MATHEMATICS SELF STUDY FOR PROGRAM REVIEW

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0. Introduction

We introduce the Mathematics Program in the context of the history of CSU Channel Islands, and mention the scope of this program review.

California State University opened its doors to transfer students in Fall 2002. But AY02-03 was already "Year 2" in the history of CSUCI: founding faculty, among them the first Chair of Mathematics, Physics, and Computer Science (Ivona Grzegorczyk) had been working for the previous year to create curriculum, recruit students and additional faculty, and develop many of the initial policies and practices of the new institution. The B.S. in Mathematics degree was one of ten degree options first offered. During Year 2 a second mathematics faculty member joined Ivona, and at the end of that year the first Mathematics major graduated from CSUCI. Year 3 saw the departure of the second Mathematics faculty member as well as the arrival of Mathematics faculty Jesse Elliott and Jorge Garcia. The program continued to grow in number and course offerings. Additional Mathematics faculty were hired in F'05 (Cindy Wyels), the same year the M.S. in Mathematics degree program was launched, and our latest faculty arrivals, Geoff Buhl and Kathryn Leonard, arrived in F'06. During F'07, Mathematics was responsible for the second-largest full-time-equivalent student load at CSUCI.

This program review was prepared during the Spring semester, 2008, during the first-ever round of program reviews at CSUCI. As such, some procedural kinks were unavoidable. In particular, some data was unavailable and other data questionable. Throughout we attempt to note our data sources and we omit use of questionable data. Some of loss of program memory due to Ivona Grzegorczyk's S'08 semester was also inevitable.

Reviewers should note that this program review concerns solely the undergraduate program in Mathematics. Comparative data for other programs takes into account only their undergraduate programs as well.

1. Defining Program Purposes and Ensuring Educational Outcomes

The program defines its objectives and establishes educational outcomes aligned with its goals and the university mission.

Mathematics was one of the ten initial programs in place when CSU Channel Islands opened its doors to students in Fall, 2002. One of the first three students to earn a degree from CSUCI (in May, 2003) was a mathematics major. Since its inception, the Mathematics Program has supported the CSUCI Mission and its outcomes, and has striven to fulfill the objectives internal to the Mathematics Program.

University Mission Statement and Learning Outcomes

CSUCI Mission Statement

> Placing students at the center of the educational experience, California State University Channel Islands provides undergraduate and graduate education that facilitates learning within and across disciplines through integrative approaches, emphasizes experiential and service learning, and graduates students with multicultural and international perspectives.

Institutional Mission-Based Learning Outcomes

> CSUCI graduates will possess an education of sufficient breadth and depth to appreciate and interpret the natural, social and aesthetic worlds and to address the highly complex issues facing societies. Graduates will be able to:
> - Identify and describe the modern world and issues facing societies from multiple perspectives including those within and across disciplines, cultures and nations (when appropriate).
> - Analyze issues, and develop and convey to others solutions to problems using the methodologies, tools and techniques of an academic discipline.

Mathematics Program Objectives, and Student Learning Outcomes

Mathematics Program Objectives

1. Provide students with the opportunity to earn a state-supported Bachelor degree in Mathematics from the California State University.
2. Prepare students for employment in a variety of high-tech and bio-tech industries, as well as in mathematics education.
3. Prepare students for further study in graduate or professional schools.
4. Offer all CSUCI students the opportunity to broaden their knowledge of mathematics.
5. Offer students an understanding of various applications of mathematical sciences in other fields, through different emphases and interdisciplinary courses.

Establishment and maintenance of the option to major in Mathematics at CSUCI accomplishes Objective 1. Objectives 2 and 3 are addressed through the course of study required of our majors. Similarly, Objective 4 is achieved through our wider course offerings as well as through open admission to our extensive seminar series and special events. The seminars, our many cross-listed courses, incorporation of applications into a wide variety of courses, and the emphases required to complete the major all contribute to achieving Objective 5. Objectives 2 – 5 will be discussed at greater length in Section 2 of this report.

During the Assessment Plan Preparation Program (APPP) of Spring and Summer 2005, the Mathematics Program revised its Student Learning Outcomes to be more clear and to be measurable. The original Mathematics Learning Outcomes follow.

Original Mathematics Learning Outcomes

1. Demonstrate critical thinking, problem-solving skills and ability to use advanced mathematical methods by identifying, evaluating, and classifying, analyzing, synthesizing, data and abstract ideas in various contexts and situations.
2. Demonstrate the knowledge of current mathematical applications, computing practices and broad technology use in industry, science and education.
3. Demonstrate ability to use modern software, abstract thinking, and mathematical practices connected to scientific and industrial problems, and demonstrate these skills that are currently used by technologies in society and education.
4. Perform skills that enable them to evaluate, propose and convey novel solutions to scientific and business problems, etc.
5. Demonstrate cooperation skills by working effectively with others in interdisciplinary group-settings - both inside and outside the classroom.
6. Demonstrate a sense of exploration that enables students to pursue lifelong learning and currency in their careers in mathematics, statistics, education, high-tech and bi-tech industries.

The revised Mathematics Learning Outcomes are below.

Current Mathematics Learning Outcomes

1. Demonstrate critical thinking skills by identifying, analyzing, and evaluating mathematical ideas and methods.
2. Demonstrate problem-solving skills by applying mathematical ideas and methods in various contexts and situations.
3. Demonstrate the ability to understand, evaluate, and create mathematical proofs.
4. Demonstrate the ability to evaluate and propose solutions to quantitative problems in the physical, biological, and/or social sciences.
5. Demonstrate knowledge of some of the current applications of mathematics in the sciences, industry, and/or education.
6. Demonstrate some of the technical skills currently employed in the sciences, industry, or education, such as the ability to use modern software.

7. Demonstrate cooperation skills by working effectively with others both inside and outside the classroom.
8. Demonstrate communication skills by expressing mathematical ideas in oral and written form.
9. Demonstrate a sense of exploration that enables one to pursue lifelong learning.

During the APPP, the Mathematics Program also devised several tools to assess these learning outcomes. This assessment began in Fall 2005, and our assessment coordinator, with the help of the faculty, has continued to collect and analyze data every semester since Fall 2005. The assessment tools that were developed as a part of the APP follow. Those that have been implemented are indicated with an asterisk.

1. Graduating students' scores on the Math CSET and Math GRE (e.g. correlate scores and math GPA)
2. Self-assessments of student learning
3. *Assessment of the ideas and methods taught or developed in math courses
4. *Cross assessment of courses and syllabi
5. *Extent and quality of student presentations at colloquium, conferences, etc.
6. *Extent and quality of student performance in the annual Putnam Mathematical Competition
7. Instructor cross-examination and evaluation of homework and exams in required courses
8. Assessment of group cooperation inside and outside the classroom (e.g. in the Math Tutoring Center, through service learning, and on projects)
9. Students' post-graduation placement in jobs and graduate schools
10. Assessment of technology use and development by students in courses.
11. Surveys of students and faculty
12. *Math 499 (capstone) assessments
13. *Embedded assessment of student learning in Mathematics General Education courses.

The Mathematics Assessment Reports for 2006-06 and 2006-07 may be found in Appendix D.

More finely-tuned course objectives have been written for each course in the Mathematics curriculum. All faculty are apprised of these course-based student learning objectives while still in the process of preparing their classes prior to the start of each semester. Faculty include these objectives prominently in all course syllabi, so that students are also aware of them and may monitor their progress towards achieving them.

Dissemination of Information about the Mathematics Program

Students and the larger campus community, as well as the general public, have access to copious information about the Mathematics Program. The Mathematics website (math.csuci.edu) provides information about the major and its emphases, sub-programs (e.g. remedial mathematics, the graduate program, and labs paired with courses), the curriculum and courses offered in any given semester, people and their contact information, special elements such as the

Math Tutoring Center and the Math Club, mathematics-related summer opportunities, links to student resources (e.g. "What Types of Jobs are Available for Math Majors?"), and more. This website undergoes a major update at the beginning of every academic year as well as periodic updates throughout the year. In addition, information about the Mathematics Program is disseminated

- via the CSUCI Catalog
- via the Schedule of Classes
- at Discover CI (an on-campus day for admitted students)
- at several Orientation sessions hosted by Student Affairs, and
- during ad hoc visits to schools and community colleges.

Mathematics faculty members (and often students in the Math Club) are present at all on-campus Orientation and Discover CI sessions.

The Mathematics program would like to regularly send faculty to K-12 schools and to our local community colleges to enhance dissemination about our program and to better recruit interested students. While some faculty have made some ad hoc visits, such a program of regular faculty outreach to K-14 is not sustainable given current staffing levels and other needs.

Operating Practices

To this point, the day-to-day operations and the longer-term planning for the Mathematics Program have been accomplished informally. (Such planning is discussed at greater length in Section 4 of this report.) We are in the process of developing program bylaws that will formalize such items as administrative assignments, voting procedures, and how decisions regarding various program governance issues are made. We expect to have a draft of our bylaws completed by May, 2008; this draft will be finalized during F'08 when all tenured and pre-tenure faculty may be present for discussion.

2. Achieving Educational Outcomes

The program achieves its educational objectives through teaching and learning, scholarship and creative activity, and support for student learning. It demonstrates that these objectives are performed effectively and that they support the University's efforts to attain educational effectiveness.

Objectives and Learning Outcomes vis-à-vis the Mathematics Curriculum

For reference, we provide here the Mathematics Program Objectives and Learning Outcomes.

Mathematics Program Objectives

1. Provide students with the opportunity to earn a state-supported Bachelor degree in Mathematics from the California State University.
2. Prepare students for employment in a variety of high-tech and bio-tech industries, as well as in mathematics education.
3. Prepare students for further study in graduate or professional schools.
4. Offer all CSUCI students the opportunity to broaden their knowledge of mathematics.
5. Offer students an understanding of various applications of mathematical sciences in other fields, through different emphases and interdisciplinary courses.

Mathematics Learning Outcomes

1. Demonstrate critical thinking skills by identifying, analyzing, and evaluating mathematical ideas and methods.
2. Demonstrate problem solving skills by applying mathematical ideas and methods in various contexts and situations.
3. Demonstrate the ability to understand, evaluate, and create mathematical proofs.
4. Demonstrate the ability to evaluate and propose solutions to quantitative problems in the physical, biological, and/or social sciences.
5. Demonstrate knowledge of some of the current applications of mathematics in the sciences, industry, and/or education.
6. Demonstrate some of the technical skills currently employed in the sciences, industry, or education, such as the ability to use modern software.
7. Demonstrate cooperation skills by working effectively with others both inside and outside the classroom.
8. Demonstrate communication skills by expressing mathematical ideas in oral and written form.
9. Demonstrate a sense of exploration that enables one to pursue lifelong learning.

Our Objectives and Learning Outcomes are embedded throughout the curriculum. We briefly summarize the curriculum below, and then explain how objectives are met and outcomes achieved, as well as how the program contributes to the mission-based elements of the University.

Requirements for the B.S. in Mathematics

The requirements for a Bachelor of Science in Mathematics degree consist of 37 credits of lower-division coursework, 19 credits of upper-division "Core" courses (taken by all Mathematics majors), a choice of interdisciplinary emphases consisting of another 6 – 10 credits of upper-division mathematics courses and courses in other disciplines, and 13 credits worth of upper-division mathematics electives. 18 of the credits required for the mathematics major fulfill CSUCI General Education Requirements. Most of the emphases (list provided below) have prerequisites (e.g. particular science courses) that also fulfill General Education requirements. Students can complete all requirements for the B.S. in Mathematics while simultaneously fulfilling General Education requirements by taking a carefully-planned sequence of 120 credits.

Lower-Division Required Major Courses	37
Upper-Division "Core" Mathematics Courses (required of all major)	19
Upper-Division Courses Required for Emphasis	6 – 10
Upper-Division Elective Courses	13
General Education Included in Major Requirements	(18)
General Education & Title V	36
Total	120
UPPER LEVEL REQUIREMENTS	(46 Units)

Emphases

Students may choose one of the emphases listed below, or may design their own. All choices of emphasis must be approved by an advisor.

- Biomathematics
- Computational Chemistry
- Computer Science
- Physics
- Actuarial Sciences/ Economics
- Business Management
- Cognitive Science
- Education
- Applied Mathematics
- Digital Design

Accomplishing the Objectives

The Mathematics curriculum accomplishes Program Objectives 1 (*opportunity to earn a state-supported Bachelors degree in Mathematics*), as well as Objectives 2 (*prepare for employment in a variety of industries and in education*) and 3 (*prepare for further study*) through the use of emphases and individualized advising. Objective 4 (*offer all CSUCI students the opportunity to broaden their knowledge and learn in this subject area*) is met via multiple approaches. Courses such as the algebra sequence, pre-calculus, and the calculus sequence offer tools used in many other disciplines. More specialized classes targeted towards specific majors' needs such as Biostatistics, Statistics for Business, and Analysis of Algorithms also help the program meet this objective. Objective 5 (*offer students an understanding of various applications of mathematical sciences in other fields*) is met for majors through the emphases, the many applications presented and studied in a variety of classes (e.g. the calculus sequence, linear algebra, and differential equations) and through the colloquium requirement. Non-majors are introduced to applications of mathematics in other fields in courses such as the applied statistics courses, Mathematical Thinking, and calculus and pre-calculus.

Accomplishing the Learning Outcomes

The program learning outcomes are also realized through the curriculum. Outcomes numbered 1, 2, 7, 8, and 9 are addressed and developed in every mathematics course taken by majors, and are all accomplished by the time students have completed the requirements for the major. The chart below ties Outcomes 6, 7, 8, and 9 to the courses required of all mathematics majors. (To determine how each course addresses the program learning outcome indicated, please refer to the course learning outcomes prominently featured in each course syllabus. All course syllabi are in Appendix A.) Of course, these learning outcomes are further reinforced via the students' choices of emphases, electives, and co-curricular learning opportunities.

Required Course	5. Demonstrate the ability to understand, evaluate, and create mathematical proofs.	6. Demonstrate the ability to evaluate and propose solutions to quantitative problems in the physical, biological, and/or social sciences.	7. Demonstrate knowledge of some of the current applications of mathematics in the sciences, industry, and/or education.	8. Demonstrate some of the technical skills currently employed in the sciences, industry, or education, such as the ability to use modern software.
Lower Division				
Calc I	introduced	introduced	introduced	introduced
Calc II	introduced	developed	developed	introduced
Calc III	introduced	developed	accomplished	introduced
Logic	developed			
Linear Alg	developed	developed	developed	introduced

Comp Sci			developed	developed
2nd CS course			developed	accomplished
Phys 200		developed	developed	
2nd Sci course		developed	developed	
Upper Division				
Discrete	developed	introduced	introduced	
Diff'l Eq'ns		accomplished	accomplished	developed
History of Math			developed	
Prob/Stats	developed	accomplished	accomplished	developed
Real Anal	accomplished			
Complex	accomplished			
Colloq			accomplished	
Emphases		accomplished		accomplished

Student learning outcomes for each course are widely available. All faculty are apprised of these course-based student learning outcomes while still in the process of preparing their classes prior to the start of each semester. Faculty include these outcomes prominently in all course syllabi, so that students are also aware of them and may monitor their progress towards achieving them. The outcomes are also available online.

Assessment of Achievement of Learning Outcomes and Levels of Attainment

The Math Program has designated a permanent faculty member to serve as Assessment Coordinator for the last 3.5 academic years. The Assessment Coordinator spent Spring '05 revising the Math Program's Learning Objectives and developing tools to assess them. In AY05-06 and AY-07 several learning outcomes were assessed as a part of an ongoing Mathematics Program Learning Outcomes Assessment Project. The reports from these projects are available in Appendix D. This assessment project is ongoing during this academic year (AY07-08); the report on this project will be available in September, '08.

In AY05-06, the Assessment Coordinator selected outcomes 5, 8, and 9 to assess.

5. Demonstrate knowledge of some of the current applications of mathematics in the sciences, industry, and/or education.
8. Demonstrate communication skills by expressing mathematical ideas in oral and written form.
9. Demonstrate a sense of exploration that enables one to pursue lifelong learning.

From the Conclusions and Implications for Program Modification section of the assessment report:

> *Statistical tests confirm that for each learning outcome, students' work exceeded the neutral point (3.0). These findings provide strong evidence that each of the three learning outcomes was met. However, scores of 3.43 and 2.88 in "depth of work (relative to level of student)" indicate that work of further depth should be*

sought from student projects. In the future, further depth will be solicited from student projects in Math 492 and 499. To attain this goal, closer supervision will be given by the faculty. (The full report is in Appendix D.)

For AY06-07, the Assessment Coordinator reassessed outcomes 5, 8, and 9 and included outcomes 2 and 3 as well.

2. Demonstrate problem solving skills by applying mathematical ideas and methods in various contexts and situations.
3. Demonstrate the ability to understand, evaluate, and create mathematical proofs.

This year the Conclusions and Implications were less clear.

With regard to the student presentations in the math capstone, Math 499, statistical tests confirm that for each learning outcome, students' work well exceeded the neutral point (3.0)[1].

With regard to the Math Application problem that was administered to the Math GE courses [to assess outcome 2], only in half of the courses, Math 101, 105, 137, 140, 151, 331, and 430, did students on average score above 50% (or greater than 2.5/5). Although this could indicate that students overall are not meeting the learning outcome "Demonstrate problem solving skills by applying mathematical ideas and methods in various contexts and situations" in the Math GE courses, our results seem rather to indicate that the chosen problem was administered too early in the semester, in that it was too difficult given the mathematical methods required as prerequisites for most of those courses. Although the problem does not require the use of mathematical methods not taught in the courses, the problem was somewhat complicated (requiring 4 parts to be solved in succession), and could be more easily solved using the methods learned in calculus (Math 150 and Math 151). In the future, if a problem is administered in the Math GE courses at the beginning of the semester, a simpler problem will be chosen. It would also be possible to administer the same problem in the same courses, but at the end of the semester. This would be a more reasonable assessment, as students would learn methods for attacking the given problem during the course of the semester.

Changes that have been implemented due at least partially to the assessment process follow.
- Student presentations from all Math 499 (Capstone) students are now required and assessed every semester.
- The assessment process itself has been revised each year to be more accurate and effective.
- Mathematics faculty met to consider course sequencing and course prerequisites and made changes within the upper-division curriculum.

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[1] This refers to outcomes numbered 5, 8, and 9.

Student Involvement in the Learning Process

Perusal of the course syllabi in Appendix A indicates that students are actively involved in the learning process, are challenged with high expectations, and are provided appropriate feedback. use a variety of methods including interactive lecture, small group work, individual in-class work, and extended projects to engage students. For example, oral presentations are required in Scientific Computing, students develop their own data sets and perform independent statistical analyses throughout the course in Statistics for Business and Economics, student in Probability and Statistics create devices generating samples from various probability distributions, and Calculus students carry out long-term group projects requiring self-learning and applications of course material. Students obtain feedback on homework assignments, projects, papers, computer lab assignments, and exams. Opportunities for re-writes and discussions as to what might be improved are common.

Student involvement in out-of-class learning is strongly encouraged and supported by program faculty. In Southern California there are many general mathematics conferences appropriate for undergraduate students; faculty recruit students to attend these conferences and frequently work with them on projects or research that students then present. For instance, in AY06-07 internal records show that – counting some repeats – 36 students presented posters at conferences, 14 students presented in 4 student research competitions (e.g. the CSU Student Research Competition or the MAA Student Poster Contest), and 74 students participated in 6 different events, including two international conferences, all organized and led by faculty.

Efficiency

Given the sequential nature of many courses in the mathematics curriculum, careful advising of students is needed for them to graduate in a timely manner. The "blue form" in Appendix B lays out the major requirements in a flowchart form; it is widely distributed at all advising events and one-on-one meetings. The blue form and the roadmaps (also in Appendix B) provide evidence that properly-prepared students[2] can complete this challenging major (and all graduation requirements) within four years. Students avail themselves of advising both through the university's professional advising staff and – more commonly for upper division students – through consultation with the mathematics faculty. Our emphasis when advising is to steer the student toward timely completion of the classes, through a clear understanding of the necessary sequences and the appropriateness of their choices. Transfer students particularly need timely advising: a mathematics faculty member meets with all transfers attending orientation and is available for individual appointments with others.

Our course scheduling takes into account the needs of our students as much as possible. Courses with multiple sections are offered both during the daytime and at least one evening a week. Courses that are offered only once a year alternate the time they are offered between daytime and evening. We coordinate course offerings with other programs to minimize course conflicts to students who take large numbers of required courses in math and in partner disciplines (e.g.

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[2] By "properly-prepared" here we mean those students not requiring remediation in mathematics.

Computer Science and Physics). It would be of interest to analyze average class sizes by type of class in future years when the university has the capability of providing this data.

The charts below indicate the number of students with Mathematics as their declared majors and the number of graduates earning degrees in Mathematics each year.

Mathematics Majors

Year	Majors
F'02	18
F'03	41
F'04	60
F'05	48
F'06	71
F'07	59
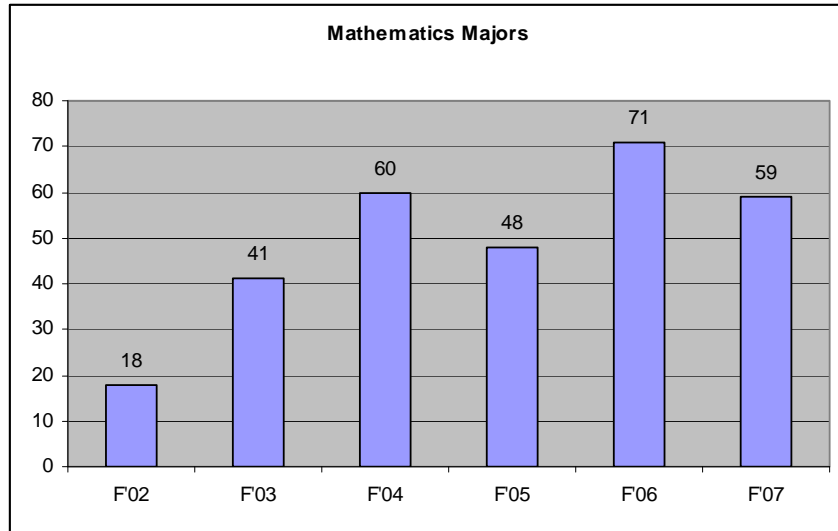
The data for AY06-07 Mathematics graduates provided conflicts with the number of graduates named by the Mathematics faculty; we consequently omit this value from the next chart.

Graduates in Mathematics

Year	Graduates
AY02-03	1
AY03-04	3
AY04-05	13
AY05-06	14
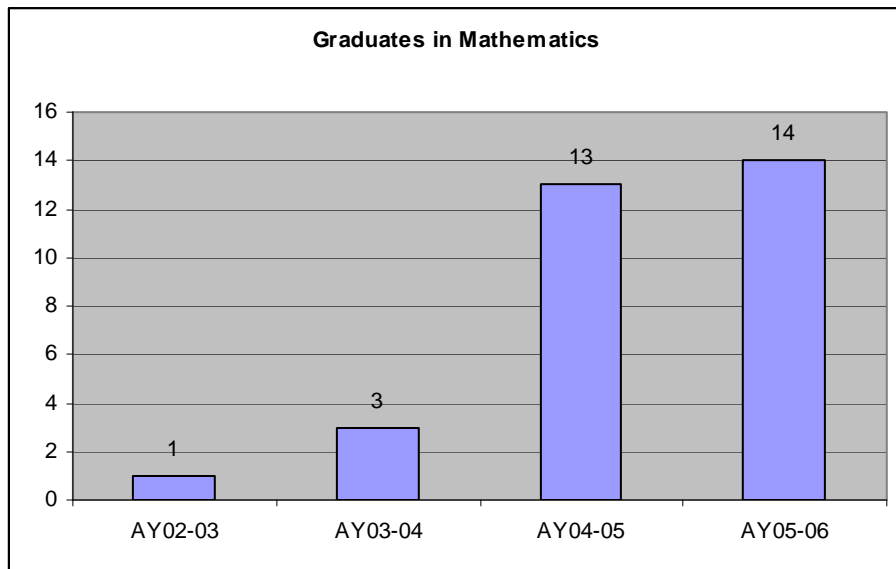
We do have the data necessary to compare the gender and ethnic make-up of the mathematics graduates with the university's graduates.

Gender Breakdown of Mathematics and all CSUCI Students

Legend:
- Females - Math
- Females - CI
- Males - Math
- Males - CI
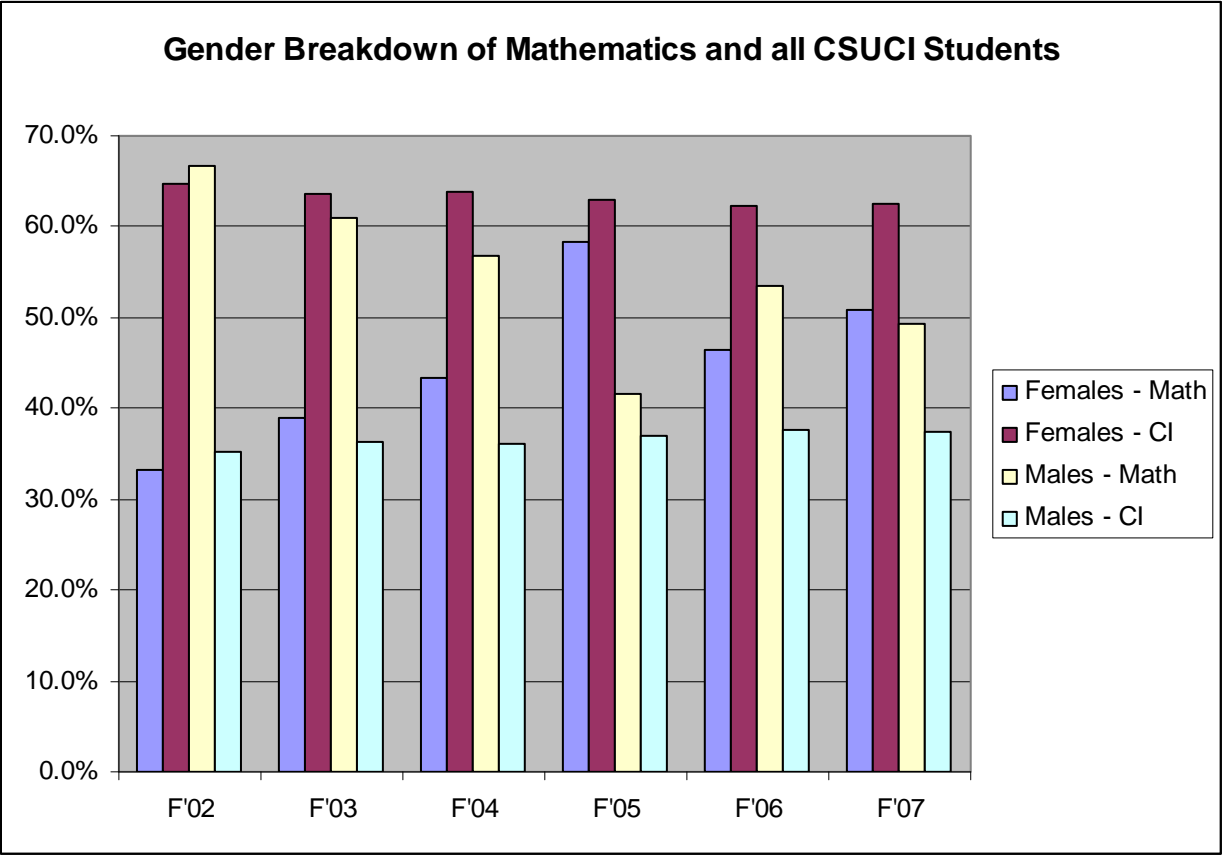
We see that the percentage of female mathematics major was initially much lower than the percentage of females in the CSUCI student body, but that these percentages have come closer to parity over the life of the Mathematics program.

The next chart presents a comparison of the ethnic breakdown of Mathematics majors with the ethnic breakdown of the CSUCI student body.

Ethnicity Breakdown of Mathematics and all CSUCI Students

Legend:
- American Indian/ Native American - Math
- American Indian/ Native American - CI
- African American - Math
- African American - CI
- Asian - Math
- Asian - CI
- Hispanic - Math
- Hispanic - CI
- White - Math
- White - CI
- Unknown - Math
- Unknown - CI
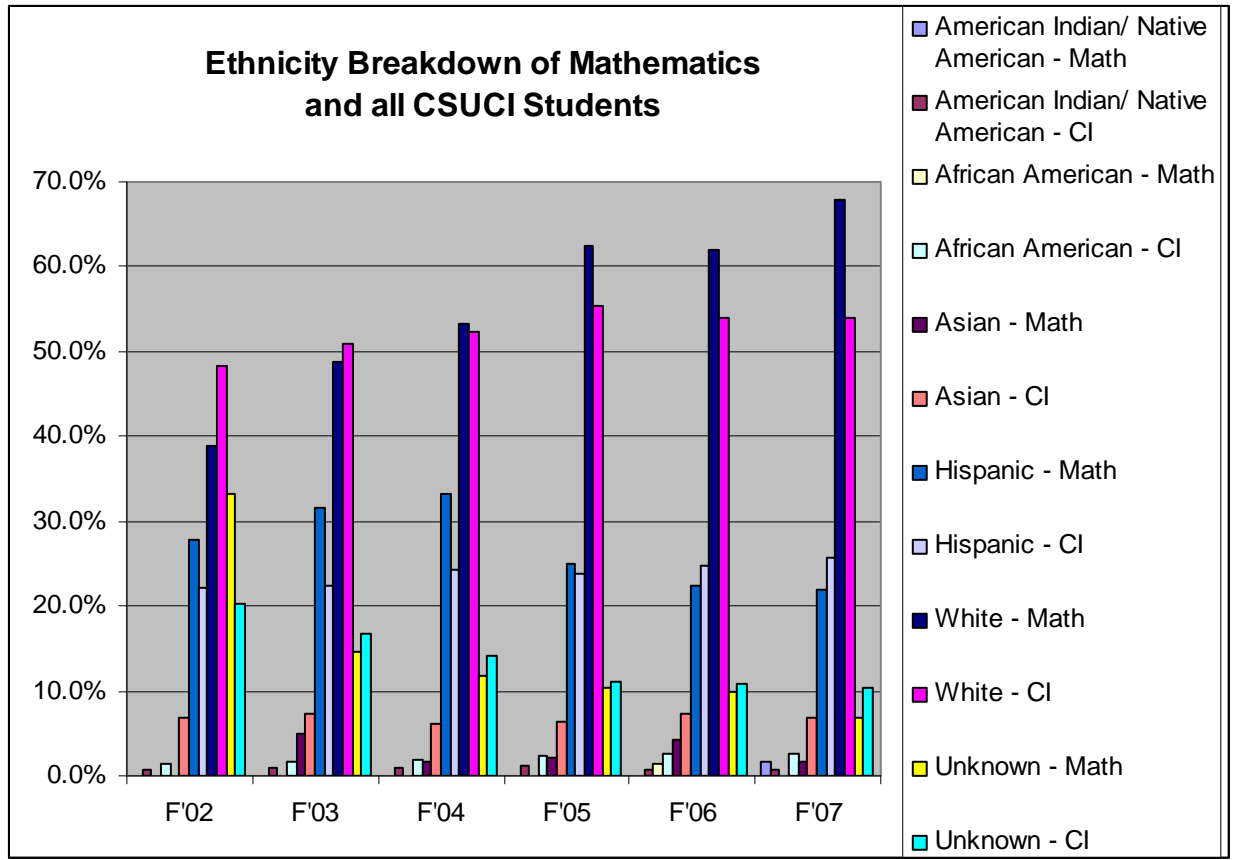
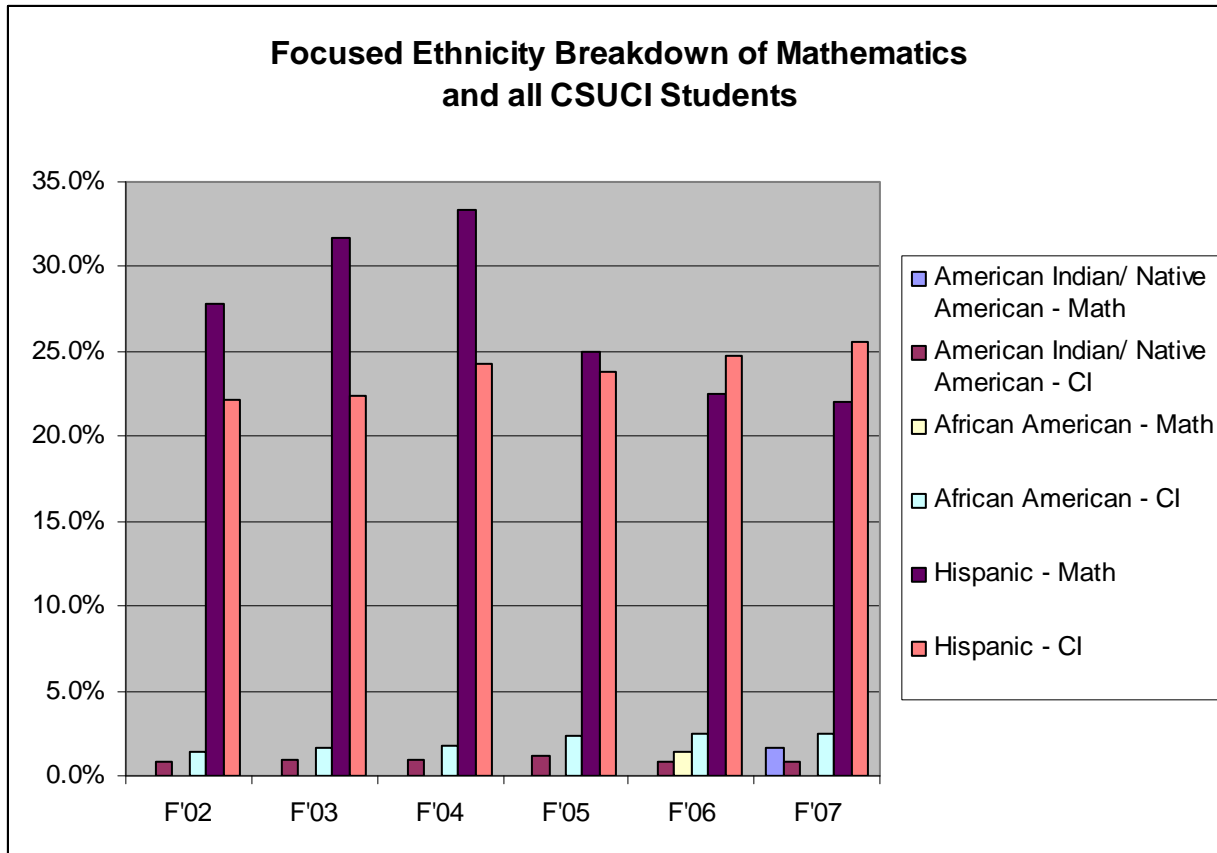Focusing on the minority populations deemed by the federal government to be under-represented in the mathematical sciences[3] (see the next chart), we note that there were proportionately more Hispanic Mathematics majors for the first four years of the program, and that there are now slightly fewer Hispanics, relative to the percentage of Hispanics within the university undergraduate student body. The sizes of the American Indian/ Native American and the African American student populations are too small to consider Mathematics' shares of these populations.

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[3] African-American, Hispanic, American Indian/ Native America, and Pacific Islander (We received no data regarding Pacific Islander students.)

Focused Ethnicity Breakdown of Mathematics and all CSUCI Students

Legend:
- American Indian/ Native American - Math
- American Indian/ Native American - CI
- African American - Math
- African American - CI
- Hispanic - Math
- Hispanic - CI

Other data on student retention and measures of student retention were not provided; we look forward to working with Institutional Research to collect and analyze such data in the future, as it could be useful in better understanding and modifying our program so as to better serve students.

Contributions to the University Mission and to General Education

The Mathematics Program contributes to the university's mission in a number of ways.

- *Placing students at the center of the educational experience* is foremost in everything we do. This is seen in various ways, including carrying out measures discussed earlier to help students keep on track to graduate, employing varied pedagogical methods, retaining moderate class sizes, spending significant out-of-class time with students, and sponsoring the many extracurricular activities discussed later in this section.
- Our commitment to *interdisciplinary learning* is evident in the requirement that each student complete an interdisciplinary emphasis, in the variety of courses that are cross-listed with other disciplines[4], and in the many in-class examples and assignments

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[4] Math/Psy 202 (Biostatistics), Math/Comp/Phys 345 (Digital Image Processing), Math/Comp/Phys 445 (Image Analysis and Pattern Recognition), Math/Comp 447 (Scientific Computing), Math/Comp 452 (Computational Bioinformatics)

emphasizing the applications of course material to problems arising in other disciplines[5]. Courses required for the major and mathematics courses that count towards the general education requirement incorporate integrative learning activities. For example, course such as Math 240 Linear Algebra and Math 350 Differential Equations have included projects in which students develop mathematical models for biological systems such as population dynamics. Various faculty grant-related endeavors also witness our commitment to interdisciplinary learning. Geoff Buhl received a Center for Integrative Studies (CIS) Interdisciplinary Teaching Collaboration Grant to work with a Computer Science faculty member to revise Scientific Computing (MATH/ CS 448) so as to enhance the interdisciplinary aspects of the course through group projects. Similarly, Kathryn Leonard received a CIS teaching grant for MATH 329, Statistics for Business and Economics. She collaborated with an economics professor to develop a course that better meets the mathematical needs of business majors in the course and that integrates more real-world business applications. Geoff has more recently prepared a proposal in conjunction with a Biology faculty member for the NSF program Interdisciplinary Training for Undergrads in Biological and Mathematical Sciences. If funded, the PIs will carry out academic year research with biology and mathematics majors.

- *Experiential and service learning* are not commonly employed in mathematics learning, other than as tutoring/ educational opportunities. However, when Jorge Garcia taught Math 202, Biostatistics, he and his students worked with a local hospital to collect data regarding transportation of elderly patients. The students analyzed the data, wrote a report, and presented their findings to the hospital. In a more traditional vein, all students choosing the Education emphasis complete an internship that requires 40 hours of observation in local schools – often with an opportunity to do some guest teaching[6].

- Those who believe that *multicultural and international perspectives* have little to do with mathematics are surprised by the depth of engagement in this facet of the university's mission by the mathematics faculty. Our relationship with the *Universidad Autonoma del Estado de Hidalgo* (UAEH) is now in its third year. CSUCI students and two faculty will be visiting UAEH for the second time in May, 2008[7], and UAEH students and faculty spent a week in conference with their CSUCI counterparts in June, 2007. CSUCI faculty have the opportunity to collaborate with UAEH faculty on extended visits, and we have included UAEH faculty in a Research Experience for Undergraduates proposal. Math faculty have also led international study-travel trips to Poland and are planning a trip to Holland this summer. Longer-term, math faculty are investigating the possibility of developing international research experiences for mathematics students. Efforts to strengthen students' multicultural perspectives include faculty member's activities with MEChA and with the Center for International Affairs, as well as the mentoring of students from non-traditional backgrounds, through one-on-one engagement as well as through grant-funded summer research opportunities.

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[5] For instance, Calculus students may complete a course project involving design of a hospital security system or a pipeline, Linear Algebra students have investigated everything from population dynamics to chemical networks, and examples from all sciences and social sciences are used extensively in statistics courses.

[6] We have formed connections with individuals at local schools as well as at the Ventura County Office of Education and have ideas regarding mutually beneficial ways to involve our students in tutoring children from migrant worker and other low-income families. While eager to turn these ideas into action, we do not feel that we can currently direct the necessary faculty time and effort away from ongoing needs and efforts.

[7] The program for the first joint conference may be found in Appendix E.

The contributions of the Mathematics Program to the General Education (GE) curriculum are extensive. The GE requirements are classified into five categories: A. Communication in the English Language and Critical Thinking; B. Mathematics, Sciences, and Technology; C. Art, Literature, Languages, and Cultures ; D. Social Perspectives; and Upper Division Interdisciplinary General Education Courses. In Category A, "Critical Thinking" is a natural for Mathematics, as is the "Mathematics" component of Category B. While Mathematics offers no courses in Category C, our History of Mathematics (MATH 331) course is an approved Social Perspectives (D) course. A variety of courses that integrate mathematics with art, history, game development, image analysis, and computing contribute to the last "Upper Division Interdisciplinary General Education Courses" category. Explanations fleshing out the title of each GE category, together with a complete list of mathematics courses approved within each category, are provided in Appendix E.

Mathematics Program Values

The Mathematics Program holds as central values those expressed in the CSUCI Mission Statement (as discussed earlier in this section). In addition, we highly value **out-of-class learning**. We implement a variety of co-curricular programs and activities each year. Examples follow:

- Faculty accompany students to several professional conferences a year: large contingents regularly attend both the Fall and the Spring Meetings of the Southern California-Nevada Section of the Mathematical Association of America. Students are encouraged to present research projects at each of these meetings. In addition, faculty accompany students to regional American Mathematical Society meetings, and to other conferences such as the Joint Mathematical Meetings held in San Diego in January 2008, the College on Vector Bundles organized by the *Centro de Investigaciones en Matemáticas* in Guanajuato, Mexico, the Southern California Conference on Undergraduate Research, and the Pacific Coast Undergraduate Conference in Mathematics.
- Mathematics has had at least one entry in the system-wide CSU Student Research Competition every year since CSUCI opened.
- The student-led Mathematics Club is very active, hosting fund-raisers, picnics (at which occur the obligatory faculty-student soccer games), Pi Day, and the like.
- Mathematics hosts two ongoing seminar series: one aimed primarily at undergraduate students, the other targeted to first-year graduate students. Both seminar series are open to the public and students with particular interests are encouraged to attend when presentations in line with their interests are given.
- Large contingents of students prepare for (with faculty guidance) and take the Putnam Exam every year. In December '07, of our (reported) 59 majors, 27 of our junior and senior students took the exam.

The Mathematics Program places a high value on **scholarship**. A perusal of faculty *CV*s and of the list of recent achievements in Appendix C shows that all faculty are actively (and successfully) pursuing research agendas. Another way to see the high value placed on scholarship within the Mathematics Program is to recognize that the requirements in our

Program Personnel Standards (in Appendix E) for tenure and promotion include a minimum of three peer-reviewed publications. All Mathematics faculty who might yet be promoted are encouraged to apply annually for CSUCI's Mini-Grant program: funded proposals provide three credits of reassigned time, thus allowing the successful proposer a reduced teaching load for one semester so that he/ she may redirect that time towards his/ her research.

We particularly encourage **incorporating students into research activities** when the nature of the activities lends itself to this. Both Kathryn Leonard and Cindy Wyels have obtained external grants for faculty-student research[8] and Kathryn is one of eight CSUCI faculty piloting the UNIV 498 program (faculty-student research). Geoff Buhl's NSF proposal to fund research with biology and mathematics students was mentioned earlier, and all six faculty submitted projects for a (unfunded) NSF Research Experience for Undergraduates proposal that will be revised and resubmitted in 2008. In addition, Mathematics faculty engage students in (unfunded) research on an ad hoc basis. These projects lead to capstone presentations, to a large number of conference posters and presentations, and to presentations on the travel/ study course to Mexico, Poland, and possibly Holland. We also on our beliefs by writing internal proposals and using some of our limited program funds to support student travel to participate in conferences.

Curricular and instructional innovations are also valued within the Mathematics Program. All Mathematics faculty use a variety of innovative techniques in their classes, such as exploratory worksheets, group and individual problem-solving, course projects, online-managed pre-class reading assignments, the creative use of technology for out-of-class communication with students, and prose writing. Three faculty have published peer-reviewed articles in the area of curricular/ instructional innovation. Again, our Program Personnel Standards reflect our value in this area: publications addressing mathematics pedagogy "count" towards scholarship. Mathematics faculty are encouraged to write grants that support innovative instruction; examples include the (funded) HP Technology for Teaching grant that allowed incorporation of technology into the calculus sequence as well as the previously mentioned Center for Integrative Studies grants.

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[8] Kathryn has written two successful grants to the Center for Undergraduate Research; Cindy has received five grants through the Mathematical Association of America's Supporting Undergraduate Minority Mathematics Achievement program (NSF and NSA funding). Both sources pay stipends to students, thus allowing them to focus time that would otherwise be spent at part-time jobs on research during the duration of the projects.

3. Developing and Applying Resources to Ensure Sustainability

The program sustains its operations and supports the attainment of its educational objectives through investment in human, physical, fiscal, and information resources. Its use of resources creates a high quality environment for student and organizational learning.

Faculty and Professional Staff

During AY07-08 the program employed 6 pre-tenure/tenured faculty, 3 full-time lecturers, 12 part-time faculty, and 9 teaching associates to provide direct instruction to students. Searches for additional tenure-track faculty were completed in AY06-07 and AY07-08 with candidates very highly regarded by the Mathematics Disciplinary Search Committee recommended. However, administrative priorities led to these two searches resulting in no hires.

Pre-tenure and tenured faculty all possess earned Ph.D.s in Mathematics and excellent professional qualifications. (For summaries of individual professional qualifications, see the CVs in Appendix C.) Four are currently pre-tenured Assistant Professors, with two of these expected to earn tenure and promotion in either AY07-08 or AY08-09. The Chair holds the rank of Professor; the remaining faculty member holds the rank of Associate Professor and directs the Masters in Mathematics program. Half of the current permanent faculty are male; one is an ethnic minority; two were born and raised in non-English-based foreign cultures.

The permanent Mathematics faculty are engaged in all aspects of the professoriate. In addition to their teaching activities, they actively pursue scholarly agendas. Since F'06, the six permanent faculty have authored 20 articles that have been accepted by or appeared in peer-reviewed journals and they have another 18 research monographs in preparation. They've given at least 22 research presentations in this time frame. (Details may be found in their CVs and in the list of faculty accomplishments in Appendix C.) These same faculty contribute to university and community service through service on committees, task forces, and through one-time activities such as orientation events and serving as Marshalls at commencement. (A list of service activities is provided in Appendix C.) The Mathematics faculty take advantage of faculty development opportunities. For example, Geoff Buhl, Kathryn Leonard, and Cindy Wyels have participated in the university-wide Critical Friends Group since its inception in S'07, Jesse Elliott participated in a university-wide Teaching Circle during S'07, all but the chair regularly carry out Mini-Grant projects[9], and Geoff and Kathryn are members of the regional NExT[10] program. All attend workshops and sessions at conferences designed to further their teaching and/or their scholarship. (A more detailed list of professional development activities is provided in Appendix C.)

The Mathematics Program shares a Faculty Support Coordinator (FSC) with Computer Science and Physics; this FSC has the aid of a student assistant for up to 20 hours/ week when classes are

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[9] These internally-funded grants provide one course's worth of reassigned time to work on the research project proposed.

[10] NExT – New Experiences in Teaching – is a highly regarded professional development program for mathematics faculty. The regional program is under the auspices of the Southern California – Nevada Section of the Mathematical Association of America.

in session. Quality and experience of professional staff have varied as we have worked with four different Support Coordinators in the last five years. The lack of stability hampered the program's functionality as each new coordinator required time to learn how to fulfill the responsibilities of the position and the faculty adjusted to a decreased level of competence and knowledge at the beginning of each transition. Our current Support Coordinator (employed Oct. '07) brings excellent experience and capabilities to the position. Assuming this position remains stable and that the support needs of all three disciplines do not increase markedly in the next few years, our current level of professional staffing is adequate to maintain and support our academic programs. However, consideration should be given as to whether some time-consuming duties that currently fall to the faculty would be better directed to staff, should additional staff be available.

The program needs additional senior-level faculty to form Program Personnel Committees, to provide leadership both within the undergraduate program and the MS program, and to ensure it can – without overburdening its current permanent faculty – carry out a significant role in university service and shared governance. It needs additional permanent faculty (of any rank) to
- improve the temporary/ permanent faculty teaching ratio (in F'07, 79% of all mathematics courses were taught by temporary faculty; of courses satisfying requirements for the B.S. in Mathematics, 73% were taught by temporary faculty),
- plan and implement outreach activities within our local K-14 education community,
- develop, implement, and oversee service learning opportunities for mathematics students,
- offer additional extra-curricular opportunities for our students,
- increase the functionality of the program, and
- continue to support the service needs of the university.

The question of whether "the program employs faculty in sufficient number… to support its academic program…[11]" will continue to be addressed throughout the next sub-sections of this report.


Workload, Evaluation, and Development

The workload for all faculty and staff within Mathematics corresponds to the current institutional norms at CSUCI. Full-time lecturers carry a 15-WTU workload; ladder (pre-tenure and tenured) faculty maintain a 12-WTU workload. Whenever possible, we wish to employ full-time lecturers who are professionally qualified for tenure-track positions. To help them maintain their scholarship agendas so they may remain so qualified, we attempt to lighten their teaching load by assigning them multiple sections of the same course each semester. Ladder faculty teach multiple sections less frequently, and are more likely to be teaching upper-division or graduate courses. Their course preparation is thus likely to be more time-consuming. Ladder faculty also receive reassigned time for various service responsibilities within the program: chairing the program, directing the masters program, serving as the assessment coordinator and the remedial mathematics coordinator, overseeing pre-service teachers' capstone projects, etc. Additional

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[11] *Guidelines for Program Review* (provided by the Office of Academic Programs and Planning, CSUCI: Criteria 1 under Element 3, p. 22.

reassigned time to better coordinate activities that are currently managed either not at all or on an ad hoc basis would improve the program's academic functionality. For instance, coordinating the several first-year calculus courses and their associated lab sections would lead to a more even experience for the students[12]. (We are awaiting administrative response to a request for assigned time for this position.)

Data[13] for FTEF[14], FTES[15], and SFR[16] show a steady increase in all three figures since 2002.

Total Full-Time-Equivalent Faculty (FTEF) and Student-Faculty Ratios (SFR)
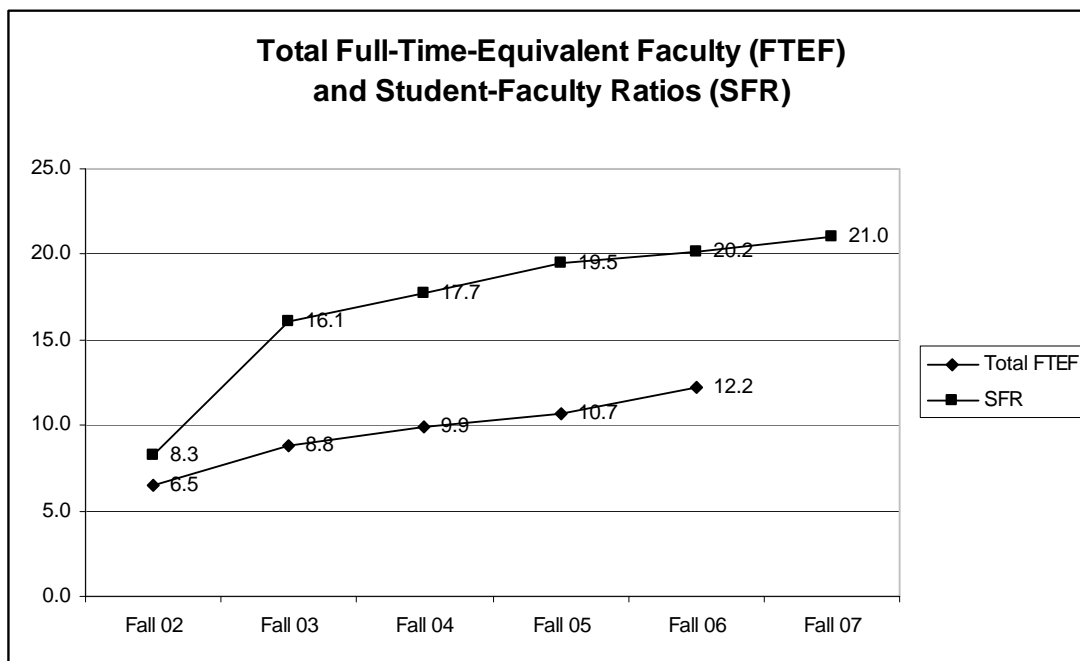
Our target FTES[17] for F'07 was 256; our actual enrollment exceeded this by 29 (11%).

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[12] For instance, we received an HP grant to revise the calculus curriculum and introduce technology into Calculus I and II. The PI dedicated time to working with three faculty members (one the first year, two the second) to bring them up to speed with the software and supplementary course materials; each of the three left CSUCI after one year. Lack of continuity and the need to retrain have negatively impacted the project.
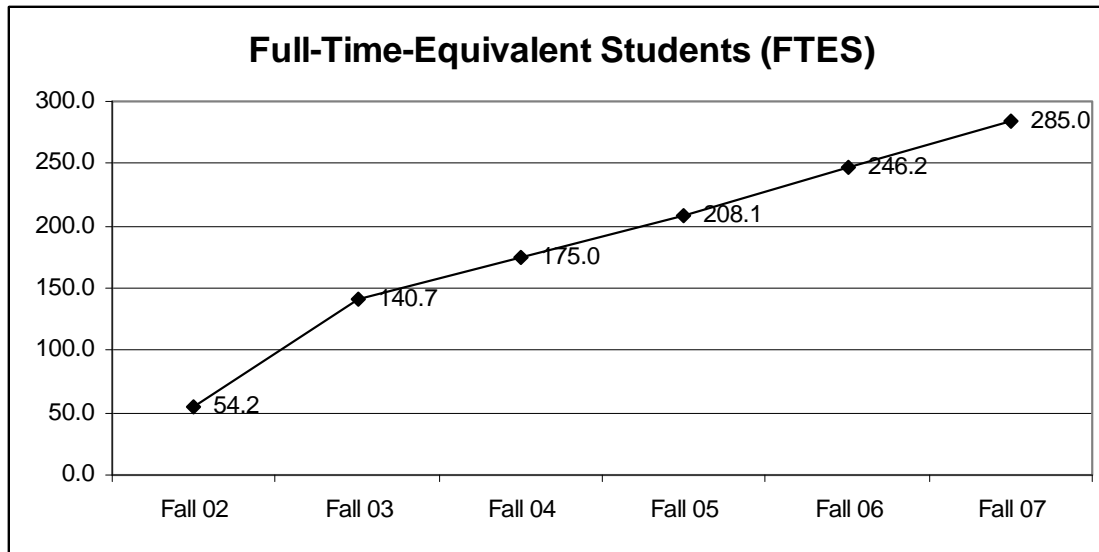
[13] Data for F'02 through F'06 was provided by Institutional Research; figures for F'07 (where present) were taken by material provided at Chairs Meetings by the Dean's Office.

[14] Full-Time-Equivalent Faculty: the number of credits of courses taken by students, divided by 15 for each full-time lecturer and by 12 for each ladder faculty.

[15] Full-Time-Equivalent Students: the number of credits of courses taken by students, divided by 12.

[16] Student-Faculty Ratio: FTEF/ FTES.

[17] A projected/ target goal for FTES; budgeting and assumptions about faculty needs, etc. are based on targets.

Full-Time-Equivalent Students (FTES)

A line chart showing FTES values from Fall 02 to Fall 07:
- Fall 02: 54.2
- Fall 03: 140.7
- Fall 04: 175.0
- Fall 05: 208.1
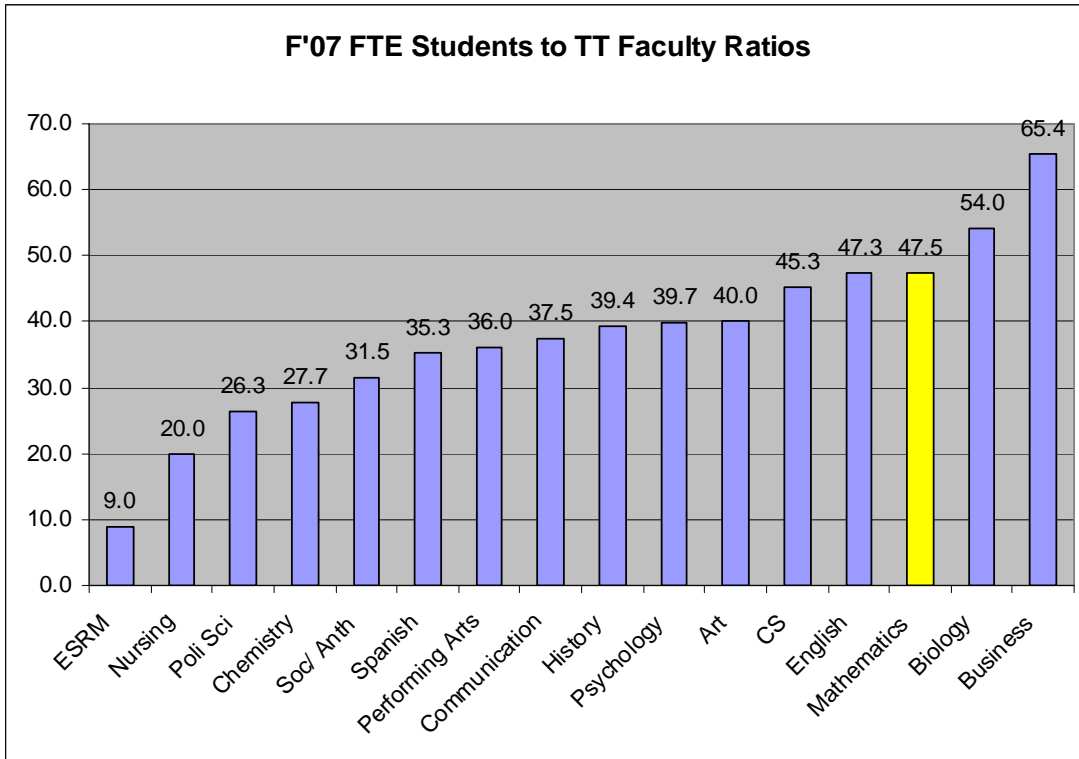- Fall 06: 246.2
- Fall 07: 285.0

A review of the percentages of classes taught by temporary faculty illustrates the need for more permanent faculty in mathematics. During F'07, <u>temporary faculty taught 79% of all courses</u> offered in the Mathematics program, and <u>temporary faculty taught 73% of the courses required</u> for the B.S. in Mathematics[18].
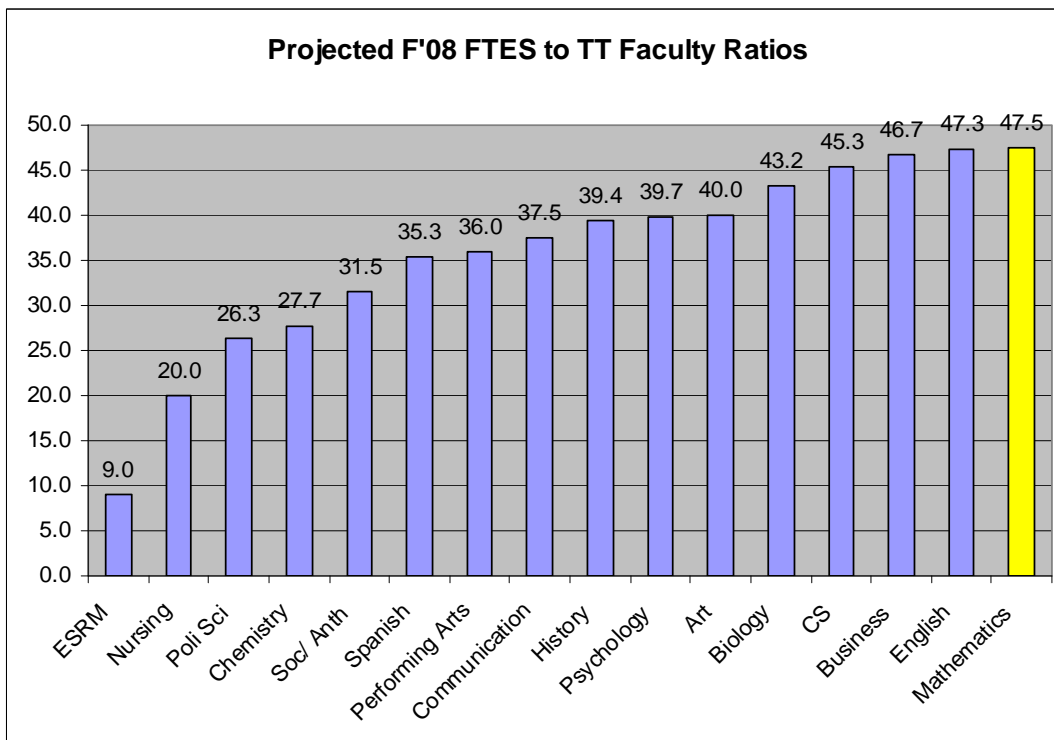
CSU Channel Islands faculty recognize that most disciplines have high need for additional ladder faculty to support their academic programs. Our unusual hiring system allows programs to advertise and complete searches for faculty candidates but, in a sense, compete with other programs for actual positions. A comparison of FTES to pre-tenure/ tenured faculty by program shows that Mathematics had the third highest such ratio as of F'07[19].

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[18] These figures are internally calculated. Data for WTUs of full-time faculty, WTUs of part-time faculty, the percentage of courses taught by full-time faculty, and the percentage of courses taught by part-time faculty were left blank in the data pack provided by Institutional Research.

[19] FTES values are from F'07 census reports provided by the Dean's Office during S'08. Numbers of TT faculty are taken (for F'07) from the CSUCI website; for F'08 they're adjusted for faculty-to-admin conversions and new hires. Liberal Studies, Early Childhood Studies, and Education FTES and counts of faculty were omitted as they either have no/ little faculty assigned or have deceptively low FTES, due to the bulk of their students being post-graduates.

F'07 FTE Students to TT Faculty Ratios

Program	Ratio
ESRM	9.0
Nursing	20.0
Poli Sci	26.3
Chemistry	27.7
Soc/ Anth	31.5
Spanish	35.3
Performing Arts	36.0
Communication	37.5
History	39.4
Psychology	39.7
Art	40.0
CS	45.3
English	47.3
Mathematics	47.5
Biology	54.0
Business	65.4

However, hiring for F'08 has now been completed, so we may easily calculate the number of pre-tenure/ tenured faculty per program for F'08. And as our enrollment is to remain static for the next year, we may use the F'07 FTES figure to determine ratios of projected F'08 FTES to pre-tenure/ tenured faculty; these may be assumed to be very accurate predictions. This comparison shows that Mathematics has the highest such projected ratio.

Projected F'08 FTES to TT Faculty Ratios

Program	Ratio
ESRM	9.0
Nursing	20.0
Poli Sci	26.3
Chemistry	27.7
Soc/ Anth	31.5
Spanish	35.3
Performing Arts	36.0
Communication	37.5
History	39.4
Psychology	39.7
Art	40.0
Biology	43.2
CS	45.3
Business	46.7
English	47.3
Mathematics	47.5

Furthermore, it is important keep in mind that none of the FTES-related figures discussed here include graduate students, who are also served by the same faculty discussed throughout this report[20].

Faculty incentives for quality work are largely comprised of personal satisfaction, the respect of one's peers, and continuation of employment. The main criteria for continued employment of non-ladder faculty is quality teaching, as reflected by student evaluations and other student feedback, peer observation of classroom practice, adherence to the course content expected, written course materials, and any additional tasks assigned to the faculty member. Ladder faculty are subject to the institution's Retention, Tenure, and Promotion policy. As CSUCI Mathematics has an approved set of Program Personnel Standards (available in Appendix E), our internal evaluation practices for retention, tenure, and promotion are fully aligned with those of the institution. An additional incentive for ladder faculty may be any pay increase resulting from a positive tenure and/ or promotion decision.

To date, the locus of faculty development has been university-wide rather than program-initiated. Mathematics faculty have collaborated on seeking out grant opportunities and preparing proposals. We share research ideas, setbacks, and successes both informally and by giving talks in either of two seminar series. Conversations aimed at improving teaching occur both one-on-one, in sporadic program meetings (e.g. discussing prerequisites for upper-division classes), and in university-wide settings (such as the campus' Critical Friends Group). Faculty avail themselves of workshops designed to enhance teaching at local and national conferences. We note that faculty avail themselves of these opportunities to consider their teaching differentially. Non-ladder, and in particular, part-time faculty are generally the least likely to receive professional guidance. Structures and practices allowing the program to provide more development within the program itself (e.g. a calculus coordinator, funds to pay part-time faculty to attend workshops) would strengthen the overall quality of our program's teaching.

Fiscal and Physical Resources; Technology and Information Resources

Physical resources fall into two categories: resources needed to support student learning, and resources needed for faculty work. Regarding student learning, the ladder faculty in the Mathematics Program have quite carefully considered the characteristics of classrooms ideally designed for the vast majority of mathematics classes; our standing statement regarding these characteristics may be found in Appendix E. To summarize, quality mathematics pedagogy requires plentiful whiteboard space (for faculty and students), the ability to project a computer monitor (without taking up whiteboard space), good lines of sight for students, movable tables and chairs to facilitate different modes of instruction, and easily-accessible computers (without compromising lines of sight or much table-top space). Out of class, students are best served through providing spaces in which they can work together and have access to whatever course software is needed. We advocate the consideration of these elements when designing classrooms,

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[20] This same remark also applies to Biology, Business, and Computer Science.

and the provision of adequate student spaces for out-of-class work. (The student work-space issue is largely addressed by the opening of the Broome library).

The Mathematics curriculum includes many courses designed to be taught either partly or completely in a computer laboratory. The Mathematics Program currently schedules two computer classrooms: the Macintosh lab (OH 1964) and BT 1704. We schedule these two rooms as fully as possible, and then depend on the scheduling wizardry of two key people in the Dean's Office to ensure that our remaining lab-dependent courses are scheduled in general-use computer labs. However, the computers in BT 1704 were obtained through a grant, and there are no funds budgeted to replace these computers as they age. A report prepared by the Chair two – three years ago, *MATH FACILITIES NEEDS: Plan for 2006 – 2010*[21], lays out projections for computer-lab needs. The summary is copied below. The computers in the existing Mac lab have been updated; a PC lab has been created through an HP grant obtained with the program and the university's dedication of a room for this lab. Other elements of the proposal have not been addressed.

2006-08

New Mac Lab	$80,000
2 servers for the math program	$10,000
PC Lab	$60,000
Wireless dedicated classroom (30 Mac Laptops + storage)	$40,000
TOTAL COST	**$190,000 + 3 dedicated rooms**

2008-10

|	
New Mac Lab	$80,000
2 servers for the math program	$10,000
PC Lab	$60,000
Update of existing equipment	$40,000
TOTAL COST	**$190,000 + 2 dedicated rooms**

Faculty need offices in which they may meet with students, prepare classes, pursue their scholarship activities, and carry out the work of the program and the university. They also need access to spaces conducive for meetings. We emphasize that these faculty needs apply to both permanent and temporary faculty.

With the exception of the two computer labs, classroom space and faculty office space are controlled by entities at higher levels than the program. As we grow, additional classroom and computer laboratory space will become necessary. Similarly, need for additional office space – particularly to attract and support the quality lecturer and part-time faculty we need to provide quality instruction and out-of-class faculty-student interaction – will need to be planned for and developed.

Our analysis in terms of fiscal resources is somewhat constrained by the limited budget data available for this report. From the figures for Operating Budget and FTES provided by Institutional Research we can ascertain that our Operating Costs per FTES decreased from F'04

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[21] Available in Appendix E.

to F'06. Our figures from the Dean's Office for F'07 show a slight increase, in spite of our exceeding our target FTES in F'07.

Operating Costs per FTES
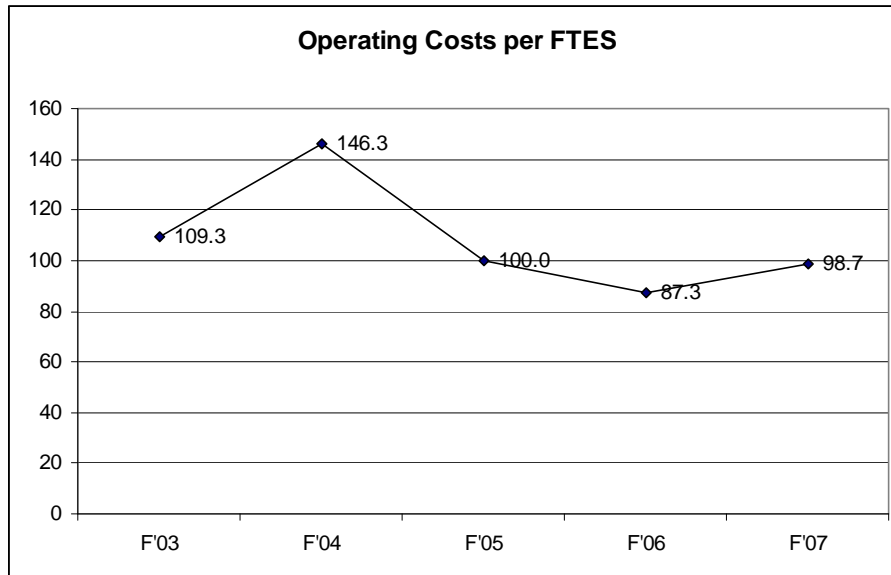
We can also calculate the Program Cost per FTES. We suspect the increase in F'06 is due to the addition of two tenure-track faculty. Of course, the most significant overall component of the program budget is due to salaries and benefits, both of which are increasing, due to contract-mandated increases in faculty salaries and rising health-care costs. The program cost per FTES should therefore be expected to rise, even without hiring needed permanent faculty.

Program Cost per FTES
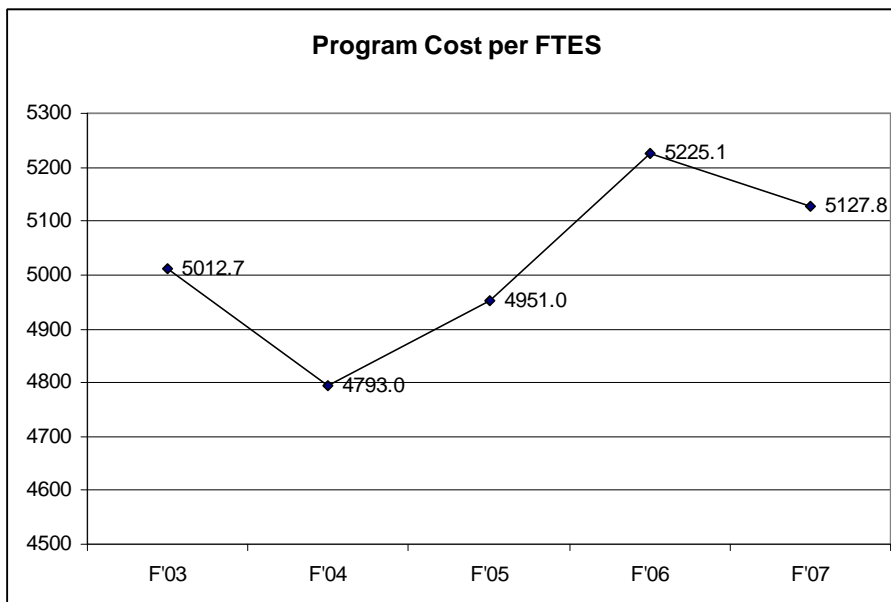
The Mathematics Program works with the university's Library staff and faculty to gain access to information resources and some course-related technology. The Library faculty/ staff are both knowledgeable and helpful; resources available on campus include MathSciNet, JSTOR, and an

efficient and capable Interlibrary Loan program. Mathematics faculty are well-served by the current arrangement in terms of information resources.

Similarly, the Mathematics Program works with the university's Information Technology staff to address technology needs. Other than a small budget line ($4020) for software, we have neither internal resources nor staff to address technology. (We do appoint one permanent faculty member to serve as our IT liaison; whether this significant commitment of that faculty member's time is well-spent is debatable.) We frequently have cost and timeliness issues regarding course-related software for some specialized courses. It is frequently too expensive to acquire a site (or department) license for one course, yet installing as many individual licenses as there are students is prohibitively difficult for IT staff to manage, given their range of responsibilities and their own staffing issues. While the customer-service orientation of IT relative to Mathematics has been uneven in the past, better communication and better understanding among program faculty as to capabilities and limitations within IT has led to our current productive working relationships regarding software installation and maintenance of course-related software. Yet problems remain: it took a year and a half for one faculty member to successfully have MatLab – software needed for her research – installed on her office computer, in spite of repeated requests and follow-ups with IT staff. The second of two MatLab toolboxes – requested now 20 months ago, has still not been installed. This lack of this last toolbox currently hinders student progress in this faculty member's section of UNIV 498, a research-based course.

An ongoing concern is the availability of computers and software for student use both in- and out-of-class. A related concern is the need to regularly update existing technology. Mathematics has developed resources (via grants and special allocations) to acquire computers for in-class use. Computers acquired through grants will need updating; no program budget exists for such costs.

Some of the items mentioned in this section in terms of workload, development, and staffing are, in the end, fiscal resource issues. A summary of resources required for Mathematics to operate more efficiently and better serve students follows.
- Additional tenure-track faculty
- Consideration of whether current faculty responsibilities (e.g. webpage development and maintenance, software acquisition and trouble-shooting with IT, scheduling and overseeing lab assistants) might be better delegated to staff, were more staff available
- Provision of Maple, Mathematica, and MatLab software campus-wide: students and faculty would benefit greatly from access to the standard three widely-used mathematical software in classrooms and in student workspaces such as the open-access labs and the tutoring center. Acquiring site-wide licenses and managing these three programs is best managed through IT.
- Increased budget for class-specific software (such as specialized statistics and gaming software) – a program responsibility
- The ability to schedule courses in appropriately-configured classrooms
- A realistic budget for lab assistants (for AY07-08, $4000 was allocated by Dean's Office from lottery funds; actual costs were approximately $17000)

- A budget line for student assistants/ mentors for specific math courses[22]
- Budget for student travel to present at/ attend conferences (none is currently allocated)
- Provisions made to update computers in computer labs

Organizational Structure and Decision-Making Processes

The organizational structure of the Mathematics Program is currently rudimentary. Faculty opinion is consulted in varying levels depending on the issue; the authority for decision-making rests with the chair. As of the writing of this internal review (March, 2008) program faculty are beginning the process of formulating program bylaws. While some efficiency may be lost by providing all faculty with a greater say in decision-making, it is hoped that the effectiveness gained by developing a more broadly-held understanding of the program and its goals, and by having all faculty more aware of various facets of the program as well of as of external constraints, will more than compensate for any loss in efficiency.

The Mathematics Program maintains open lines of communication with external partners. The Chair is an active participant of the campus/community Business and Technology Partnership and sits on the Applied Mathematics and CS and Engineering subgroup. The Gaming minor was developed in conjunction with industry experts and has ties with a non-profit gaming company. Mathematics faculty are members of the School of Education's Advisory Board and participate in the Mathematics and Science Teaching Initiative. We frequently interact with faculty from other regional institutions through inviting them to give seminars at CSUCI and through our travel to their institutions to present seminars ourselves.

Analysis Regarding Developing and Applying Resources to Ensure Sustainability

The CSUCI Mathematics Program operates within a resource-scarce environment. Creativity and flexibility are necessary to ensure that students are provided a high-quality learning experience; our analysis raises concerns regarding our ability to sustain the level of the student experience without additional investment in human, physical, fiscal, and information resources.

Our largest single concern is shared university-wide: faculty and staff overwork and the questionable sustainability of current practices. More permanent faculty are desperately needed to provide quality teaching. Students are not well served when 79% of mathematics courses are taught by temporary faculty. No one – students, faculty, the university, nor the community – is well served when the high service load of a young, ambitious university is distributed to a small number of permanent faculty. Among other problems, the current situation does not allow the faculty to implement desirable initiatives, such as outreach to local K-14 institutions and tutoring in the schools programs.

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[22] Course assistants provide a two-sided benefit: the students in the course have a peer to help them with coursework, who will be available at different times than the instructor, and who can provide advice and mentoring in course content and beyond. The assistants themselves revisit and reaffirm mathematical expertise, gain experience teaching math, and earn money from a task that focuses on – instead of away from – their academic goals.

We are also concerned about flat or lower operating costs, both university-wide and within Mathematics. We are already serving 11% more full-time-equivalent students than the number for which our current budget was allocated. As the bullet list in the previous subsection indicates, additional budget items are necessary for continued improvement of the program and the services it provides.

4. Creating an Organization Committed to Learning and Improvement

The program faculty and staff reflect about how effectively the program is accomplishing its purposes and achieving its educational objectives. These reflections are evidence-based and participatory, and are used to establish program priorities and practices in teaching, learning and scholarship.

The Mathematics Program is one of four programs currently undertaking first-ever program reviews at CSUCI. Our participation provides the opportunity to carefully consider the procedures and policies we have in place to help us determine how effectively we are accomplishing our purpose, and to determine what other policies and procedures might be instituted at the program and the university levels to allow for better understanding of our effectiveness.

As Mathematics grew from a program with one permanent faculty member to three and then four permanent faculty, most planning was done informally, through the chair or via individual initiatives. Since the program attained its current permanent faculty size of six in Fall 2006, we have been moving towards a more formal model of planning. While we do not as yet have regularly-scheduled meetings, faculty have exercised the wherewithal to call planning-oriented meetings of all permanent faculty; these have resulted in spirited and thorough curriculum discussions (e.g. concerning priorities and alignment with objectives) leading to several curriculum modifications. Similarly, meetings and informal discussions prior to and during the AY07-08 hiring season led to a better common understanding of program and institutional priorities for hiring. While much quality work and thinking will always occur in unplanned and ad hoc discussions between small groups of faculty members, we recognize that as we continue to grow we will need to continue incorporating more structured forms of planning activities. As indicated earlier, the construction of program bylaws (begun S'08, expected completion F'08) will constitute a significant step towards codifying planning processes.

However, best practices dictate that our planning be informed by relevant data. Some of this data is best collected internally through our own assessment data. Other data, e.g. faculty and student demographics, WTUs and FTES, and information about alumni outcomes are best collected by other university entities. The university as a whole is in the early stages of collecting, receiving, and analyzing data.

Mathematics, true to its central place among the liberal arts, does not have external accreditation bodies. The professional association most associated with undergraduate level mathematics, the Mathematical Association of America, does, however, make thoughtful, thorough, and regularly-updated recommendations for Mathematics departments through its Committee on the Undergraduate Program in Mathematics. While our curriculum is currently fairly well aligned with these recommendations, periodic consultation and review is important as one facet of keeping the curriculum and our practices current.

All Mathematics faculty hired since Fall 2005 fall under the current Retention, Tenure, and Promotion policies, and have approved professional development plans (available in Appendix C) in place. This practice will be standard for all faculty hired in the future.

Recommendation on Program Improvement

The self-study will conclude with specific recommendations for program improvement. These recommendations should b clearly linked to evidence provided in the self-study narrative and be framed as actionable items that if undertaken by the program faculty and staff, and by others in the wider University, will improve program quality.

The Mathematics Program is well on its way to creating a student-centered program of high academic quality. It has a solid curriculum and provides numerous extracurricular learning opportunities. The full-time faculty are excellent teachers who hold the students to high intellectual standards. These faculty share the traits of being dedicated, knowledgeable, capable, and overworked.

Our most critical needs require administrative acceptance and action. The largest hurdle to seriously addressing the issues under our direct control is undoubtedly the time needed by faculty away from teaching, class preparation, grading and committee work in order to think about, discuss, explore, and create various possibilities. Consequently, our primary recommendation concerns resources. As supported through Section 3 of this document, we need more permanent faculty. We also need the university to carefully consider the fiscal and physical resources of the program in light of our analysis of current and projected needs.

Internally, we make the following recommendations, subject to the caution that those requiring additional faculty time and energy, or additional unallocated budget, may only be accomplished by identifying current activities that may be suspended. Essentially, significant action on all but the first item will only be feasible once the size of the permanent Mathematics faculty grows.

- Institute data-based planning processes.
- Plan and implement a sustainable and ongoing program of K-14 outreach activities.
- Implement a more comprehensive program student advising to go beyond advising within the major to typing together academic program and co-curricular activities with post-graduation goals/ educate re post-grad options.)
- Regularly focus on areas of the curriculum to consider revisions and improvements.
- Create and implement a program of formative teaching evaluations.

We ask external evaluators and other reviewers of this document to make recommendations on staffing vis-à-vis ideal program priorities. In the event that the university is not convinced of the need to commit resources to hiring additional mathematics faculty or is unable to do so, we would greatly appreciate guidance on which elements of our program should retain priority and which should be dropped. We believe our current activities are barely sustainable under current conditions, and we have identified other facets that we should incorporate in order to improve better serve students, the university, and the community. However, our permanent faculty simply can not be asked to contribute more, and it is questionable as to whether all can maintain their current levels of engagement.

We are enthusiastic about the current state of the CSUCI Mathematics Program and its potential. We believe we have created the capacity to provide high-quality academic experiences for our students, as long as concerns regarding faculty hires and budget needs are addressed.

Appendix A – Course Syllabi

MATH 94 INTRODUCTION TO ALGEBRA (5)

MATH 95 INTERMEDIATE ALGEBRA (5)

MATH 101 COLLEGE ALGEBRA (3)

MATH 105 PRE-CALCULUS (4)

MATH 108 MATHEMATICAL THINKING (3)

MATH 137 STRATEGIES AND GAME DESIGN

MATH 140 CALCULUS FOR BUSINESS APPLICATIONS (3)

MATH 150 CALCULUS I (4)

MATH 151 CALCULUS II (4)

MATH 201 ELEMENTARY STATISTICS (3)

MATH 202 BIOSTATISTICS (3)

MATH 208 MODERN MATHEMATICS FOR ELEMENTARY TEACHING I-NUMBERS AND PROBLEM SOLVING (3)

MATH 230 LOGIC & MATHEMATICAL REASONING (3)

MATH 240 LINEAR ALGEBRA (3)

MATH 250 CALCULUS III (3)

MATH 300 DISCRETE MATHEMATICS (3)

MATH 308 MODERN MATHEMATICS FOR ELEMENTARY SCHOOL TEACHING II-GEOMETRY, PROBABILITY AND STATISTICS (3)

MATH 318 MATHEMATICS FOR SECONDARY SCHOOL TEACHERS (3)

MATH 329 STATISTICS FOR BUSINESS AND ECONOMICS (3)

MATH 330 MATHEMATICS AND FINE ARTS (3)

MATH 331 HISTORY OF MATHEMATICS (3)

MATH 345 DIGITAL IMAGE PROCESSING (3)

MATH 350 DIFFERENTIAL EQUATIONS AND DYNAMICAL SYSTEMS (3)

MATH 351 REAL ANALYSIS (3)

MATH 352 PROBABILITY AND STATISTICS (3)

MATH 354 ANALYSIS OF ALGORITHMS (3)

MATH 393 ABSTRACT ALGEBRA I (3)

MATH 399 MODERN TOOLS IN MATHEMATICS (1)

MATH 428 PHILOSOPHY OF MATHEMATICS (3)

MATH 429 OPERATIONS RESEARCH (3)

MATH 430 RESEARCH DESIGN AND DATA ANALYSIS (3)

MATH 437 MATHEMATICS FOR GAME DEVELOPMENT (3)

MATH 445 IMAGE ANALYSIS AND PATTERN RECOGNITION (3)

MATH 448 SCIENTIFIC COMPUTING (3)

MATH 450 PARTIAL DIFFERENTIAL EQUATIONS AND MATHEMATICAL PHYSICS (3)

MATH 451 COMPLEX ANALYSIS (3)

MATH 452 COMPUTATIONAL BIOINFORMATICS (4)

MATH 480 DIFFERENTIAL AND RIEMANNIAN GEOMETRY (3)

MATH 482 NUMBER THEORY & CRYPTOGRAPHY (3)

MATH 484 ALGEBRAIC GEOMETRY AND CODING THEORY (3)

MATH 490 TOPICS IN MODERN MATHEMATICS (3)

MATH 492 INTERNSHIP (1-3)

MATH 493 ABSTRACT ALGEBRA II (3)

MATH 494 INDEPENDENT RESEARCH (1-3)

MATH 497 DIRECTED STUDIES (3)

MATH 499 SENIOR COLLOQUIUM (1)

Appendix B – Advising Documents

1. Major Requirements Flowchart ("blue form")

2. Roadmaps

3. Mathematics Advising Form

Appendix C – Tenure-Track and Tenured Faculty Information

1. *Curricula Vitae* for all tenure-track/ tenured faculty

2. Professional Development Plans for those faculty under the "new" Retention, Tenure, and Promotion Policy (Buhl, Leonard, Wyels)

3. Faculty Accomplishments 2006 and 2007

4. Faculty Service Activities

5. Faculty Professional Development Activities

Appendix D – Assessment Reports

1. Mathematics Program Learning Outcomes Assessment Project 2005-2006

2. Mathematics Program Learning Outcomes Assessment Project 2006-2007

Appendix E – Disparate Evidence

1. Mathematics and Physics Program Personnel Standards

2. General Education requirements and GE Mathematics courses

3. Mathematics Classroom Design Recommendations

4. Mathematics Facilities Needs, Plan for 2006-2010

5. Program for the First Joint Meetings of CSU Channel Islands and *Universidad Autónoma del Estado de Hidalgo*, March 20 – 24, 2006