are able to express their mathematical thinking orally in a precise fashion and use an effective presentation style along with a variety of aids (such as visual slides and whiteboards) to communicate formal concepts and results coherently and clearly.

For each course in the curriculum and each student learning outcome above, the department assigns an assessment marker of I for “Introduced,” P for “Practiced,” or C for “Competency.” Students in the academic disciplines of Science, Technology, Engineering and Mathematics (STEM) have additional outcomes as specified by the various STEM education programs.

### 2.4 Student Performance on Licensure/Certification Exams

Students who plan to teach at the secondary school level must meet state licensure requirements. These students are required to consult with advisors in the College of Health, Education and Professional Studies, and the Department of Mathematics. Through careful course selection, such students should be able to major in both Secondary Mathematics and Applied Mathematics: General Mathematics. Student performance on licensure/certification exams has not historically been tracked at the department level.

In Fall of 2014 Trey Marsden passed the Society of Actuaries’ and the Casualty Actuarial Society’s first actuarial exam, 1/P Probability. He is currently preparing for the second exam, 2/FM Financial Mathematics.

### 2.5 Placement of Students in Occupations Related to Major Field of Study

Student’s admittance to and performance in graduate school is not systematically tracked at the department level, nor is placement into occupational positions related to major fields of study. Tracking of students post graduation requires substantial resources and investment of time. Such an effort may be best coordinated at the university level, perhaps by Alumni Affairs, rather than the department level in order to ensure that it is done in a systematic manner, and we would hope to pursue this avenue in the future.

We encourage students who are planning to pursue a Ph.D. in mathematics to let their advisors know as soon as possible. We tell our students that applying to Ph.D. programs is much more complicated than applying to university, as they will need to take both the general and mathematics subject GREs, write a statement of purpose, research which graduate programs are best suited to them, and find three to four people who will write letters of recommendation for them.

One former undergraduate is currently a PhD student at Emory University. She has passed all of her qualifying exams and she is focusing on her research in graph theory.

### 2.6 Employer Satisfaction with Academic Program

Numerous efforts are currently underway to encourage students engagement in the department’s vibrant community. There is some anecdotal evidence that suggest good job prospects for students and employer satisfaction with our graduates.

• Two current students work as client data specialists in the UNUM Scholars Program. At UNUM, they work directly with their team and indirectly with several other teams to process client requests, including bank drafts, loans, surrenders, intake, and IPNing and imaging, while communicating with their team in order to work efficiently and stay on top of their turn-around times. They also get to job-shadow and meet with different people in different positions in different departments. This not
only helps them network but also aids in getting a field for which directions they want to head in as they start their professional careers.

- One recent graduate currently works as a mathematics teacher at Lenoir City High School in Lenoir City, Tennessee.

- Another recent graduate currently works as a computer scientist at the United States Department of Defense. As a software engineer and software architect in a small, multidisciplinary engineering team, he creates and maintains software for electronic warfare systems. Most of the work he does requires real-time processing of high-velocity data and interacting with embedded hardware systems.

- Another recent undergraduate major finished our program and is currently pursuing his master’s degree in applied mathematics.

### 2.7 Student Results on Exit Exams

As there is no general licensure exam required for mathematicians, we have no specific results to track nor any training required for our students for such an exam.

On the Senior Exit Exam (ETS Proficiency Profile) used at the University of Tennessee at Chattanooga, majors in Mathematics performed well compared to their peers in the College of Arts & Sciences and within the entire University. The first table below shows that majors in the Department of Mathematics exceeded the University and College average scores in each of the Skills (Critical Thinking, Reading, Writing, and Mathematics).

<table>
<thead>
<tr>
<th>Skill (Score)</th>
<th>Critical Thinking</th>
<th>Reading</th>
<th>Writing</th>
<th>Mathematics</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>112.40</td>
<td>119.54</td>
<td>115.81</td>
<td>115.20</td>
<td>450.49</td>
</tr>
<tr>
<td>College</td>
<td>113.02</td>
<td>120.09</td>
<td>116.13</td>
<td>114.51</td>
<td>451.30</td>
</tr>
<tr>
<td>Department</td>
<td>113.36</td>
<td>120.82</td>
<td>116.18</td>
<td>119.00</td>
<td>457.73</td>
</tr>
</tbody>
</table>

Table 2.1: UTC Senior Exit Exam 2013-2014, Skill Subscores

The same exam tested across three Content Areas: Humanities, Social Sciences, and Natural Sciences. In the Humanities and Natural Sciences areas, Mathematics majors were close to the averages for the University and College. In the Social Sciences the Mathematics majors were above the comparable averages for the University and College. See Table 2.2 below.

<table>
<thead>
<tr>
<th>Content Subscore</th>
<th>Humanities</th>
<th>Social Sciences</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>115.34</td>
<td>114.11</td>
<td>116.24</td>
</tr>
<tr>
<td>College</td>
<td>115.69</td>
<td>114.80</td>
<td>116.68</td>
</tr>
<tr>
<td>Department</td>
<td>115.09</td>
<td>116.45</td>
<td>116.73</td>
</tr>
</tbody>
</table>

Table 2.2: UTC Senior Exit Exam 2013-2014, Content Subscores

Finally, in the specific area of Mathematics the majors for the Department were more frequently measured proficient than the population for the entire College. Naturally, this result is expected given that our majors are studying Mathematics. Data for the entire University was not available. See Table 2.3 below.

<table>
<thead>
<tr>
<th>Percent at Proficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
</tr>
<tr>
<td>University</td>
</tr>
<tr>
<td>College</td>
</tr>
<tr>
<td>Department</td>
</tr>
</tbody>
</table>

Table 2.3: Percent of Majors at Level of Mathematical Proficiency
### 2.8 Student Results on NSSE

The National Survey of Student Engagement (NSSE) is used by UTC and other Tennessee universities to evaluate how thoroughly students are actively engaged in various aspects of their undergraduate education, and then to compare those results with the results for students at peer institutions within the Southeast and across the U.S. The results for the Department are compared with University and College results in the tables below. Note that the number of respondents is quite low – only four students.

<table>
<thead>
<tr>
<th>QUESTION/STATEMENT</th>
<th>RESPONSE OPTIONS</th>
<th>PERCENTAGES UTC</th>
<th>PERCENTAGES COLLEGE</th>
<th>PERCENTAGES DEPT.</th>
<th>VALID N: (DEPT.)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How would you evaluate your entire educational experience at this institution?</td>
<td>Poor</td>
<td>3.0</td>
<td>3.8</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td>11.2</td>
<td>11.1</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>53.8</td>
<td>53.5</td>
<td>50.0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Excellent</td>
<td>32.0</td>
<td>31.6</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td>2. If you could start over again, would you go to the same institution you are now attending?</td>
<td>Definitely no</td>
<td>5.6</td>
<td>5.2</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Probably no</td>
<td>10.9</td>
<td>12.8</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Probably yes</td>
<td>42.5</td>
<td>44.1</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Definitely yes</td>
<td>41.0</td>
<td>37.9</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td><strong>CURRICULUM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Institution contributes to you acquiring job or work related knowledge and skills.</td>
<td>Very little</td>
<td>12.9</td>
<td>18.3</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>29.2</td>
<td>32.8</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Quite a bit</td>
<td>30.7</td>
<td>26.2</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
<td>27.2</td>
<td>22.8</td>
<td>50.0</td>
<td>2</td>
</tr>
<tr>
<td>2. Institution contributed in developing clear and effective speaking skills.</td>
<td>Very little</td>
<td>11.9</td>
<td>13.8</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>31.4</td>
<td>31.1</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Quite a bit</td>
<td>35.2</td>
<td>33.2</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
<td>21.5</td>
<td>21.8</td>
<td>50.0</td>
<td>2</td>
</tr>
<tr>
<td>3. Institution contributed in developing clear and effective writing skills.</td>
<td>Very little</td>
<td>6.7</td>
<td>6.9</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>25.0</td>
<td>21.1</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Quite a bit</td>
<td>36.9</td>
<td>36.0</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
<td>31.4</td>
<td>36.0</td>
<td>50.0</td>
<td>2</td>
</tr>
<tr>
<td>4. Institution contributed to your ability to solve complex real-world problems.</td>
<td>Very little</td>
<td>12.6</td>
<td>15.6</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>31.4</td>
<td>30.6</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Quite a bit</td>
<td>31.3</td>
<td>30.2</td>
<td>50.0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
<td>24.7</td>
<td>23.6</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td>5. Institution contributed to thinking critically and analytically.</td>
<td>Very little</td>
<td>2.7</td>
<td>3.8</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>18.2</td>
<td>14.6</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Quite a bit</td>
<td>38.5</td>
<td>38.7</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
<td>40.6</td>
<td>42.9</td>
<td>75.0</td>
<td>3</td>
</tr>
<tr>
<td>6. Institution contributed to working effectively with others.</td>
<td>Very little</td>
<td>6.6</td>
<td>8.0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>30.7</td>
<td>35.3</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Quite a bit</td>
<td>34.3</td>
<td>29.4</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
<td>28.3</td>
<td>27.3</td>
<td>50.0</td>
<td>2</td>
</tr>
<tr>
<td>7. Institution contributed to developing or clarifying a personal code of values and ethics.</td>
<td>Very little</td>
<td>15.6</td>
<td>18.7</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>30.3</td>
<td>30.8</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Quite a bit</td>
<td>29.3</td>
<td>25.6</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
<td>24.8</td>
<td>24.9</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td>8. Institution contributed to encouraging contact among students from different backgrounds (social, racial/ethnic, religious, etc).</td>
<td>Very little</td>
<td>14.5</td>
<td>14.9</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>30.7</td>
<td>31.3</td>
<td>50.0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Quite a bit</td>
<td>29.9</td>
<td>27.4</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
<td>24.9</td>
<td>26.4</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td>9. Institution contributed to being an informed and active citizen.</td>
<td>Very little</td>
<td>15.3</td>
<td>16.8</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>30.7</td>
<td>31.9</td>
<td>50.0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Quite a bit</td>
<td>33.6</td>
<td>28.4</td>
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</tr>
<tr>
<td></td>
<td>Very much</td>
<td>20.5</td>
<td>22.8</td>
<td>25.0</td>
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</tbody>
</table>
### Student Survey Results (NSSE)

<table>
<thead>
<tr>
<th>QUESTION/STATEMENT</th>
<th>RESPONSE OPTIONS</th>
<th>PERCENTAGES</th>
<th>VALID N/ (DEPT.)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Quality of interactions with faculty members.</td>
<td>2. Talked about career plans with a faculty member or advisor.</td>
<td>3. Worked with a faculty member on activities other than coursework (committees, student groups, etc.).</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2.9</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.2</td>
<td>2.3</td>
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<td>1</td>
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<td>2.5</td>
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<td>0.0</td>
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<tr>
<td></td>
<td>1</td>
<td>0.0</td>
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<tr>
<td></td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Valid N = the number of majors answering the question on the NSSE 2014
**Not enough evaluations completed to analyze data
Scale: 1 to 7; 1 = Unavailable, unhelpful, and unsympathetic; 7 = Available, helpful, and sympathetic

## 3 Curriculum

### 3.1 General Education Course Syllabi

The program of study for a baccalaureate degree at the university consists of two categories of focused coursework. The first is required for the major, and the second is comprised of courses from a variety of disciplines that serve as prerequisites to the major, also known as General Education coursework. Students have several choices in the General Education coursework, each satisfying a specific set of required Student Learning Outcomes (SLO). These SLO reflect the academic mission of the university for expected student intellectual, academic, social, and ethical/moral growth and expand students’ fundamental knowledge, abilities, and aesthetic sensibilities. They lead to more enriched lives and a more comprehensive view of our global world and establish a foundation for, and provide an enhancement to, the coursework in the major. Two of the General Education categories of study defined by the university are Mathematics and Statistics.
A significant part of service that the department provides to the larger university is through the offering of several General Education courses in these two categories.

### 3.1.1 Mathematics Category

Almost all undergraduate students must complete three credit hours in the Mathematics category. Of the purpose for this category, the university course catalog states:

> The purpose of this category is to develop students’ ability to use abstract and deductive reasoning, to think logically and creatively about quantitative phenomena, and to analyze and solve real-world and abstract mathematical problems.

In addition to this statement of purpose, five Category Outcomes are defined as follows:

- Explain key mathematical concepts or prove mathematical statements.
- Describe both the strengths and limitations of mathematics in addressing human problems.
- Use a variety of appropriate mathematical concepts, skills, tools, and methods to solve quantitative problems that arise in students’ personal and professional lives.
- Analyze and resolve real-world and abstract quantitative situations that require critical thinking, logical reasoning, and the ability to identify assumptions and separate relevant from irrelevant information.
- Communicate, interpret, and justify results with clarity and coherence.

A course qualifies in the Mathematics category if the University General Education Committee certifies that it satisfies the above Category Outcomes, as demonstrated by actual course materials and graded student work provided by the department.

Currently, the following courses are certified for General Education for the 2014–2015 academic year in the Mathematics category:

- MATH 1010 - Mathematics in Our Modern World
- MATH 1130 - College Algebra
- MATH 1830 - Calculus for Management, Life, and Social Sciences
- MATH 1950 - Calculus with Analytic Geometry I
- MATH 2160 - Mathematics for Elementary and Middle School Teachers II

All of these courses are taught exclusively within the department, and all but MATH 1950 - Calculus with Analytic Geometry I are taught for the benefit of majors other than those within the Department. Specifically, MATH 1010 - Mathematics in Our Modern World is taught specifically for non-technical majors while many students in the sciences, health sciences, social sciences, and business are the key demographic for MATH 1130 - College Algebra and MATH 1830 - Calculus for Management, Life, and Social Sciences. The class MATH 2160 - Mathematics for Elementary and Middle School Teachers II is a service course just for some education majors in the School of Education within the College of Health, Education, and Professional Studies.

During the 2012–2013 academic year, MATH 1710 - Precalculus I and MATH 1720 - Precalculus II, which had long been certified in the Mathematics category, were de-certified for failing to meet some General Education requirements. From some students who changed majors this created an awkward step in their progress toward a degree. Specifically, a student might complete MATH 1710 - Precalculus I or MATH 1720 - Precalculus II and not have yet earned any General Education credit in the Mathematics category. If that student then switched to a degree program which required only MATH 1130 - College Algebra, they might already have satisfied what were essentially the same learning outcomes but not have satisfied the General Education requirement stipulated by the university.

For this reason, and to simplify the General Education Mathematics category for students more broadly, MATH 1710 - Precalculus I was submitted during the 2014–2015 academic year for certification as a General
Education course in the Mathematics category. The General Education Committee certified MATH 1710 - Precalculus I and in the coming semesters the department will pursue certification for MATH 1720 - Precalculus II as well as MATH 1730 - Combined Precalculus in future terms.

An example syllabus for each of these General Education Mathematics courses is given in a separate appendix.

3.1.2 Statistics Category

All undergraduate students must complete three credit hours in the Statistics category. The university course catalog states:

The purpose of this category is to develop students’ ability to use statistical reasoning in their personal and professional lives.

In addition to this statement of purpose, six Category Outcomes are defined as below:

- Apply conceptual understandings of basic statistical principles to real-world situations.
- Use statistical thinking.
- Explain statistical concepts and interpret statistical results using appropriate statistical vocabulary.
- Apply techniques of descriptive and inferential statistics and basic probability principles to real data.
- Recognize the strengths and limitations of statistics in addressing human problems and conduct investigations of statistically accessible problems.
- Use software packages for data analysis and statistical understanding.

A course qualifies in the Statistics category if the University General Education Committee certifies that it satisfies the above Category Outcomes, as demonstrated by actual course materials and graded student work provided by the Department.

Currently, the following courses are certified for General Education for the 2014–2015 academic year in the Statistics category:

- ENGR 2220 - Probability and Statistics for Engineering
- HHP 4010 - Measurement and Evaluation in Exercise Science and Leisure Studies
- MATH 2100 - Introductory Statistics
- MATH 3100 - Applied Statistics
- MATH 4140 - Mathematical Statistics
- MGT 2110 - Statistical Methods for Business I
- PANM 2050 - Introduction to Statistics for Public Administration and Nonprofit Management
- PSY 2010 - Research Methodology: Introductory Statistics in Psychology
- SOC 2500 - Social Statistics

Unlike the Mathematics category, where all classes for that category are taught by the department, the majority of students enroll for Statistics outside of the department. For example, the classes certified in the Statistics category and outside the department had enrollment of 1,131 students during the 2013–2014 academic year, compared to 984 students within the department during the same period. A key reason for this difference is that several degree programs like those in engineering, business, and the social sciences prefer to offer their students a class tailored to their respective disciplines.

Syllabi for all mathematics general education courses are collected in Appendix A. Each course syllabus follows a standard format (see the “Sample Syllabus” in Appendix A) and lists standard information such as the professor’s name, contact information, class meeting times and locations, an ADA statement, textbook and technology requirements, etc. In addition to these standard items, every syllabus for a general education course must fully conform to the university’s syllabus policy and also include the following items:
• A verbatim statement of the general education objectives for the relevant subject area(s);

• An explanation of how the general education objectives will be accomplished;

• A verbatim statement of the General Education Student Learning Outcomes (SLOs);

• An explanation of how the SLOs will be assessed;

• A course schedule (e.g., topics, assigned readings, other assignments, due dates, assessments) that includes sufficient detail for the General Education Committee to determine the appropriateness of the requested general education classification(s).

General Education at the university is framed by the university’s General Education Student Learning Outcomes; the General Education coursework in which the outcomes are embedded comprises a common General Education curriculum that all undergraduates, regardless of program of study, are expected to experience as an integral portion of the baccalaureate degree. The preliminary work on the General Education Initiative was carried out by the university’s General Education Committee, an ad hoc committee appointed by the Faculty Senate. Once created, the university’s General Education Committee will be responsible for oversight of General Education coursework and expected learning outcomes. The faculty and staff in each baccalaureate program are responsible for integrating the common general education curriculum and the associated student learning outcomes into the baccalaureate program of study. Mathematics courses in the general education category are regularly reviewed by this General Education Committee. The committee examines course syllabi (which must include objectives and goals), tests, and other submitted materials and compares these items to the General Education Guidelines. All of these courses have been recertified by the committee at least once during the last five years. In addition to adhering to the overall goal of general education, courses in the general education category are expected to:

• Develop a variety of qualitative problem solving strategies requiring logical thinking and persistence, including the ability to pose questions, identify and analyze critical information, and test hypotheses or conclusions;

• Emphasize basic quantitative concepts, such as number sense, data collection and analysis, the use and interpretation of abstract symbols, variable relationships and rates of change, distributions, graphs, and the properties of geometric shapes;

• Develop some mathematical or statistical models of phenomena from the world around us;

• Cultivate the use of mathematical reasoning skills;

• Develop a sense of the nature of proof and its critical role in mathematical thinking, and explore the strengths and limitations of mathematics and statistics in addressing many human problems;

• Foster appreciation for historical, logical, or intuitive aspects of the development of mathematical or statistical concepts;

• Communicate using appropriate mathematical and statistical vocabulary and notation;

• Include appropriate computational and procedural skills;

• Use appropriate technology to aid in the understanding of mathematical principles and in the solution of realistic mathematical problems;

• Include a writing component which counts for at least 1/5 of the grade (Writing in this category is defined to mean the use of English sentences and symbolic representations, such as formulas or equations, for the purpose of demonstrating students understanding of the concepts articulated in the above guidelines for this category.);

• Statistics courses are expected to include development of the underlying axioms of probability as well as statistical applications.
3.1.3 Course Redesign

The General Education courses MATH 1130 and MATH 2100 are being redesigned. The department undertook these course redesign processes to:

- Improve student retention and pass rates
- Reduce cost-per-students expenses
- Maintain positive student attitudes

3.1.4 Course Redesign: MATH 2100

MATH 2100 is a General Education course in Statistics offered every semester with an enrollment of more than 400 students, usually subdivided into nine or ten sections of forty-five students each. Even if each MATH 2100 instructor organizes his or her course independently, in the current model, class time is mainly devoted to the instructor’s lecture, in-class tests and quizzes, and occasional group activities. On the other hand, homework mainly consists of a list of problems relative to the material presented in class, which students need to complete, either on paper or through online software provided by Hawkes Learning Systems. According to the university course catalog and the General Education goals, a student in this course should:

- learn to interpret and use statistical and probabilistic models of the real world phenomena
- learn to solve practical problems using statistical vocabulary, notation, and appropriate technology

Recently, the department determined that the current model is no longer appropriate and requires a substantial revision, in order to address the following issues observed by instructors and students:

- **No links to real world phenomena.** Most problems and exercises in current textbooks already describe real world phenomena. Take, for example, the following problem: “The body temperatures of adults are normally distributed with a mean of 98.60° F and a standard deviation of 0.73° F. What temperature represents the 85th percentile?” However, this problem is merely a mathematical computation, as it does not relate to everyday experiences. In other words, it does not provide any evidence that solving such problem will enhance the student’s overall knowledge. To view the problem from a different perspective, we would need to start with real-world experiences, such as a students taking their temperatures in class and determining how each reading compares with others.

- **Poor student-instructor contact.** There is not much interaction while an instructor is lecturing, as students are rarely asking questions. Out of class, students make little use of office hours. Some instructors include occasional class discussions but not on a regular basis.

- **Poor interaction between students** As quizzes and, often, homework are used for assessment, students are not necessarily encouraged to collaborate both in class and out of class.

- **Poor incorporation of appropriate technology.** Several instructors are still using printed tables for the normal and the binomial distributions, missing completely one of the General Education goals. Other instructors require the use of a TI-84 calculator, but nowadays industry jobs require the use of computer programs such as Excel.

- **Lack of ways to help struggling students.** Weak students do not benefit much from a lecture, as they are probably missing the important steps, or they cannot take good notes in class, so that, when working on their homework, they have no way to succeed, regardless of how much time they may be willing to spend. While office hours could be a solution, very few students take advantage of this opportunity. A consequence of this is the high DFW-rate\(^1\) for General Education Mathematics and Statistics courses.

- **Poor attendance.** Unless enforced by introducing strong penalties and/or bonus points, attendance tends to drop after just a few weeks of the course. While this is certainly the result of several causes, it is clear that a substantial proportion of the students do appreciate the value of class attendance.

---

\(^1\)Percentage of students who earned a rate of D or F, or who withdrew from the course after several weeks.
• **Chronic lack of class time.** Any effort to address all of the above issues necessarily asks for more class time devoted to discussions, group activities, and class experiments. The result is less time left to lectures, which in turn will reduce the amount of material covered in the course. Some instructors have introduced extra sessions or help sessions, in which only a small fraction of the class attends, either due to lack of student interest, or scheduling conflicts.

The above discussion clearly emphasizes the effects of the shortage of class time to enhance student collaboration and involvement through group activities and real experiments, to provide assistance to the weak student, and to organize discussions and design projects. Therefore, the department strongly feels that class time should not be reduced, making the so-called Supplemental Model the most appropriate choice for our course redesign. To implement the model, the main idea is to move out of class part (about 50%) of the material that is usually presented during lectures. This material should probably consist of those sections or parts of a section that students can handle by themselves, while leaving the more advanced aspects to the in-class instruction. To assist students in their self-teaching, the use of the currently available technology plays a key role. Students will have access to several 10-minute-long video-clips, linked to an online tutorial system that provides immediate feedback on their progress. The use of some specific tutorial systems, like MyStatLab and StatCrunch, also will allow students to design and create their own experiments, enabling them to poll other students all over the country, therefore collecting real data into ready-to-use Excel spreadsheets that can be used for statistical description and statistical inference. A tutorial system will also enable an instructor to monitor student activity and progress. To further encourage the students to come to class prepared, a reading quiz may be administered at the beginning of each class. Having students cover a substantial amount of material out of class will produce several benefits, including:

- More time will be available during class for group activities, experiments, discussions, and reviews. During group activities, for instance, the instructor will walk around the classroom and provide assistance and guidance to students working on problems and projects. Discussions will also facilitate and emphasize critical thinking versus mere problem solving.

- Students will understand and appreciate the importance of coming to class prepared, and their understanding of the lecture will improve substantially.

- Student will be engaged in active learning, and they will no longer have a passive attitude in the learning process. Instead, they will be engaged with the material they read, watch, write, and talk about.

- Working and organizing their study at home will also help a students to become independent learners.

Redesigning the course along these guidelines will address the above mentioned issues and yield the following benefits:

- **Links to real-world phenomena.** Class experiments and online surveys will provide the missing link to real world phenomena.

- **Student-instructor contact.** Class activities and discussions will help in this direction.

- **Interaction between students.** Group activities and discussion will enhance student interaction.

- **Incorporation of appropriate technology.** Students will make use of popular computer programs, such as Excel, in their assignments.

- **Ways to help struggling students.** This will be accomplished by having more contact during class, video-tutorials, and personal study plans.

- **Attendance.** Students will be motivated to come to class prepared, as a traditional lecture is enhanced through interesting activities.

- **More class time.** The course redesign provides more class time for a better overall experience.
Implementing the suggested guidelines in the document Report of Full Explanation and Rationale, and Benefits will achieve certain common course outcomes. The redesign of MATH 2100 will provide students with: (1) a strong foundation in statistics, which will include a working knowledge of basic concepts such as mean, median, percentile, expected value, point and interval estimates; (2) advanced concepts such as variability, correlation, estimation, statistical distributions; and (3) and knowledge of key principles such as the Central Limit Theorem, and the empirical rule. The following are direct consequences of these outcomes:

- Improved student learning as demonstrated by lower percentages of DFW rates
- Increased course completion
- Improved retention
- Increased student and faculty satisfaction with new modes of instruction
- Additional opportunities for faculty to get students engaged in the in-class learning process and to go through certain topics in certain detail and depth
- Improved faculty-student relation
- Additional opportunities for students to familiarize with statistical software
- Produce self-directed learners of the subject

3.2 Major Course Syllabi

In the current academic year, the department offers only a Bachelor of Science degree in Applied Mathematics with three concentrations. These three concentrations offer students a reasonably broad set of specializations, with paths from the university to business, industry, education, or a post-graduate degree program. To that end, the student must select a concentration in one of the following three areas: Actuarial Science, General Mathematics, or STEM Education.

Prior to this academic year, the department offered the Bachelor of Arts degree in Mathematics, a traditional liberal arts mathematics degree, but deactivated that degree program due to low degree production. The department has endeavored to move all current students in the B.A. degree into the B.S. degree.

3.2.1 General Education for Mathematics Majors

Like all degree programs at the university, the Bachelor of Science in Applied Mathematics requires that the student complete a set of General Education courses. Requiring this breadth of coursework ensures that each of our majors may earn a well-rounded education outside of their chosen field, Mathematics.

- Rhetoric and Writing (6 hours)
- Fine Arts and Humanities (12 hours)
- Historical Understanding (3 hours)
- Literature (3 hours)
- Thought, Values and Beliefs (3 hours)
- Visual and Performing Arts (3 hours)
- Natural Sciences (7-8 hours)
- Behavioral and Social Sciences (6 hours)
- Mathematics (3 hours)
- Statistics (3 hours)
• Non-Western Culture (3 hours)

There are only three special cases for this set of General Education courses.

• STEM Education majors are required to take:
  ◦ STEM 3010 - Perspectives on Science and Mathematics for the Thoughts, Values and Beliefs Category.
  ◦ PSY 1010 - Introduction to Psychology and another three-hour class in the Behavioral and Social Sciences Category.
  ◦ PHYS 2300 - Principles of Physics - Mechanics and Heat, PHYS 2300L - Principles of Physics Laboratory-Mechanics and Heat, PHYS 2310 - Principles of Physics - Electricity and Magnetism, and PHYS 2310L - Principles of Physics Laboratory - Electricity and Magnetism. These courses collectively satisfy the Natural Sciences General Education Category.

• Actuarial Science majors may count ECON 1010 - Principles of Economics: Macroeconomics and ECON 1020 - Principles of Economics: Microeconomics toward their Behavioral and Social Sciences Category, even though traditionally the category required classes from two different areas.

3.2.2 Major Coursework for Mathematics Majors

Below, we outline the coursework that defines our majors, and the three concentrations, emphasizing what all our students share and where the concentrations permit for specialization. We begin with the former.

Core Coursework. Every Bachelor of Science in Applied Mathematics major is required to take the following core coursework, regardless of their concentration. This coursework is the foundational educational experience that connects all of our students.

• Calculus, Linear Algebra, and Differential Equations
  ◦ MATH 1950 - Calculus with Analytic Geometry I
  ◦ MATH 1960 - Calculus with Analytic Geometry II
  ◦ MATH 2200 - Elementary Linear Algebra
  ◦ MATH 2450 - Introduction to Differential and Difference Equations
  ◦ MATH 2560 - Calculus with Analytic Geometry III

• Logic and Proof
  ◦ MATH 3000 - Introduction to Logic and Proof

• Analysis
  ◦ MATH 3510 - Introduction to Analysis I

• Algebra
  ◦ MATH 3250 - Introduction to Modern Algebra, or
  ◦ MATH 4200 - Linear Algebra and Matrix Theory

• Statistics
  ◦ MATH 3100 - Applied Statistics, or
  ◦ MATH 4130 and 4140 - Introduction to Probability and Statistics and Mathematical Statistics

• Computer Science
  ◦ CPSC 1100 - Fundamentals of Computer Science
This coursework covers three semesters of differential and integral calculus, one semester of basic linear algebra, and one semester of differential equations. Then, beyond the level that a standard student in engineering or physics would take, our majors go on to learn about how mathematicians think and work in our Introduction to Logic and Proof class. All students are then prepared for three major disciplines within Mathematics: Analysis, Algebra, and Statistics. (There are other major areas, but these are the three our curriculum stresses.)

On top of these mathematics courses, we require our majors to have an introduction to modern computing through the Fundamentals of Computer Science course. In that course, they are introduced to programming through a compiled language such as Java.

**Concentration Coursework – Bachelor of Science Applied Mathematics**

This degree program resembles the defunct Bachelor of Arts in Mathematics, which we would characterize as a traditional liberal arts degree in mathematics. Unlike the Bachelor of Arts degree, the Bachelor of Science degree does not require a foreign language. In addition to the core coursework listed above, the general mathematics degrees requires a speech course (THSP 1090 or THSP 2090), a writing course (ENGL 2820), electives in Mathematics, and an approved minor or program of study. In the case of the program of study, the program must consist of eighteen hours of courses in other disciplines, including at least eight hours at the 3000–4000 level, and it must be approved by the department’s curriculum committee.

**3.3 SACS Outcomes Data**

In Tables 3.1, 3.2, and 3.3, we summarize the mathematics assessment results for 2012 to 2013, as well as course enrollment figures.

<table>
<thead>
<tr>
<th>Problem Solving Skills</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Ave. Score/ Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibits unacceptable problem solving skills</td>
<td>Shows minimal command of skills needed</td>
<td>Demonstrates strong command of problem solving skills and at time is innovative in approach</td>
<td>Outstanding problem solving skills and use of innovative approaches</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td>Makes an unacceptable number of major computational errors</td>
<td>Makes computational errors some of which are serious</td>
<td>Makes only a few minor computational errors</td>
<td>Makes no computational errors</td>
<td>2.93</td>
<td></td>
</tr>
<tr>
<td>Writing Proficiency as Related to Mathematical Proofs</td>
<td>Basic level; contains an unacceptable number of grammatical/stylistic errors</td>
<td>Demonstrates minimal ability to communicate mathematical concepts with some grammatical/stylistic errors</td>
<td>Very good at communicating mathematical content with few to no errors</td>
<td>Outstanding ability to communicate mathematical ideas</td>
<td>2.93</td>
</tr>
<tr>
<td>Knowledge Synthesis from Different Sources</td>
<td>Unable to integrate concepts from different sources</td>
<td>Minimal ability to integrate concepts from different sources</td>
<td>Clearly demonstrates ability to integrate knowledge coherently from different sources</td>
<td>Outstanding ability to integrate knowledge from various sources</td>
<td>2.93</td>
</tr>
</tbody>
</table>

Table 3.1: Math assessment results for 2012 to 2013.

**3.4 Curriculum Review/Revision Information**

**3.4.1 Undergraduate Curriculum Changes**

The following curriculum proposals submitted by the department were approved by the university.

- MATH 355, 455 (MATH 3510, 4510 in the new four digit system)
  
  Effective Date for Curricular Offering: August 2010

  The Department of Mathematics proposed two new courses entitled *Introduction to Analysis I*, MATH 3510, and *Introduction to Analysis II*, MATH 4510. Each course will be a three credit-hour course. MATH 350 will be deleted from the catalog. MATH 3510 will replace MATH 350 as a required course for mathematics majors.
### Degrees/Majors

<table>
<thead>
<tr>
<th>BS Mathematics</th>
<th>Student Learning Outcomes</th>
<th>Means of Assessment</th>
<th>Assessment Data</th>
<th>Improvements Based on Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A student will be able to:</td>
<td></td>
<td></td>
<td>1. Portfolios are now maintained by one administrative assistant who understands the degree requirements and portfolio procedure.</td>
</tr>
<tr>
<td></td>
<td>• Demonstrate innovative approaches to solving problems</td>
<td></td>
<td></td>
<td>2. Since the number of student portfolios is low, the assessment target has been revised to a minimum score for each student in each category, rather than a target mean. 75% of students will achieve a minimum score of 3 on each skill.</td>
</tr>
<tr>
<td></td>
<td>• Demonstrate proficiency in computational skills without errors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Demonstrate proficiency in writing mathematical proofs and communicating mathematical content without error</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Integrate knowledge from different sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A portfolio of student artifacts is collected for each math major from these courses during their major coursework:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Math 3000, Foundations of Mathematics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Math 3510, Introduction to Analysis I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Math 3250, Introduction to Modern Algebra or Math 4200, Linear Algebra and Matrix Theory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Two additional upper level mathematics courses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A panel of faculty members evaluates the portfolios using the attached rubric.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Target: Mean scores will be 2.8 or higher (70%) for each skill.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Table 3.2: Mathematics outcomes assessment.

- **MATH 1130, 1710, 2150 (MATH 131, 144, 215 in the former three digit system)**
  
  Effective Date for Curricular Offering: August 2010
  
  Change the Math ACT on MATH 131, 144, 215 from a minimum of 24 to a minimum of 22 (the corresponding Math SAT would drop from 560 to 520). Any student with a Math ACT less than 22 will be required to take the Mathematics Placement Test unless the student has already passed a college-level or developmental mathematics course. This change was made after a study of the outcomes for students compared to their Math ACT scores.

- **MATH 1921, 2160, 4120 (Change titles of 4250, 4570, and delete 155 and 428)**
  
  Effective Date for Curricular Offering: August 2010
  
  For MATH 4120, replace ENGR 3322 by ENGR 2220 as a prerequisite to MATH 420. For MATH 2160, delete MATH 214 as a prerequisite. Change the title of MATH 4570 from *Introductory Complex Variables* to *Complex Analysis*. Change the title of MATH 4250 from *Abstract Algebra to Modern Algebra I*. Remove MATH 1915, *Honors Calculus*, from the catalog. Deactivate MATH 4710, *Packages for Mathematical Computation*, from the catalog, including from the list of approved courses for the Bachelor’s of Arts in Mathematics degree. For MATH 1921, delete MATH 160 as a pre- or corequisite. Also, modify the statement of prerequisites to make it easier for transfer students to understand. The current prerequisites are given as “Prerequisites: Mathematics 152 with a minimum grade of C. Pre- or Corequisite: Mathematics 160 or 161.” We propose changing this to “Prerequisites: Mathematics 151 and 152 with minimum grades of C. Pre- or Corequisite: Mathematics 161. Previous calculator or compute experience is not required. A student who transfers in a four credit hour calculus course equivalent to Mathematics 151/152 with a C or better or an S, such as the Advanced Placement AB calculus course, has satisfied the prerequisites.”

- **MATH 4250 Prerequisite Change**
<table>
<thead>
<tr>
<th>NO.</th>
<th>TITLE</th>
<th>CREDIT HOURS</th>
<th>ACADEMIC YEAR 2012-2013</th>
<th>ACADEMIC YEAR 2013-2014</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>FALL</td>
<td>SPRING</td>
</tr>
<tr>
<td>MATH 1010</td>
<td>Mathematics in our Modern World</td>
<td>3</td>
<td>437</td>
<td>206</td>
</tr>
<tr>
<td>1130</td>
<td>College Algebra</td>
<td>3</td>
<td>956</td>
<td>501</td>
</tr>
<tr>
<td>1710</td>
<td>Precalculus I</td>
<td>3</td>
<td>206</td>
<td>88</td>
</tr>
<tr>
<td>1720</td>
<td>Precalculus II</td>
<td>3</td>
<td>192</td>
<td>205</td>
</tr>
<tr>
<td>1730</td>
<td>Combined Precalculus</td>
<td>4</td>
<td>84</td>
<td>68</td>
</tr>
<tr>
<td>1830</td>
<td>Calculus for Management, Life, and Social Sciences</td>
<td>3</td>
<td>376</td>
<td>377</td>
</tr>
<tr>
<td>1910</td>
<td>Calculus I</td>
<td>3</td>
<td>197</td>
<td>130</td>
</tr>
<tr>
<td>1911</td>
<td>Calculus I Laboratory</td>
<td>1</td>
<td>190</td>
<td>122</td>
</tr>
<tr>
<td>1920</td>
<td>Calculus II</td>
<td>3</td>
<td>90</td>
<td>108</td>
</tr>
<tr>
<td>1921</td>
<td>Calculus II Laboratory</td>
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<td>61</td>
<td>74</td>
</tr>
<tr>
<td>1950</td>
<td>Calculus with Analytic Geometry I</td>
<td>4</td>
<td>155</td>
<td>145</td>
</tr>
<tr>
<td>1960</td>
<td>Calculus with Analytic Geometry II</td>
<td>4</td>
<td>66</td>
<td>61</td>
</tr>
<tr>
<td>2030</td>
<td>Discrete Mathematics for Computer Science</td>
<td>3</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>2100</td>
<td>Introductory Statistics</td>
<td>3</td>
<td>411</td>
<td>383</td>
</tr>
<tr>
<td>2150</td>
<td>Mathematics for Elementary &amp; Middle School Teachers I</td>
<td>3</td>
<td>147</td>
<td>98</td>
</tr>
<tr>
<td>2160</td>
<td>Mathematics for Elementary &amp; Middle School Teachers II</td>
<td>3</td>
<td>115</td>
<td>87</td>
</tr>
<tr>
<td>2200</td>
<td>Elementary Linear Algebra</td>
<td>3</td>
<td>96</td>
<td>120</td>
</tr>
<tr>
<td>2300</td>
<td>Mathematical Models, Functions, and Applications</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2450</td>
<td>Introduction to Differential and Difference Equations</td>
<td>3</td>
<td>64</td>
<td>58</td>
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<tr>
<td>2550</td>
<td>Multivariate Calculus</td>
<td>3</td>
<td>25</td>
<td>56</td>
</tr>
<tr>
<td>2560</td>
<td>Calculus with Analytic Geometry III</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3000</td>
<td>Introduction to Logic and Proof</td>
<td>3</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>3030</td>
<td>Discrete Structures</td>
<td>3</td>
<td>1</td>
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<tr>
<td>3100</td>
<td>Applied Statistics</td>
<td>3</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>3250</td>
<td>Introduction to Modern Algebra</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>3510</td>
<td>Introduction to Analysis I</td>
<td>3</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td>The Historical Development of Mathematics</td>
<td>3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>4010</td>
<td>Basic Concepts of Geometry</td>
<td>3</td>
<td></td>
<td>7</td>
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<tr>
<td>4050</td>
<td>Introduction to Point Set Topology</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4100</td>
<td>Introduction to Probability and Statistics</td>
<td>3</td>
<td>5</td>
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<tr>
<td>4110</td>
<td>Mathematical Statistics</td>
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<tr>
<td>4120</td>
<td>Applied Statistics Methods</td>
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<td>7</td>
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</tr>
<tr>
<td>4200</td>
<td>Linear Algebra and Matrix Theory</td>
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<td>4</td>
<td></td>
</tr>
<tr>
<td>4250</td>
<td>Modern Algebra I</td>
<td>3</td>
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<td></td>
</tr>
<tr>
<td>4270</td>
<td>Number Theory</td>
<td>3</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>4300</td>
<td>Mathematics of Interest</td>
<td>3</td>
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<td></td>
</tr>
<tr>
<td>4310</td>
<td>Operations Research (Linear)</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4320</td>
<td>Operations Research (Nonlinear)</td>
<td>3</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>4450</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
<td>1</td>
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</tr>
<tr>
<td>4460</td>
<td>Partial Differential Equations</td>
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<tr>
<td>4510</td>
<td>Introduction to Analysis II</td>
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<tr>
<td>4570</td>
<td>Complex Analysis</td>
<td>3</td>
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<td>1</td>
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<tr>
<td>4600</td>
<td>Numerical Analysis I</td>
<td>3</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>4610</td>
<td>Numerical Analysis II</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4700</td>
<td>Techniques of Applied Mathematics</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4720</td>
<td>Introduction to Graph Theory</td>
<td>3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>4998</td>
<td>Individual Studies</td>
<td>3</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

* Collected from the Teaching Load Summary each semester.

Table 3.3: Course enrollment from 2012 to 2014.
Effective Date for Curricular Offering: Fall 2010
Change the prerequisite on MATH 4250 from MATH 321 or 412 with a minimum grade of C to MATH 321 with a minimum grade of C.

- MATH 2200 Modify Prerequisites
  Effective Date for Curricular Offering: Fall 2010
  In order to meet the needs of the Computer Science Department, the Mathematics Department wishes to change the prerequisites on MATH 2200 from “MATH 1910/MATH 1911 with minimum grades of C or department head approval” to “MATH 1910/MATH 1911 or MATH 2030 with minimum grades of C or department head approval.”

- MATH revisions: Drop UHON 2140 option, delete 4500, change name of 4450, revise BA course list
  Effective Date for Curricular Offering: Fall 2011
  Drop UHON 2140 from approved speech courses for Applied Mathematics, B.S., and Mathematics, B.A. Drop MATH 4500, Modern Analysis from the catalog. Change the name of MATH 4450 and 5451 to Ordinary Differential Equations. Currently, in addition to a list of required courses, Mathematics B.A. students must choose five additional mathematics courses at the 3000–4000 level (excluding 3030) including one from one list and one from a second list. We wish to add MATH 4460 to the first list.

- MATH 1010 Math in Modern World, 2100 Elem Stat, 2150 Math for Elem Ed I, 2160 Math for Elem Ed II (change in prerequisites)
  Effective Date for Curricular Offering: Fall 2012
  The Department of Mathematics is responding to the legislation in the Complete College Tennessee Act which prohibits four year colleges and universities from teaching remedial and developmental Math courses. In effect, this eliminates our offering MATH 1005 and 1006 (the old MATH 105 and 106). To comply with this mandate, we propose to eliminate the prerequisite for MATH 1010.

- MATH 3000 Introduction to Logic and Proof (Name change from Foundations of Mathematics)
  Effective Date for Curricular Offering: Fall 2012
  Name change from MATH 3000 Foundations of Mathematics to MATH 3000 Introduction to Logic and Proof.

- MATH 1010 Mathematics in Our Modern World
  Effective Date for Curricular Offering: Fall 2012
  The changes we propose are of an editorial nature to improve the felicity and clarity of the catalog text. The rationale for the change is to reflect the course content the Mathematics Department deems should be covered in this course.

- MATH 1730 Combined Precalculus
  Effective Date for Curricular Offering: Fall 2013
  The Mathematics Department proposes a new course.

- MATH New Calculus Courses 1950, 1960, 2560; Revise 1920, 2550; Delete 1910, 1911, and 1921.
  Effective Date for Curricular Offering: Fall 2013
  Three new four-hour courses MATH 1950, MATH 1960, and MATH 2560. Revise course descriptions of current MATH 1920 and MATH 2550. Delete MATH 1910, 1911, and 1921. Update the Catalog to reflect these additions and changes.

- MATH Changing the Behavioral and Social Sciences Requirement
  Effective Date for Curricular Offering: Fall 2013
  For all Applied Mathematics concentrations and for the Mathematics, BA degree, we request that Behavioral and Social Sciences general education requirement be changed from “Two approved behavioral
or social sciences courses in two different disciplines” to “Two approved behavioral or social sciences courses.”

- MATH 1130 and 1710: Changes in prerequisites
  Effective Date for Curricular Offering: Fall 2013
  The Mathematics Department proposes to lower the minimum Math ACT on MATH 1130 and MATH 1710 from 22 to 19. The equivalent SAT Math scores are 520 and 460, respectively.

- MATH Renumbering and modification of descriptions of MATH 4270, 4100, 4110, and 4120.
  Effective Date for Curricular Offering: Fall 2014
  MATH 4270 Number Theory (the department wishes to modify the name and the description in the catalog. This will bring some consistency between the undergraduate and graduate course offerings and reflect current practice.) MATH 4100 Introduction to Probability and Statistics (the department wishes to modify the numbers and shorten the description in the catalog of three statistics courses. This will bring some consistency between the undergraduate and graduate course offerings and allow us to number statistics courses systematically.) MATH 4110 Mathematical Statistics (the department wishes to modify the numbers and shorten the description in the catalog of three statistics courses. This will bring some consistency between the undergraduate and graduate course offerings and allow us to number statistics courses systematically. The course number of the prerequisite has also been updated to reflect the change above.) MATH 4120 Applied Statistical Methods (the department wishes to modify the numbers and shorten the description in the catalog of three statistics courses. This will bring some consistency between the undergraduate and graduate course offerings and allow us to number statistics courses systematically. The course number of the prerequisite has also been updated to reflect the change above.)

- MATH 4170 Nonparametric Statistics
  Effective Date for Curricular Offering: Fall 2014
  This is a new course proposal.

The following changes have been made for the undergraduate statistics courses.

<table>
<thead>
<tr>
<th>Former Number</th>
<th>Course</th>
<th>New Number</th>
<th>Catalog Description</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 4100</td>
<td>Introduction to Probability and Statistics</td>
<td>MATH 4130</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>MATH 4110</td>
<td>Mathematical Statistics</td>
<td>MATH 4140</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>MATH 4120</td>
<td>Applied Statistical Methods</td>
<td>MATH 4160</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 3.2: Number Changes in Statistics Courses.

3.4.2 Assessment Plan for Mathematics Programs

Assessment is an ongoing process in the department. External reviews are conducted every five years. These generally include reviews of departmental offerings, course content, textbooks, and examinations. In these reviews experienced professionals usually compare our program with others and provide the department with reports detailing its perceived strengths and weaknesses. Other programs also undergo similar external reviews. Based on these reviews, and in consultation with client departments, the department makes necessary changes for improvement of its program. Internally, the department reviews its curriculum periodically, has dialogs with client departments, reevaluates textbooks annually, keeps current on national curriculum trends, and studies course grade distributions. In addition, faculty share and review examinations, regularly collect student evaluations of teaching, and undergo annual reviews for merit.
3.4.3 Data Collection

In data collection a balance must be reached between the cost (time, money, etc.) and usefulness of the data while not imposing unreasonable demands on faculty, university resources, students, and graduates. There is no single nationally accepted method, such as standardized testing, for overall assessment. While the core topics of most courses are the same nationally, there is no consensus with regard to the importance or depth of coverage of each topic. Any national comparison would be further complicated by differing entrance standards and missions of universities. Many evaluation criteria cannot be quantified with a simple numerical scale. For example, there is no national ranking for textbooks. Thus, while the department does review textbooks annually, and uses those reviews to select high quality textbooks, little would be gained from further analysis. This is also true for many other evaluation methods listed below. The following are feasible means of data collection which can lead to a meaningful assessment. Much of these data could be collected through one instrument, such as a survey, while others have been studied for many years.

- College Graduation Exit Survey
- Post-graduate Survey
- Input from Client Departments
- Feedback from General Education Assessment
- Textbook Evaluation
- Exam Evaluation
- Distribution of Grades in Mathematics Courses
- Distribution of Grades in Client Courses
- Student Research and Contests Results
- Graduate School Acceptance
- Graduate Degrees Earned
- Classroom Observations of Student Teachers
- Profile of Entering Students
- Course evidence of learning grids for courses within the majors
- Course evidence of learning grids for the general education QL courses
- Course evidence of learning grids for courses for elementary major courses

To draw accurate conclusions it is necessary that the data sets be sufficiently large, be from target populations, and be reliable. For accurate targeting it will be necessary to subdivide some groups, like minors, teaching minors and elementary mathematics endorsements. Finally, the surveys and their results should also be analyzed for unintended biases and reliability of data. The department is doing the following:

- Maintaining an address file of graduates
- Administering, over time, exit interviews and a questionnaire that inquires about results of standardized tests, acceptance to graduate school, curriculum strengths and weaknesses, obtaining employment, quality of job training, obtaining advanced degrees, teaching effectiveness
- Performing surveys of majors that make inquiries about courses and reasons they choose or changed major
- Study the results of general education assessment and then respond in appropriate ways
• Establish and maintain measurable program learning outcomes and measurable course learning outcomes
• Target questions on tests and finals that access whether students are meeting the course learning outcomes and collect the data for the evidence of learning spreadsheets
• In courses where appropriate, access student papers or projects and collect data on these and report on the completion rates

3.5 Catalog Information

General Education courses
• Rhetoric and Writing (6 hours)
• Fine Arts and Humanities (12 hours)
• Historical Understanding (3 hours)
• Literature (3 hours)
• Thought, Values and Beliefs (3 hours)
• Visual and Performing Arts (3 hours)
• Natural Sciences (7-8 hours)
• Behavioral and Social Sciences (6 hours)
• Mathematics (3 hours)
• Statistics (3 hours)
• Non-Western Culture (3 hours)

Applied Mathematics: Actuarial Science, B.S.

Program Requirements
• CPSC 1100 - Fundamentals of Computer Science
• ENGL 2820 - Scientific Writing
• MATH 1950 - Calculus with Analytic Geometry I
• MATH 1960 - Calculus with Analytic Geometry II
• MATH 2200 - Elementary Linear Algebra
• MATH 2450 - Introduction to Differential and Difference Equations
• MATH 2560 - Calculus with Analytic Geometry III
• MATH 3000 - Introduction to Logic and Proof
• MATH 3510 - Introduction to Analysis I

One course from:
• THSP 1090 - Public Speaking
• THSP 2090 - Business and Professional Speech Communication
Actuarial Science Requirements

- MATH 4130 - Introduction to Probability and Statistics
- MATH 4140 - Mathematical Statistics
- MATH 4200 - Linear Algebra and Matrix Theory
- MATH 4600 - Numerical Analysis I

9 additional hours in Mathematics at the 3000–4000 level, excluding Mathematics 3100

- ACC 2010 - Principles of Accounting I
- ACC 2020 - Principles of Accounting II
- ECON 1010 - Principles of Economics: Macroeconomics
- ECON 1020 - Principles of Economics: Microeconomics
- ECON 3240 - Intermediate Microeconomic Theory
- ECON 3250 - Intermediate Macroeconomic Theory
- FIN 3020 - Essentials of Managerial Finance
- FIN 3370 - Principles of Insurance

One course from:

- MATH 4160 - Applied Statistical Methods
- MATH 4310 - Operations Research (Linear)
- MATH 4320 - Operations Research (Non-Linear)

Applied Mathematics: General Mathematics, B.S.

Program Requirements

- CPSC 1100 - Fundamentals of Computer Science
- ENGL 2820 - Scientific Writing
- MATH 1950 - Calculus with Analytic Geometry I
- MATH 1960 - Calculus with Analytic Geometry II
- MATH 2200 - Elementary Linear Algebra
- MATH 2450 - Introduction to Differential and Difference Equations
- MATH 2560 - Calculus with Analytic Geometry III
- MATH 3000 - Introduction to Logic and Proof
- MATH 3510 - Introduction to Analysis I

One course from:

- THSP 1090 - Public Speaking
- THSP 2090 - Business and Professional Speech Communication
General Mathematics Requirements

- MATH 3250 - Introduction to Modern Algebra or
- MATH 4200 - Linear Algebra and Matrix Theory

15 hours chosen from A or B:

A. MATH - 3100 Applied Statistics and 12 additional hours in Mathematics at the 3000-4000 level

B. MATH 4130 - Introduction to Probability and Statistics, MATH 4140 - Mathematical Statistics, and 9 additional hour in Mathematics at the 3000–4000 level excluding MATH 3100.

Applied Mathematics: STEM Education, B.S.

Program Requirements:

- CPSC 1100 - Fundamentals of Computer Science
- MATH 1950 - Calculus with Analytic Geometry I
- MATH 1960 - Calculus with Analytic Geometry II
- MATH 2200 - Elementary Linear Algebra
- MATH 2450 - Introduction to Differential and Difference Equations
- MATH 2560 - Calculus with Analytic Geometry III
- MATH 3000 - Introduction to Logic and Proof
- MATH 3510 - Introduction to Analysis I

Additional Program Requirements

- PHYS 2300 - Principles of Physics - Mechanics and Heat
- PHYS 2300L - Principles of Physics Laboratory-Mechanics and Heat
- PHYS 2310 - Principles of Physics - Electricity and Magnetism
- PHYS 2310L - Principles of Physics Laboratory - Electricity and Magnetism
- PSY 1010 - Introduction to Psychology

- CPSC 1000 - Introduction to Computing or
- EDUC 4170 - Technology and Learning

- MATH 4010 - Basic Concepts of Geometry and
- MATH 3250 - Introduction to Modern Algebra or
- MATH 4200 - Linear Algebra and Matrix Theory

12 hours chosen from A or B:

A. MATH 3100 - Applied Statistics and 9 additional hours in Mathematics at the 3000-4000 level

B. MATH 4130 - Introduction to Probability and Statistics, MATH 4140 - Mathematical Statistics, and 6 additional hours in Mathematics at the 3000–4000 level, excluding Mathematics 3100

STEM Requirements:
• STEM 1010 - Step One: Inquiry Approaches to Teaching Science and Mathematics and
• STEM 1020 - Step Two: Inquiry-Based Lesson Design in Math and Science or
• STEM 1030 - Step One/Step Two: Inquiry-Based Mathematics and Science Teaching
• STEM 2010 - Knowing and Learning
• STEM 2020 - Classroom Interactions
• STEM 3010 - Perspectives on Science and Mathematics
• STEM 3020 - Research Methods in Science
• STEM 4010 - Project-Based Instruction
• STEM 4020 - Apprentice Teaching

3.6 Information Regarding Current Approaches/Issues in the Discipline

Mathematics may grow as a discipline, but much of the core knowledge for University students has remained constant for decades. What is more likely to change is the manner in which the curriculum is taught rather than the curriculum itself.

In this respect, the department has made some changes in how it presents Mathematics to UTC students:

• **Class size** – College Algebra (MATH 1130) is now being taught in very large sections (200+ students) during the Fall semesters. While more students are taking College Algebra, this increase has brought with it a higher percentage of students who withdraw or are unsuccessful (in the sense of earning a grade of D or F). However, an analysis of these classes has also shown that students who pass through MATH 1130 with a grade of C or better are just as likely to succeed in a subsequent class, like MATH 1830, as they were before the move to large sections.

• **Online classes** – Prior to Spring 2015, there were no online courses in the Department of Mathematics. Now that MATH 1010 (Mathematics in Our Modern World) is being taught online, we will carefully measure its success and use that experience to inform our design of future online classes.

Nationally, there is a “need to increase the number of students who receive undergraduate STEM degrees”, as identified by the President’s Council of Advisors on Science and Technology in their 2012 report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, and Engineering*. In order to positively contribute to this effort, we will need to not only address the productivity of our own major degree program but also contribute to the success and skill development of majors in fields like Engineering, Computer Science, Chemistry, Physics, Biology, and Environmental Science.

Specific recommendations that we can address locally are:

• Adopt and develop empirically validated teaching practices to maximize the efficacy of mathematics instruction

• Expand opportunities for research in the first two years of postsecondary education to address retention and prepare future professionals

• Identify career pathways for current and future students, and improve collection of data to optimize placement of students

In Fall 2014, the UNUM Chair of Excellence, Jin Wang, submitted two NSF grant proposals which – if funded – would help address the first two points. As part of the Department’s current Retention Plans, we are already systematically collecting data about our students with an eye toward refining our preparation of students for future employment.
3.7 Information Regarding Curricular Opportunities for Development of Critical Thinking

Much of Mathematics as a discipline is focused on critical thinking. From the most basic General Education courses in the department, through the courses in the major, and into the department’s graduate program, the curriculum emphasizes critical thinking.

Specifically, Mathematics in Our Modern World (MATH 1010), College Algebra (MATH 1130), and Precalculus I (MATH 1710), are all General Education courses that are required to meet a University standard for critical thinking. Specifically: “Analyze and resolve real-world and abstract quantitative situations that require critical thinking, logical reasoning, and the ability to identify assumptions and separate relevant from irrelevant information.” All three of these courses were re-certified as General Education courses meeting this standard during the 2014 calendar year. Collectively, nearly 2400 students passed through these courses in that period and therefore were required to meet this University standard for critical thinking.

On top of these lower-level classes one may also count Calculus with Analytic Geometry I (MATH 1950), also a General Education course, which was recently re-certified and upholds the same standards, albeit for students who have achieved a higher level of mathematical training.

Those figures don’t include nearly 1000 students per year who enrolled in Introductory Statistics (MATH 2100), which is a certified General Education course in the Statistics (not Mathematics) category. The standards in that category which address critical thinking are “Use statistical thinking” and “Explain statistical concepts and interpret statistical results using appropriate statistical vocabulary.”

Critical thinking is required as an essential part of the discipline in all upper-division Mathematics courses. This includes, as a fundamental building block of the Mathematics degree program, Introduction to Logic and Proof (MATH 3000). In this course students are trained to be future mathematicians familiar with the modes of logical argument and analysis so integral to the discipline.

3.8 Curricular Research Opportunities

3.8.1 Research Experience for Undergraduates: Summer 2013

In the summer of 2012, John Graef, Lingju Kong, Min Wang, and Andrew Ledoan applied for federal funding and received financial support from the National Science Foundation (NSF) to organize and set up a Research Experiences for Undergraduates (REU) Site in Differential/Difference Equation Models and Number Theory for the academic years 2013 through 2015. Graef is the principal investigator of this NSF grant, and Kong is the co-principal investigator. The four mentors would share their research in Differential Equations, Difference Equations, Number Theory, Probability Theory, and Mathematical Physics (especially billiards) with advanced undergraduate students who are fascinated by mathematics, who like to solve challenging mathematical problems, who are inquisitive about what mathematicians do, and who would enjoy staying at the metropolitan campus for two months during the summer and exploring mathematics. It would be one mentor per research project.

This exciting educational and research outreach program provides an opportunity for undergraduate students to participate in a deeper experience in mathematics that is usually not available during the academic year. Furthermore, this program is especially beneficial for undergraduate students who are considering graduate study and research in mathematics, as well as for those who are interested in teaching mathematics at any level. It is worthwhile to point out that this is first time that the department had received such funding. What is so unexpected is that the total amount that was awarded here is much more than the amount that was given to the more experienced REU programs at Emory University and a host of other institutions.

In the spring term of 2013, the four mentors reviewed 29 student applications from mostly regional universities across the country and invited nine undergraduate students to the department to participate in our summer REU program. After two months of rigorous work, five original research papers on topics in Differential Equations and Number Theory were completed under the supervision of the mentors, and these papers were subsequently accepted for publication in peer reviewed journals. Several participants presented their joint work at regional, national and international conferences, some of whom were later accepted into Master’s and Ph.D. programs. Specifically, two of Kong’s students were accepted into the Ph.D. programs at Vanderbilt University and North Carolina State University, and both are currently studying Applied
Mathematics. One of Ledoan’s students decided that academic research was not his goal and accepted a job offer from International Business Machines Corporation to work as a software engineer.

3.8.2 Research Experience for Undergraduates: Summer 2014

The number of applicants in 2014 was 70. This past summer, the mentors invited a second group of nine undergraduate students, many of whom came from prestigious national universities such as Rutgers University, Georgia Institute of Technology, and Baylor University. Two of these students are our mathematics majors, and they did remarkably well on their research projects. The first student did her research in Classical Analysis and Probability Theory under the directions of Ledoan, and she presented her joint work at the Thirty-Fourth Annual Mathematics Symposium at Western Kentucky University on October 10, 2014. The second student did his research in Differential Equations under the direction of Wang. Currently in the Brock Scholar Program, he will be working on his honors thesis with Wang.

Three original research papers on topics in Differential Equations and Probability Theory were written under the supervision of the mentors and will be submitted for publication. Two of Ledoan’s students were invited to present a twenty-minute report talk at this year’s Young Mathematicians Conference (YMC) at Ohio State University on August 23, 2024, where they met with directors of graduate studies from the University of Illinois at Urbana-Champaign, University of Pennsylvania, and University of Chicago, to name a few. This wonderful conference for undergraduate student researchers has a very competitive selection process with over 40 mathematics faculty reviewers. This year, only 50 abstracts out of 140 abstracts submitted by 200 students were selected for invitation to YMC. These two students will be taking the general and mathematics Graduate Record Examinations and applying for a strong Ph.D. program in Number Theory this coming fall term. Furthermore, one of Kong’s students presented a talk at the Thirty-Fourth Southeastern Atlantic Regional Conference on Differential Equations on October 11, 2014. Other students have expressed interests in presenting talks at several regional, national, and international conferences.

Many excellent mathematics departments maintain an on-going REU program. Our current REU program has funding through the summer of 2015. Needless to say, the department will strive to maintain an on-going REU program. Its research opportunities provide a most rare and enriching hands-on experience for undergraduate students that prepares them for their careers or further education. In an exit survey, one the participants from the REU Summer 2013 wrote that the program was a life-changing experience. Indeed, it is a great effect that the mentors have on their students.

3.9 Student Internship, Practicum, and/or Clinical Opportunities

An internship for promising mathematics students was established with Blue Cross/Blue Shield of Tennessee (BCBST) beginning in the summer of 2002. This program provides students with opportunities to work with statistical concepts inside Chattanooga’s insurance industry. Aaron Fisher (Bachelor of Science in Applied Mathematics: Actuarial Science, Magna Cum Laude, 2013) interned at Tennessee Valley Authority in the summer of 2011.

As mentioned previously, some current students work as client data specialists in the UNUM Scholars Program. While not directly related to the actuarial training in our degree program, students are using this opportunity to meet and network with actuaries inside UNUM and thereby gain valuable information and connections as they start their professional careers.

4 Teaching and Learning Environment

The Department of Mathematics is housed in the state of the art Engineering-Mathematics-Computer-Science (EMCS) building, which was built in 2002.

Classrooms in EMCS vary in size (anywhere from 30 to 49 seats). EMCS also has Card Auditorium and Benwood Auditorium with capacities of 141 and 295 seats, respectively. Every classroom and auditorium is fitted with a computer-podium, overhead projector, document camera, and a retractable projector screen. The classrooms have large windows that allow for an abundance of natural light in addition to the adjustable artificial lighting.
4.1 Information Regarding Current Instructional Practices

The Department of Mathematics coordinates instructional standards by utilizing course coordinators for all 1000 and 2000 level courses. This process ensures a standard syllabus for the same course, and similar course work for each course. Course coordinators are also required to meet with instructors who teach that course on a regular basis to discuss course related issues that may arise.

In general, mathematics courses at UTC are taught in the traditional manner by introducing a concept along with definitions and rules, and then providing the students with suitable examples, from elementary to more advanced. Class discussions of this particular concept would then follow allowing students time for questions. Some of our more experienced faculty use what is called “flipped-classroom.” For this method, the students are required to read a section ahead and at the next class meeting, they have the opportunity to ask questions. Thus, the class is based solely on the questions asked by students. Individual instructors give more detailed information below about instructional methods.

Over the past few years, many of the freshman and sophomore level mathematics courses have adopted some form of web-based instructional method. For example, students are required to complete and submit homework assignments on-line. One advantage is that students get immediate feedback on the correctness or incorrectness of their problems. Grading policies vary by instructor, but in most cases, online homework counts for some part of a student’s final grade for the course. In addition to the online homework requirement, students in Math 1130, College Algebra, are required to spend at least one hour per week in the computer lab (Math Plaza) working on their homework assignments where tutors are available for help.

The following courses utilize some form of web-based instruction/homework:

- Math 1010 Mathematics in our Modern World
- Math 1130 College Algebra
- Math 2100 Introductory Statistics
- Math 1710 Precalculus I
- Math 1730 Combined Precalculus
- Math 1830 Calculus for Management, Life, and Social Sciences
- Math 1950 Calculus with Analytic Geometry I
- Math 1960 Calculus with Analytic Geometry II
- Math 2200 Elementary Linear Algebra
- Math 2560 Calculus with Analytic Geometry III

We have solicited direct input from several of our course coordinators and faculty to describe some of the teaching strategies used in the classroom. Each quote is in the instructor's own words, without editing. The following is by Ms. Meg Kiessling, course coordinator for Math 1710, Precalculus 1.

The teaching strategy used for Math 1710, Precalculus I, has been modified to include recitation sessions and the use of i-clickers during regular lectures. The class is taught using large sections (120 students), which meet 3 times a week.

The students also attend a recitation session once a week. The recitation sessions are composed of groups of 20 to 40 students depending upon total enrollment. Graduate teaching assistants run the recitation sessions using notes and methods provided by the instructor. Recitation sessions provide extra time for students to work practice problems, to see more examples, and to ask questions about homework problems.

During the large group lectures, students are encouraged to participate using their i-clickers. The i-clickers are used for multiple purposes. In order to see if students are doing their homework, some textbook problems are assigned and these are used in the next lecture as clicker questions. Students use the i-clickers to enter their answers and then the problems are reviewed. Also during
lecture, after new material has been presented and example problems worked, the students are given a similar problem to solve and enter their responses using the i-clickers. This encourages student participation during the lectures and also provides immediate feedback to the instructor as to whether or not the students understand the new material.

The following is from Ms. Angelique Ramnarine, course coordinator for Math 1010, Math in our Modern World.

Instructors decide upon their preferred method of delivery during lecture sessions - either on the whiteboard or on the overhead using student handouts/worksheets. The handouts are essentially outlines for lecture sessions and provide a way to help students organize the material for the course. These handouts are posted on the UTC Learn Bb course pages and students are expected to bring them to class to work through with the instructor.

Quiz Assessments utilize the UTC Learn Bb [Blackboard] system. The problems are either multiple choice or short answer (i.e. students type in their final answers).

Homework Assessments utilize the MyMathLab system. Students answer either multiple choice or short answer questions.

The following is from Sumith Gunasekera, course coordinator for Math 2100, Introductory Statistics.

In addition to teaching this class in a traditional way of standing at the blackboard and explaining the subject material, several colleagues who are teaching this class do In-Class Group Project, and the most of the others use the web-based homework on Hawkes Learning System. In group projects, the class would be divided into several groups, each with around 4 -5 students, and one of the projects that is already at the end of each chapter would be assigned once we are done with material on those chapters. The duration of these projects are 30-40 minutes. These Web-base Homework and In-Class Group Projects are so far very successful.

The following is from Betsy Darken, faculty member.

In all of my classes, I organize my students into teams. Lately I’ve been doing this by asking the students on the first day of class to line up according to their answers to the question, How confident are you that you will do well in this course? (They line up from most confident to least confident.) This does a relatively good job of creating heterogeneous teams. During class, I often have teams work together on various problems, usually preceded by some lecturing. Sometimes I present the teams with a new concept that they need to figure out for themselves, such as determining how to restrict the sine function to obtain a one-to-one function. After students work in teams, I call on students individually but let them know that I am expecting a team answer. In a few classes I’ve tried a structured approach called team-based learning, which includes some team quizzes and peer evaluations of team work.

I use teams to create a more active class and get students more involved with their learning. In questionnaires I have given to classes, the great majority of students give positive to very positive responses to the use of teams. Some teams work so well that they get together outside of class to help each other out. A few teams are complete duds.

In my upper division classes, where I also use teams, I have occasionally had teams go to the board to do proofs.

I use online HW, along with paper HW, in lower division classes. I provide links to videos (Kahn Academy, etc. from Matt [Matthews]).

I occasionally use items I’ve found online, such as an animated version of values spinning off the unit circle onto the sine wave.

The following is from Aniekan Ebiefung, faculty member.

One way to motivate students’ interest in statistics is to design projects using data that relate to students in a personal way. I do this in all my statistics classes. Most of the statistical projects in my statistics classes use data generated by and from the students. For example, using the
class grades or student heights as a data set, I asked each student to compute the percentile rank of his/her grade. This is time consuming since I have to check about 120 answers rather than one, but it is good for the student to relate in a personal way to the projects. I also encourage students to do projects using Excel. Graduates who came back to talk in the department said they used excel software at work, except for specialized jobs.

The following is from Roger Nichols, faculty member.

I used an online homework system, MyMathLab, when I taught MATH 1830 (Calculus for Management, Life and Social Sciences) during Fall 2012, Spring 2013, Fall 2013, and Spring 2014. Each semester, I gave 13 weekly homework assignments for the students to complete. On my evaluations, over and over again, students rated the online homework as one of the things that helped them most in the class.

This semester, I’m using WebAssign in MATH 1950 (Calculus with Analytic Geometry I) in the same way.

The quotes above are representative samples of the work of all our faculty members.

4.2 Student interaction with students and faculty.

The Department of Mathematics promotes interaction between students and between students and faculty members using several practices. We describe some of these practices.

4.2.1 Student Organization

Once a year, students are invited for induction into the local chapter of a national mathematics honor society, Pi Mu Epsilon. These invitations are based on academic performance. During the following year, members of PME are given the opportunity to participate in several events, mainly service oriented. Members are invited to participate in university-sponsored events such as Fall Visiting Day, New Student Orientations, Academic Departments Majors Fair, etc. PME sponsors an annual Sudoku contest where non-perishable food is collected for the benefit of Chattanooga Community Kitchen. PME also sponsors a movie night for the enjoyment of all our students and faculty members. The movie is usually a mathematics themed movie, and refreshments are provided to the moviegoers.

4.2.2 Social Events

The Department has three official social events designed primarily to promote interaction between students and faculty members. The first is a welcome back party in September of each year, where pizza and drinks are served to all our students and faculty members. This party is held on a weekday from 11 to 1. The second event is held close to the conclusion of the fall semester. At this event, faculty members bring a variety of dishes. Since we have a very diverse faculty, one might see dishes traditional to Russia, Italy, China, Africa, and elsewhere. Students are not required to bring dishes; they are only required to participate. The third event is the Department Honors Day, which is discussed below under Student Awards, Student Honors Day.

4.2.3 Department Committees

Students are appointed to serve on several department committees, namely, Student Relations Committee, Curriculum Committee, and Colloquium Committee. Students provide a perspective not always obvious to faculty members.

4.2.4 Department Colloquium Events

Students are invited to attend every department colloquium event that is suitable for undergraduates. Invitations are sent via campus-wide email as well as department-wide email.
4.2.5 Problem of the Month

Once a month, Dr. Stan Byrd posts a non-trivial problem, at several locations in the EMCS building, to be solved by undergraduates. He awards $20 to the student with a best solution. This award comes from his wallet.

4.2.6 Communication

The Department uses a list server, Math-friends, to communicate important events and general information to its students via email.

4.2.7 Student Awards, Student Honors Day

Every year during April, the Department of Mathematics holds its Honors Day. At this event, students and faculty members sit down together for a catered lunch. Then the awards, as described below, are presented to students. Also at this event, new PME members are inducted into the society. We note that each of the awards includes a monetary component. The amounts may vary, depending on the growth of each endowment. Usually the award is between $500 and $1000.

The Department of Mathematics offers several scholarships and awards each year to deserving students. There are two scholarships given to incoming freshmen each year who wish to major in Mathematics. Seven scholarships and awards are given to upperclassmen each year based on academic excellence in the field of Mathematics.

- The Marjorie Watson Mathematics Scholarship: Intended for an incoming freshman attending the University of Tennessee at Chattanooga who majors in mathematics. This is a $5000 scholarship, with $2000 awarded in the freshman year, and $1000 awarded for each of the sophomore, junior and senior years.

- The Dorothy Dean Shelton Mathematics Scholarship: Intended for an incoming freshman attending the University of Tennessee at Chattanooga who majors in mathematics. This scholarship will insure that all tuition, fees, books, room and board for an in-state student are fully paid.

- Actuarial Science Award: Established in 2003 by the Mathematics Department in recognition of students passing the Actuarial examinations.

- Freshman Mathematics Award: Awarded to a freshman as of the Spring semester when the test is administered or the previous Fall semester. This student scored the highest of all participants on the Freshman Mathematics Award Test.

- James G. Ware Mathematics Education Award: Established in 1994 by Dr. James G. Ware, faculty member of the Department of Mathematics for 30 years, 22 of which were as head of the department, upon the occasion of his retirement. The award goes to the outstanding student planning to teach Mathematics at the high school level.

- John W. Jayne Memorial Mathematics Award: Established in 1994 by family and colleagues in memory of Dr. John W. Jayne, member of the Department of Mathematics for 22 years, who died in 1993. The award is given each year to an outstanding Mathematics student.

- Outstanding Graduate Student Award: Presented to an outstanding student in the Mathematics Graduate Program.

- Ruth Clark Perry Memorial Mathematics Award: Established in 1969 by Mrs. Leonora Miller Seids of Perry, Oklahoma, in memory of her friend, UC Dean of Women from 1924 to 1943 and Professor of Mathematics from 1922 until her death in 1955, to be awarded to an outstanding upper class woman majoring in Mathematics.

- Winston L. Massey Memorial Mathematics Award: Established in 1973 by the University of Chattanooga Foundation in honor of W. L. Massey, Guerry Professor of Mathematics, on the occasion of his retirement after 40 years of service to his alma mater, for an outstanding upper class man majoring in Mathematics.
4.3 Information Regarding Advising for Majors

It is a university policy that every student is advised by an adviser in his or her major department before registering for classes for the following semester. To accomplish that goal, a student may register once they have obtained a pin number from their adviser to use in the registration process online. Without this pin number, a student is not allowed to register.

During the last 5 years, two faculty members, Matt Matthews and Lucas van der Merwe, were responsible for student advising. In order to soften the load around registration time, Matt started what is called Advising Night, each semester right before online registration opens for students. This event also doubles up as a social event, complete with pizzas and drinks. Many of our instructors would show up at the event to make a pitch for an upper-level mathematics class they would teach the following semester. After a student is advised, they would receive their pin number.

Last year, the process was revamped to include more of our faculty members, for a total of 8. The new advisors attended an instructional seminar given by the department. They also attended an instructional seminar given by the university. Every one of these faculty members participated this past summer (2014) in a total of 11 new-student, or transfer-student, orientations. A typical new-student orientation lasts for 2 days on campus of which our advisers spend at least an hour per day with new mathematics majors. The official mathematics advisers are now Andrew Ledoan, Roger Nichols, Roy Liu Xuhua, Sumith Gunasekera, Lani Gao, Steve Kuhn, Francesco Barioli, and Lucas van der Merwe. Every mathematics major, including the STEM mathematics education major, is assigned to one of the mathematics advisers. This adviser is keeping track of each student’s academic progress. Starting next semester, the Department will require every mathematics major to visit his or her adviser at least three times per semester. The STEM mathematics education majors also have an adviser, Linda Gehron, in the STEM education program.

In addition to advising in the department, UTC maintains an office, Center for Advising and Student Success, located in the University Center. They advise freshmen and undecided students, and council students that experience life’s difficulties.

4.4 Information Regarding Enrichment Opportunities for Students

As outlined above, there are a variety of ways in which majors in the Department’s program can enrich their undergraduate degree program. From the Department’s Pi Mu Epsilon honor society to its community-building social events, from the ongoing colloquium series to inclusion of students in the Department’s committees, students in the Applied Mathematics program are afforded ample opportunities to take part in the broader community within their discipline.

The Department also actively informs students of Mathematics-oriented events beyond UTC. Local and regional conferences are routinely promoted to majors, and attendance is encouraged. When possible, students are provided with support to travel to these conferences, and in some cases faculty have accompanied students to these events.

The REU program directed by Drs. Graef and Kong, et al, has also included majors from UTC in its activities.

4.5 Library Holdings

The mission of the UTC Library is to support the teaching and research of the faculty and students of the University of Tennessee at Chattanooga through the development of collections and services that promote and enhance the University’s curriculum and research endeavors.

4.5.1 Library Personnel, Budget and Facilities

The Library engages 20 faculty librarians and 12 support staff specialists to support the UTC community. The Library budget for 2013-2014 was approximately 3.3 million dollars. The Library building is 116,349 square feet, has a book shelving capacity of 500,000 volumes, and a seating capacity of 675 readers. The building was first occupied in 1974 and is typically open over 88 hours a week. The campus is currently in the final building phase of a new library with an anticipated opening date of January 2015; there is a one-page summary of new building features in Appendix A.
4.5.2 Library Collections

As of June 2014, the Library’s monograph collection consists of 463,762 unique titles, of which 11,243 of the books bear the call numbers QA, appropriate to the study of mathematics. The Library’s collection of audiovisual material consists of 21,853 unique titles, and 135 of those deal with mathematics. The 2013-2014 allocation for one-time expenditures for the Mathematics Department was $3,450 from a total allocation to Academic Affairs of $197,050.

As of June 2014, the Library, through subscriptions to full-text resources, databases, journal packages, and individual journals makes available over 25,000 serial titles, including open access titles. Of those, over 13,000 titles are direct subscriptions, mostly in digital form. The Library has identified 33 currently received journal subscriptions supporting the Mathematics department’s curricular and research needs; a list of these titles is included at the end of this document in Appendix B. All electronic subscriptions are accessible 24/7 from any internet connection.

The primary discovery tools used to identify mathematics and related topics journal articles and other materials are: MathSciNet, ACM Digital Library, Safari, Web of Science, JSTOR, ScienceDirect, and the Springer Journal Collection. In addition, the Library subscribes to databases such as Academic One File, JSTOR, Project Muse, Omnifile Full Text and other useful full-text titles. In 2013-2014, the Library paid $1,089,475 for direct subscriptions, journal packages, and databases, of which $34,082 was for mathematics-specific subscriptions subject focused databases, not including the cost of multi-disciplinary journal packages and databases.

4.5.3 Library Services

The Library has a Subject Specialist Program where a librarian is assigned to each academic department to enhance communication, collection development, and general support for students and faculty. The Subject Specialist assigned to the Mathematics Department is Andrea Schurr. Professor Schurr has worked closely with faculty in the department in support of resources and services.

The Library has created a research guide for students studying Mathematics to easily access relevant databases, journals, electronic books, and helpful information, including citing sources. The guide is available on the Library web site at: http://guides.lib.utc.edu/math.

The Library has a robust and well-respected Instruction program. Last year, the Instruction Team taught 321 courses and reached 5,731 students. Library faculty work closely with discipline faculty to design instruction sessions tailored to course and assignment objectives. The Library did not conduct instruction for the Mathematics Department.

The Library offers free interlibrary loan (ILL) service to students and faculty who need to acquire materials that are not owned by the Library. The electronic ILL management system, ILLiad, allows patrons to submit and track the progress of requests, receive email notification of arrival dates, and receive articles electronically. The Library also participates in a program called Rapid ILL which expedites the delivery of the requests to the patron. In 2013-2014, 12,153 interlibrary loan borrowing requests were filled for the UTC community of scholars; of those, 161 were filled for faculty or students in the Mathematics Department.

The Library’s Reference Desk is open 88 hours per week to assist faculty and students with research queries. Last year the Reference Desk fielded 14,714 questions and consultations. In addition to physical assistance, the Library offers online reference services in the form of real-time instant messaging assistance and an email reference service. One-on-one research consultations are available to students and faculty seeking in-depth assistance. The Library also staffs information desks on the 2nd and 3rd floors to provide assistance in the use of the print periodical and circulating book collections.

The Library offers a well-utilized course reserve service for faculty and students so that faculty may place high demand materials on electronic or print reserves to ensure they are available to students. Last year, 3 faculty members from the Mathematics Department made 6 materials available via Course Reserves in 5 courses.

The Library has friendly borrowing policies and allows semester-long borrowing of monographs for students and year-long borrowing for faculty members. In 2013-2014 total monograph and audio-visual circulation was 31,909. In addition, the Library circulates more than 100 laptop computers, other equipment (cameras, calculators, e-book readers, and more), and group study rooms to students. Last year the laptops and other equipment circulated 36,877 times, while our 12 group study rooms were used 7,168 times.
4.5.4 New University Library

The new library represents one of the largest capital projects recently undertaken at UTC. It opened at the end of January 2015. It has 5 floors with total size of 180,000 square feet.

The new LEED-certified library is chockfull of new strategic campus partnerships and is envisioned as the premier location for student academic needs outside the classroom. New and expanded partnerships represented in the new building include: Art Department, Center for Advisement and Student Success, Copy Services, Graduate Student Association, Information Technology Division, Office of Students with Disabilities, Online Education, Southern Writers, Teaching Resource Center, and Writing Center. Designed with a robust technological infrastructure and themes of transparency, collaboration, and flexibility, student access and success was at the center of building planning processes.

Features of the new library:

- 37 study rooms (29 small, 7 medium, 1 large)
- 2 practice presentation rooms
- 24 hour student study space
- 4 lounges (2 quiet, computer and graduate student)
- Café (a big one!)
- Information commons
- Gig City Studio 305: advanced media studio and creator space
- Over 200 desktop computers (and a yet to be determined number of laptops)
- Seating for over 2,100
- 7 classrooms
- 8 seminar and conference rooms
- 29 faculty and graduate student carrels
- 2 visiting scholar rooms
- Grand reading room
- Moveable compact stacks with storage for 600,000 volumes
- New materials browsing area (think more Barnes and Noble)
- Expanded special collections storage with unique climate controls
- New auditorium housing 2 lecture halls of 225 seats each adjacent to the new library.

4.6 Inclusion of Perspectives and Experiences of Underrepresented Groups

According to the American Mathematical Society’s *Fall 2012 Departmental Profile Report*, published in February 2014, approximately 40% of all undergraduate mathematics degrees are awarded to women. As outlined in Chapter 6, the demographics of the Department’s undergraduate program has shifted and now women represent approximately half of currently enrolled majors. This coincides with the growth of the STEM Education concentration in the Department’s B.S. degree program, and indeed many of these new majors are STEM Education majors.

In order to promote Mathematics as a profession to all of its students, including women, the Department maintains a membership in the Associate for Women in Mathematics. As part of this membership, the Department receives gratis AWM memberships for a number of its majors. The majors are informed of these memberships and any student wishing to take part is provided with one a year-long membership free of charge.
4.7 Student Evaluation of Faculty Teaching

In each course undergraduate students are provided with an online survey as a means to provide evaluation of faculty instruction and course effectiveness. A collection of seven multiple-choice questions are supplied by the University while the Department supplied five additional questions. After these items a selection of free-response questions are posed and students are provided with ample space for their comments.

Starting in Fall 2011 the University made a transition from paper forms administered during class meetings to the new online forms. As a result of this change, the number of responses from students dropped dramatically. In Fall 2014, the response rate from all classes taught by the Mathematics Department was 41% (i.e. 1405 evaluations returned out of 3461 offered). That represents the lowest rate of response during a fall semester since the inception of the new online system.

The results in Figure 4.7 are the aggregate of all undergraduate evaluations submitted from the Spring 2012 semester through the Spring 2014 semester.

These responses suggest that the Department is succeeding with its instructional mission, which includes teaching a large number of undergraduates, especially freshman students in General Education courses. Given that the Department is on the front line of student success and retention, the data in the table demonstrate that Departmental faculty are succeeding in providing ample opportunities to undergraduates taking Mathematics courses.

5 Faculty

5.1 Faculty Size

The department has changed considerably with respect to individual faculty since the last five-year review period, Fall 2004 to Fall 2009. However, the number of full-time faculty lines remains about the same. At the time of the previous review, there were 20 tenured and tenure-track faculty lines, including three and one-half full-time lecturers with one-year appointments. Currently, there are 20 tenured and tenure-track faculty lines and nine full-time lecturers. The benefit from these one-year appointments is that the dependence on adjunct faculty, who only teach one or at most two courses per semester, has been removed. Typically, the department relies on faculty overloads to fill courses in demand and only uses adjuncts in extreme circumstances when it is not possible to cover a course with an overload. The number of full-time faculty is broken down according to professional rank in Table 5.1.

<table>
<thead>
<tr>
<th>Professional Rank</th>
<th>Fall 2009</th>
<th>Fall 2014</th>
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<tr>
<td>Professor</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>5</td>
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<td>5</td>
</tr>
<tr>
<td>Lecturer</td>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 5.1: Number of full-time faculty according to rank in Fall 2009 and Fall 2014.

Three faculty members have retired since the last five-year review: Billy Edwards in 2012, Irene Loomis in 2013, and Ed Rozema in 2014. In 2012, the department hired five tenure-track faculty at the rank of assistant professor: Cuilan Gao, Andrew Ledoan, Xuhua Liu, Roger Nichols, and Min Wang. Sergei Avdonin was hired to fill the position of UNUM Chair of Excellence in Applied Mathematics. He served in this position from 2012 to 2013. Jin Wang was subsequently hired as UNUM Chair of Excellence in 2014. In Fall 2014, Min Wang resigned to work in the private sector.

The following roster lists member of the department according to their current individual rank or position.

**Fall 2014 Department Roster**

**Professor:** Boris Belinskiy, Betsy Darken, Aniekan Ebiefung, John Graef, Lingju Kong, Stephen Kuhn, Ossama Saleh, Eugene Schlereth, Ronald Smith, Lucas Van der Merwe, Terry Walters, and Jin Wang
### Student Evaluation of Faculty Instruction

#### Spring 2012 - Spring 2014

<table>
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<th>University-Level Questions</th>
<th>All Terms</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>The instructor is willing to help students.</td>
<td>6.28</td>
<td>6340</td>
</tr>
<tr>
<td>The instructor encourages students to be actively engaged in learning the content of this course.</td>
<td>6.05</td>
<td>6349</td>
</tr>
<tr>
<td>The instructor provides timely feedback on assignments and exams.</td>
<td>6.19</td>
<td>6350</td>
</tr>
<tr>
<td>The instructor includes activities and assignments that help students learn the content of this course.</td>
<td>5.94</td>
<td>6342</td>
</tr>
<tr>
<td>The instructor clearly communicates expectations of students for this class.</td>
<td>6.09</td>
<td>6350</td>
</tr>
<tr>
<td>The instructor expects high quality work from students.</td>
<td>6.38</td>
<td>6312</td>
</tr>
<tr>
<td>Overall, this class has provided an excellent opportunity for me to increase my knowledge and competence in its subject.</td>
<td>5.86</td>
<td>6315</td>
</tr>
</tbody>
</table>

**Note:** On a 1.0 - 7.0 Scale

<table>
<thead>
<tr>
<th>Department-Level Questions</th>
<th>All Terms</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>My instructor is approachable.</td>
<td>5.31</td>
<td>6231</td>
</tr>
<tr>
<td>My instructor shows respect for students.</td>
<td>5.42</td>
<td>6202</td>
</tr>
<tr>
<td>My instructor has aided my comprehension of the material in this course.</td>
<td>5.11</td>
<td>6162</td>
</tr>
<tr>
<td>My instructor is meeting the objectives specified in the course syllabus.</td>
<td>5.55</td>
<td>6106</td>
</tr>
<tr>
<td>My instructor is following the policies specified in the course syllabus.</td>
<td>5.64</td>
<td>6084</td>
</tr>
</tbody>
</table>

**Note:** On a 1.0 - 6.0 Scale

Figure 4.7: Aggregate course evaluation data for Spring 2012 through Spring 2014.
Student credit-hour (SCH) production, as indicated in Table 5.2, has fluctuated over the period since the last review. The retention rate of mathematics majors nearly doubled, and this led to a steady increase in the overall number of mathematics majors. In Fall 2013, the department had 88 undergraduate majors compared to only 49 majors in Fall 2009. The increase in the number of mathematics majors has led to a greater demand for advisors to advise students majoring in mathematics. To meet this demand, the junior faculty and a selected number of senior faculty now share the responsibility of advising students.

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>10,580</td>
<td>9,906</td>
<td>10,556</td>
<td>7,774</td>
<td>7,952</td>
</tr>
<tr>
<td>Fall</td>
<td>12,720</td>
<td>13,327</td>
<td>10,531</td>
<td>12,198</td>
<td>?</td>
</tr>
</tbody>
</table>

Table 5.2: SCH production in mathematics by year from 2010 to 2014.

The SCH production per full-time FTE faculty (SCH/FTE ratio) remains high in comparison to other departments within the sciences and engineering, as indicated in Table 5.3. The table does not take course releases for individual faculty into account.

<table>
<thead>
<tr>
<th>Department</th>
<th>SCH/FTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology/Environmental Science</td>
<td>365.56</td>
</tr>
<tr>
<td>Chemistry</td>
<td>432.34</td>
</tr>
<tr>
<td>Computer Science and Engineering</td>
<td>233.52</td>
</tr>
<tr>
<td>Engineering</td>
<td>203.40</td>
</tr>
<tr>
<td>Engineering Management and Technology</td>
<td>149.00</td>
</tr>
<tr>
<td>Mathematics</td>
<td>421.02</td>
</tr>
<tr>
<td>Physics, Geology, and Astronomy</td>
<td>361.00</td>
</tr>
</tbody>
</table>

Table 5.3: SCH/FTE ratio across various departments in the sciences for Fall 2013.

The official teaching load responsibility for university faculty is twenty-four semester hours per academic year, although exceptions may be made if a department has a graduate program. Due to the mathematics graduate program and restructuring of certain lower division courses, the teaching load for the mathematics faculty was reduced to eighteen semester hours per academic year, starting in Fall 2003.

Beginning in Fall 2000, the department began the practice of releasing a faculty member who has an ongoing research program per semester from teaching a course in order to devote additional time to his or her research. Faculty are added or removed from the rotation based on their research productivity. This practice was expanded to two faculty members per semester starting in 2006.

Since the end of the Spring 2012 semester the Department has not regularly employed adjunct instructors. Prior to that time, adjunct instructors were used each semester to teach developmental mathematics courses. Due to changes in Tennessee law, UTC was no longer permitted to teach developmental mathematics and those courses were eliminated.
5.2 Faculty Diversity

The department features a diverse and talented group of international faculty from eight different countries: China, Egypt, Italy, Nigeria, Russia, South Africa, Sri Lanka, and the United States. According to the 2012 Annual Survey of the Mathematical Sciences in the U.S., the most recent survey of the profession published by the American Mathematical Society, 29% of full-time faculty in four-year institutions were women in Fall 2012. At present, only 10% of the faculty in mathematics at the university are women. The recent retirement of Irene Loomis, which produced a vacant full-time position, had an effect on this statistic.

The mathematics faculty have interests in many areas of the mathematical sciences, including:

- Differential and Difference Equations
- Discrete Mathematics
- Dynamical Systems
- Fluid Mechanics
- Functional Analysis
- Granular Materials
- Graph Theory
- Group Theory
- Integral Equations
- Linear Algebra and Matrix Theory
- Mathematical Biology
- Mathematics Education
- Mathematical Physics
- Number Theory
- Numerical Analysis
- Operations Research
- Operator Theory
- Partial Differential Equations
- Probability Theory
- Statistics

These research specialties fit well with the needs of the mathematics program, especially for the various concentrations of the Bachelor of Science in Applied Mathematics. In response to the increase in student interest of the Actuarial Science concentration, the department hired Cuilan Gao in 2012.

The mathematics faculty received their PhDs from a wide range of prestigious universities:

- Auburn University
- Clemson University
- Florida State University
- North Carolina State University
- Northern Illinois University
- The Ohio State University
- St. Petersburg State University
- Southern Illinois University
- University of Alabama at Birmingham
- University of Georgia
- University of Illinois at Urbana-Champaign
- University of Mississippi
- University of Nebraska–Lincoln
- University of Nevada at Las Vegas
- University of Padova
- University of South Africa–Pretoria
- University of South Florida
- The University of Tennessee, Knoxville
- Washington University

5.3 Faculty Preparation

Faculty credentials are appropriate to the level of the undergraduate mathematics degree program. They meet SACS guidelines, which require all faculty teaching mathematics general education courses or other mathematics baccalaureate courses to possess either a doctorate or master’s degree in the discipline. All tenured and tenure-track faculty within the department hold a doctorate, and each lecturer holds either a doctorate or a master’s degree.
5.4 Faculty Scholarship/Productivity

The department prides itself on a tradition of active and productive research. In spite of the high SCH/FTE ratio, the faculty remain active in research as demonstrated by publications in national and international refereed journals, invited and contributed presentations at national and international conferences, service on editorial boards, and refereeing and reviewing activities. The number of papers that have appeared in print and the number of presentations by faculty at national and international conferences for the academic years 2010 to 2014 are given in Table 5.4.

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>Publications</th>
<th>Presentations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>43</td>
<td>10</td>
</tr>
<tr>
<td>2011</td>
<td>51</td>
<td>20</td>
</tr>
<tr>
<td>2012</td>
<td>65</td>
<td>30</td>
</tr>
<tr>
<td>2013</td>
<td>89</td>
<td>21</td>
</tr>
<tr>
<td>2014</td>
<td>46</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 5.4: Mathematics faculty publications and presentations from 2010 to 2014.

The department has been successful in obtaining grants from various internal sources to support its research efforts over the past five years. These internal grants take the form of Faculty Development Grants, Faculty Research Grants, and Ruth S. Holmberg Grants for Faculty Excellence. These funds are used to release faculty from teaching or to support travel to conferences. From 2010 to 2014, several faculty members received research grants from external sources totaling $586,328. Several externally funded grants and faculty achievements are worthy of mention here.

- The conference *New Trends in Differential and Difference Equations* was held at the university on March 15-16, 2013 to honor the 70th birthday of Prof. John R. Graef.

- John Graef, Lingju Kong, Andrew Ledoan, and Min Wang were awarded funding in the amount of $290,000 from the National Science Foundation for the project entitled “REU Site: Differential/Difference Equation Models and Number Theory.”

- In August 2011, Steve Kuhn was awarded the National Science Foundation Robert Noyce Scholarship Grant “UTeChattanooga Noyce Scholarship Program (UNSP)” in the amount of $1.2 million for five years to provide full scholarships for Juniors and Seniors and a variety of Freshmen and Sophomores.

- In January 2011, Steve Kuhn was awarded a Department of Education Fund for the Improvement of Post-Secondary Education (FIPSE) grant in the amount of $770,000 to support the Center for Leadership in STEM Education.

- In July 2013, Roger Nichols was awarded an AMS-Simons Travel Grant in the amount of $4,800 for research-related travel during the period July 2013 to July 2015.

- The paper *Periodic solutions of first order functional differential equations* by John Graef and Lingju Kong, published in Applied Mathematics Letters in 2011 is listed on the journal website as one of journal’s most read articles.

- In 2014, Aniekan Ebiefung was awarded a Tennessee Higher Education Commission (THEC) grant for the project “Building the staircase to Algebra through Grade 5 Mathematics for 5th Grade Mathematics Teachers.”

Further details concerning faculty achievements and service to the mathematical community may be found in individual curriculum vitae.

To foster a collaborative research atmosphere, the department runs a colloquium series which features presentations from distinguished visitors, faculty, and graduate students. The average number of presentations per year for the period 2009 to 2014 is fourteen. Over this period, the colloquium series has featured a number of guest speakers from various colleges and universities, including Carnegie Mellon, College of...
William and Mary, East Carolina University, L. N. Gumilyov Eurasian National University (Kazakhstan), Masaryk University (Czech Republic), Razi University (Iran), University of Albany, University of Missouri, and Vanderbilt University.

Faculty members in the department regularly serve on external college- and university-wide committees. Every university committee has had a member from the department at least once over the past five years. In addition, a member of the department has served on the Faculty Senate each of the last five years. The following faculty members are currently serving on external committees:

- Francesco Barioli (Learning Support Services)
- Boris Belinskiy (Academic Standards, Faculty Senate)
- Betsy Darken (Chair of Academic Standards, General Education, Honor Court)
- Aniek An Idjelb (Faculty Development Grants)
- Cuilan Gao (Faculty Rating of Administration)
- Sumith Gunasekera (Faculty Research)
- Lingju Kong (Faculty Research, Graduate Council)
- Stephen Kuhn (Curriculum, Honor Court)
- Andrew Ledoan (Chair of Departmental Honors, Faculty Senate)
- Xuhua Liu (Student Rating of Faculty Instruction)
- Roger Nichols (Faculty Research)
- Lucas Van der Merwe (Athletics)
- Terry Walters (Academic Standards, Curriculum)

5.5 Faculty Professional Development Plan

All faculty are required to complete an annual Evaluation and Development by Objectives (EDO) report. This professional development report consists of two components:

- Development by objectives
- Annual evaluation

To complete the development by objectives portion of the EDO report, the faculty must clearly identify their objectives for the upcoming year within each of the following three standard evaluation categories:

- Instructional and advisement activities
- Research, scholarly, and creative activities
- Professional service activities

By completing the development by objectives portion of the EDO report, the department ensures that each faculty member has a professional development plan in place to enhance his or her role as a member of the department and the university.
5.6 Faculty Evaluation System

The second component of the annual EDO process requires the faculty to complete an Individual Performance Report Form and conduct a self-assessment to review progress toward meeting their objectives from the previous year in the three standard evaluation categories. The full EDO report is officially submitted to the department where it is then reviewed by the department head. The Individual Performance Report Form is used by the department head to gauge whether or not faculty are meeting the individual objectives they set. Upon evaluation of the full EDO report, the department head provides commentary under each of the three standard evaluation categories on both the annual evaluation and development by objectives portions. The department head and the faculty member then meet to discuss the outcome of the review.

6 Support

6.1 Equipment

6.1.1 Computers and Technology Support

All faculty have an office computer at a minimum and the level of technology is generally adequate for our needs. The university purchases incoming faculty a computer as a part of the initial contract. However, there is no long-term plan to replace computers. Therefore, we will continue the practice of attempting to upgrade equipment on an as-needed basis by requesting funds from the College of Arts and Sciences, seeking grants, or (in the absence of other options) spending from the Department’s operating budget.

The university offers adequate technical support by having a staff of technicians who can service most computer problems. The university also has site licenses for necessary computer software such as the Microsoft Office, SPSS, SAS, Maple, and Mathematica. Software needed by mathematics faculty, but for which the university does not hold a site license, is purchased using available funds.

Many faculty use the internet to distribute class materials to students. In addition to email, the primary means for communicating with students is through the UTC Learn (Blackboard) content management system. The UTC Learn system provides a uniform course content structure for students taking courses throughout different departments in the university. Faculties typically provide syllabi, guidelines, objectives, assignments, and other course materials online. Security features permit instructors to restrict access to course materials only to students enrolled in their section of a course. Moreover, UTC Learn provides a means of emailing students—either individually or in groups—as well as a grade center so that students can track their own grades (for homework, tests, quizzes, and so forth) as they are recorded by the instructor.

Some faculty also use individually authored web pages hosted on university servers (outside the UTC Learn system) to communicate with their students.

An increasing number of courses are being taught using online homework systems such as MyMathLab and WebAssign. These systems typically offer a variety of means by which students may practice and be evaluated on knowledge and mastery.

For example, MyMathLab offers homework, quizzes, and other materials through a web browser. However, MyMathLab is tied to specific textbooks and is maintained by Pearson Publishing. While instructors may author their own problems, the publisher typically provides a large selection of problems that instructors may assemble into assignments for their students. WebAssign offers a similar product, but is somewhat more publisher-agnostic.


In addition to these technologies, the department uses email to stay in contact with students seeking a degree in Mathematics, seeking a minor in Mathematics, taking many mathematics classes. The primary vehicle is the Math Friends mailing list, administered through the university RAVEN system, to which new students are added each semester at their request. Through this mailing list, the department can notify students of employment opportunities, research and grant opportunities, as well as events within the
department itself (e.g., the annual pizza party held at the beginning of the Fall semester). In December 2009, to increase communication among students and faculty and to maintain connections with our graduates as they leave the university the department started an official group on Facebook.

The Department also makes heavy use of the ARGOS and Self-Service Banner systems for scheduling, planning, and grade tracking. Specifically, the Department uses ARGOS and bespoke reports created by the Banner programmers on campus to collect information about majors, student success rates, course progression efficiency, and other aspects of student instruction. As it relates to student communication, the ARGOS system is used each semester to create an email list of all Mathematics majors. In this way, we can reach them directly for special announcements and events.

One very serious problem the department faces is that there is no funded university or college plan for regular replacements for faculty or laboratory computers. Also, all of the computers in the computer lab are first-generation Windows 7 machines and will likely become a serious liability in the coming years. These computers are in constant use by students and will require a lot of maintenance to keep them working.

The Department has spent its own operating budget to replace computers periodically, and in some cases the College of Arts & Sciences has provided one-time programs to replace computers, but these are not a reliable program on which to run a Department. A University-wide program to fund replacements for faculty computers, and possibly lab computers, would be welcome.

For the moment, the Department collects Lab Fees from students in classes like MATH 1010, MATH 1130, and MATH 1710 and these funds may be used to replace computers in the Math Plaza computer lab.

6.1.2 Other Equipment
The department owns a risograph, a small photocopy machine, and a fax machine that we fund out of our operating budget. We also have access to photocopy accounts through the university’s document service contractor that we continue to use when necessary. But we have found that we are able to maximize our resources by using our own equipment, so we encourage faculty to use these resources as much as possible. We also strongly encourage faculty to post their syllabi and other written materials for classes on their UTC Learn sites to eliminate waste and expense. Many of our students are comfortable with on-screen reading and may choose to print the documents only if they wish.

6.2 Facilities
6.2.1 Office Space
The Department of Mathematics occupies the entire west wing of the fourth floor of the Engineering, Mathematics, and Computer Science (EMCS) Building as well as the majority of the west wing on the second floor. The department’s main office is on the fourth floor and consists of a large reception and secretarial area, private offices for the head, Chair of Excellence, faculty, and a conference room. The remainder of the wing contains twenty-four faculty offices, a mail/duplication room, and a file and storage room for office records. The second floor space includes six faculty offices, with some sharing done by persons on one-year appointments, the department’s computer laboratory, and the graduate students’ offices. A study room (EMCS 205G) has been opened for undergraduates on the second floor.

All the tenure-track and tenured faculty members and two lecturers are housed in the fourth floor of the EMCS building. The other lecturers/instructors and all the graduate teaching assistants are housed in the second floor. Significant capital was spent to install the cubicles for use by graduate students and lecturers on the second floor. Being in such proximity to each other has enabled members of the department to collaborate more on course development and other pedagogical matters, as well as develop close friendships. A faculty meeting room (EMCS 205F) is planned. Moreover, the department’s Math Plaza is resided in the old Maclellan Gym and it contains office space for the director and two supervisors.

6.2.2 Classrooms
Classroom space is at a premium on our campus. In many recent semesters, the university has used literally every classroom space available on campus at “prime times,” such as Tuesday/Thursday and Monday/Wednesday/Friday mornings. For this reason, as well as to accommodate the needs of working or
otherwise nontraditional students, we have begun offering more classes in mid and late afternoon each weekday except Friday.

Most Mathematics faculty teach in the EMCS building. Classrooms used by the department have table and chair settings rather than arm-desks. Each room has a multimedia teaching podium with a Pentium computer connected to the university network, a VCR, laptop connection, document camera, and a ceiling mounted projector and screen.

6.2.3 Computer Classrooms

The department’s computer laboratory (EMCS 206) contains 46 Dell Pentium machines, one networked printer, and a multimedia teaching podium. All the computers in the Lab were purchased in 2009 using the stimulus funds. In addition to being a regular classroom, the computer laboratory has been particularly used for Math 4600/5600: Numerical Analysis I and Math 4600/5600: Numerical Analysis II for instruction on the use of Matlab, a numerical programming environment, and technical writing with the LaTeX typesetting system. The department’s Math Plaza contains spacious space for tutoring, 102 Dell Pentium machines, two networked printers, and a multimedia teaching podium.

6.2.4 Clerical Support

The department is fortunate to have an excellent administrative support staff: Heather Heinlein. The department had a three-quarter time support person until the budget cuts in 2008 removed the funding for that position. The funding has still not been restored. The department is far too large for just one administrative support person and a second full-time person is needed. Our department would benefit tremendously from additional clerical support to relieve our existing support staff and provide additional support to our large number of faculty.

6.2.5 Library Support

Library support at the university has been somewhat lacking, a situation acknowledged by the administration. The library does receive the full journal packages from the AMS, Elsevier, and SIAM and the library does subscribe to MathSciNet. The number of other print journals in mathematics has been shrinking every year for the last ten. One bright spot is the Inter Library Loan (ILL) Service that faculty can access electronically from their offices to request materials. The ILL office does a good job in locating materials in a timely fashion. Each year the department recommends purchases to the university library in excess of the funds allocated to it for new materials; this amount has remained at $2,500 per year since the last review. The library does have a program where individual faculty members may request up to $500 in additional purchases for specially needed items. The awards are made on a competitive basis; journal purchases are always excluded.

6.3 Operating Budget

The operating budget for the department is highly insufficient as it is for every other department on campus. The size of the faculty and the number of mathematics students taught each semester strain resources to the limit. The fact that faculty has been successful in obtaining travel support from other sources on and off campus has helped a great deal, but the University should adequately fund the departments on which it relies to achieve its mission.

Permission to fill vacant tenure-track lines on a permanent basis need to be granted and a serious discussion of new lines in the budget needs to take place. The Tables 6.3 and 6.3 illustrate the proportion of dollars we received in total, per student major, and full-time faculty member. Clearly, these figures demonstrate that we have limited operating budgets.
Table 6.3: Operating budgets for fiscal years 2009 to 2013.

Table 6.3: Operating budgets per student major for fiscal years 2009 to 2013.
No discussion of resources would be complete without some mention of the relative cost of a program. The Mathematics Department is the second largest producer of credit hours in the University and has the next to lowest cost per credit hour of any department or unit on campus.

The following figure gives some comparisons in the cost in dollars per credit hour between the Mathematics Department, the College of Arts & Sciences, and the University.

<table>
<thead>
<tr>
<th></th>
<th>FY2009</th>
<th>FY2010</th>
<th>FY2011</th>
<th>FY2012</th>
<th>FY2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget/faculty</td>
<td>$635.05</td>
<td>$666.16</td>
<td>$792.78</td>
<td>$2,574.98</td>
<td>$2,487.69</td>
</tr>
</tbody>
</table>

Table 6.3: Operating budgets per full-time faculty member for fiscal years 2009 to 2013.

Comparison of Cost per SCH

<table>
<thead>
<tr>
<th></th>
<th>FY2009</th>
<th>FY2010</th>
<th>FY2011</th>
<th>FY2012</th>
<th>FY2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
<td>$99.70</td>
<td>$83.79</td>
<td>$86.35</td>
<td>$99.30</td>
<td>$138.98</td>
</tr>
<tr>
<td>College</td>
<td>$131.62</td>
<td>$116.59</td>
<td>$122.45</td>
<td>$128.38</td>
<td>$136.33</td>
</tr>
<tr>
<td>University</td>
<td>$157.05</td>
<td>$141.74</td>
<td>$146.17</td>
<td>$150.19</td>
<td>$160.50</td>
</tr>
</tbody>
</table>

Table 6.4: Comparison of cost per SCH for fiscal years 2009 to 2013.
No discussion of resources would be complete without some mention of the relative cost of a program. The Department of Mathematics is the second largest producer of credit hours in the university and has the next to lowest cost per credit hour of any department or unit on campus. The following figure gives some comparisons in the cost in dollars per credit hour between the department, the College of Arts and Sciences, and the university.

The conclusion is clear: the department produces more than its share of the “bang for the buck.” But doing more with less has its limits.

With continued growth in students and faculty, finding sufficient funds to achieve the high level of quality that we desire as a department is a challenge, and yet our faculty continue to excel in their teaching scholarship and service. Our ability to maintain and even improve the quality of our service is due in large part to the industriousness and ingenuity of our faculty who constantly seek funds from available resources to provide support for faculty development, instructional needs, and research opportunities. (See the following table for details of our external grant funding.) We have been very successful winning internal grants, but we could improve our fiscal situation by seeking more external grants. Not only do external grants provide important research and other learning opportunities for our students who work with faculty on the projects, but each grant whose budget includes F&A funds (indirect costs) returns 40% of those funds to the department. For example, the largest grant our department was awarded during this program review period, $290,000 from the National Science Foundation, included $15,838 indirect costs. Of that amount, $6,335.2 will come to the department’s operating budget.

### 6.4 Enrollment and Graduation Rates

#### 6.4.1 Enrollment Growth

Since Fall 2009, enrollment of undergraduate mathematics majors has grown from 49 to 86, which represents an increase of 75.5%. Over this period, there has been no increase in the number of faculty in the department.

#### 6.4.2 Enrollment Diversity

The diversity of majors in mathematics reflects that of the university and the surrounding community. Overall, about half of the Mathematics students are women. The following figures give the enrollment

---

Table 6.5: Enrollment growth in mathematics at the start of each academic year, Fall 2009 to Fall 2013.

<table>
<thead>
<tr>
<th>Year</th>
<th>BS Appl Math</th>
<th>BA Math</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2009</td>
<td>36</td>
<td>13</td>
</tr>
<tr>
<td>Fall 2010</td>
<td>44</td>
<td>16</td>
</tr>
<tr>
<td>Fall 2011</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>69</td>
<td>11</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>82</td>
<td>6</td>
</tr>
</tbody>
</table>

---
6.4.3 Degrees Awarded

The following figure shows that the number of degrees awarded has remained relatively steady over the five year period. As the state funding formula has transitioned from enrollment to retention and completion, we anticipate that more emphasis will be placed on the number of degrees awarded.

6.4.4 Student Retention

The following figure represents the department’s retention of students. As can been seen, the department currently retains 59.7% of its students, which represents an increase of 8.4% over the period. This percentage is unremarkable compared to the university and college trends.

In addition to serving our majors and minors, and the department offers a wide variety of courses for General Education that significantly increases our enrollment so that in fact we are by far the second largest producer of credit hours at the university. In fact, over the past five years our growth in credit hour production has outpaced the university as a whole, and we are now responsible for about 13% of the credit hour production for the College of Arts & Sciences and about 9% of the credit hour production for the university as a whole as detailed as follows.
Fall 2011 Mathematics Major Enrollment Information

<table>
<thead>
<tr>
<th>Region</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Black</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Two or More Races</td>
<td>6</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>White</td>
<td>30</td>
<td>28</td>
<td>58</td>
</tr>
</tbody>
</table>

Table 6.7: Demographics for mathematics major enrollment in Fall 2011.

Fall 2012 Mathematics Major Enrollment Information

<table>
<thead>
<tr>
<th>Region</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Black</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Two or More Races</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>White</td>
<td>26</td>
<td>28</td>
<td>54</td>
</tr>
</tbody>
</table>

Table 6.8: Demographics for mathematics major enrollment in Fall 2012.
The following figure shows that the number of degrees awarded has remained relatively steady over the five year period. As the state funding formula has transitioned from enrollment to retention and completion, we anticipate that more emphasis will be placed on the number of degrees awarded.

<table>
<thead>
<tr>
<th>Table 6.9: Demographics for mathematics major enrollment in Fall 2013.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
</tr>
<tr>
<td><strong>Male</strong></td>
</tr>
</tbody>
</table>

Table 6.10: Degrees awarded in mathematics for fiscal years 2009 to 2013.
Table 6.11: Retention for the university, the college, and the department for fiscal years 2009 to 2013.

<table>
<thead>
<tr>
<th>Year</th>
<th>Female</th>
<th>Male</th>
<th>Black</th>
<th>Hispanic</th>
<th>Two or More Races</th>
<th>Unknown</th>
<th>White</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-10</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>32</td>
</tr>
<tr>
<td>2010-11</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td>2011-12</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>38</td>
</tr>
<tr>
<td>2012-13</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>36</td>
</tr>
</tbody>
</table>

Table 6.12: Credit hour production for the academic years 2009–10 to 2012–13. These totals do not include summer credit hour production. Data for 2013–14 is not yet available.

<table>
<thead>
<tr>
<th>Year</th>
<th>Mathematics</th>
<th>College</th>
<th>UTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-10</td>
<td>23759</td>
<td>171040</td>
<td>237331</td>
</tr>
<tr>
<td>2010-11</td>
<td>22626</td>
<td>171834</td>
<td>241293</td>
</tr>
<tr>
<td>2011-12</td>
<td>23883</td>
<td>181641</td>
<td>256616</td>
</tr>
<tr>
<td>2012-13</td>
<td>17925</td>
<td>184304</td>
<td>258640</td>
</tr>
</tbody>
</table>

Mathematics as Percentage of the College of Arts & Sciences and UTC Total

<table>
<thead>
<tr>
<th></th>
<th>2009-10</th>
<th>2010-11</th>
<th>2011-12</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math as % of College</td>
<td>13.89%</td>
<td>13.17%</td>
<td>13.15%</td>
<td>9.73%</td>
</tr>
<tr>
<td>Math as % of UTC Total</td>
<td>10.01%</td>
<td>9.38%</td>
<td>9.31%</td>
<td>6.93%</td>
</tr>
</tbody>
</table>

Table 6.13: Mathematics as percentage of the College of Arts & Sciences and university total.
6.4.5 Summary

As stated previously, the mathematics program has accomplished most of the goals set five years ago. We have developed specific program outcomes and devised strategies to measure these outcomes annually. We continue to use university and program data to strengthen our effectiveness. Students report they have strong research, oral, written, and critical thinking skills. We have a strong curriculum that is consistent with national norms. We have modified the curriculum as needed. Our majors participate fully in the university’s strong general education program and have sufficient hours to pursue other interests. Students report they have ample opportunities to apply knowledge outside the classroom and interact with faculty. They are exposed to professional and career opportunities outside the major. Student evaluations of faculty demonstrate strong teaching in the program. We have a highly qualified, extremely diverse faculty who are exceptionally productive at all levels. Our enrollments continue to grow. We have managed to find creative ways to deal with challenges posed by a general lack of university resources.