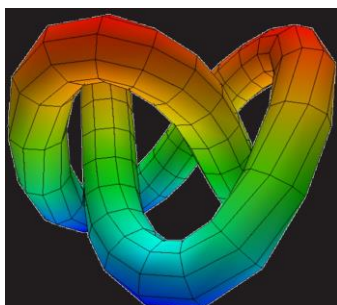




# **PROGRAM REVIEW MATHEMATICS**

## **M.S. in Mathematics Program 2016**



**Name of Degree: Mathematics, M.S.**  
**Department: Mathematics and Applied**  
**Physics Program Director: Jesse Elliott**  
**Department chair: Ivona Grzegorzczuk**  
**Program/department website: [math.csuci.edu](http://math.csuci.edu)**

**Reviewer names and affiliations:**

Prof. Michael Krebs  
Department of Mathematics  
Loyola Marymount University

Prof. Helena Noronha  
Mathematics Department  
CSUN

Note the following document organization for CSUCI program review elements:

Chapter II -Element One - Defining Program Purposes and Ensuring Educational Outcomes

Chapter IV - Element Two - Achieving Educational Outcomes

Chapter III - Element Three - Developing and Applying Resources to Ensure Sustainability

Chapter V - Element Four - Creating an Organization Committed to Learning and Improvement

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## I. Executive Summary

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The Mathematics department at CSUCI and its curriculum provide a strong and flexible graduate program in mathematics. Thesis units (6) and research projects included in the program provide an opportunity for more focused and/or interdisciplinary training in pure, applied or industrial mathematics as well as mathematics education. Our Master's degree program has are well prepared to enter the workforce in technical or interdisciplinary fields or as collage level mathematics educators, and are also ready to pursue more advanced studies in mathematics. The program produced graduates who have done well in getting employment after graduation in industry, banking or research and development units. The mathematics department's faculty are talented teachers and successful researchers and professionals. All of our hires have attained tenure and promotion when eligible. With the growth of the Mathematics Program has come an increased opportunity for students to be engaged with faculty on research projects or internships in the community. Additionally, critical to the functioning of our large department, is a competent staff that is able to handle the challenges associated to running this complex operation.

### A. PREVIOUS REVIEWS

MS program at CI started in 2005 as a pilot program on self-support status through CI Extended Education. It was reviewed and approved by the Chancellors Office for permanent status in 2010. Department received commendations for its curriculum, attracting around 40 students and graduating 10-15 of them per year.

. The department also received commendations for the:

Quality the curriculum and the program faculty

Professional and scholarly productivity of the faculty

Student involvement in research/problem solving with faculty

Informative web page

## II. Program Purposes and Ensuring Educational Outcomes

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### A. HISTORY AND CONTEXT

The Mathematics Department at CSUCI is 15 years old as it started when the university opened in 2001. The program offers a complete set undergraduate courses leading to a Bachelor of Science degree in mathematics. The department also offers minors in mathematics, statistics and foundational mathematics. Master of Science in Mathematics degree started in 2005 as a pilot program, and became permanent program in 2010. The strength of our undergraduate program gives a chance to conditionally admitted students to quickly supplement their background. The mix of pure and applied mathematics in our programs increases both the usefulness of and the

demand for graduates with a degree in mathematics, as for several decades there is a significant national shortage of professionals with advanced mathematics skills. Note that our permanent faculty as well as our qualified lectures teach graduate level courses depending on their specializations and demand. Many of our MS students choose to continue to graduate school. Almost all of them find mathematics degree related employment within two months after finishing their graduate degree.

To facilitate our graduate students' schedule, we offer most of the courses after 5pm. After mastering three core courses, students have choice of electives and they select thesis topic following their interests either in pure, applied areas or mathematics educations. Most of them work as Graduate Teaching Assistants at CI gaining valuable experience for their future careers. In their second year, most of them work in local colleges as independent instructors. About 30% of math graduate students work for local industry. Every year, several MS graduates continue to Ph.D. programs.

The rich variety of courses offered by the department permits the students not only to obtain a broad exposure to those areas of mathematics which are fundamental to advanced mathematical study or secondary school teaching, but also in interdisciplinary areas of mathematics such as physical sciences, engineering, art, data analytics, business, management sciences, computer science, and operations research.

## **B. PROGRAM MISSION AND GOALS**

The University's Mission statement is:

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 graduate students with multicultural and international perspectives.

Following the above our program's mission is the following:

*Mathematics can be pursued as a scholarly discipline of an especially elegant and creative art form or it can be treated as a valuable tool in an applied discipline. Our program addresses both needs. Students are given a strong background in mathematics and statistics as well as a substantial amount of interdisciplinary applications in physics, computer and information sciences, computer imaging, biostatistics, artificial intelligence, and/or business.*

### **Careers**

The mathematics major will prepare students for teaching careers, studies in graduate programs (in pure mathematics, applied mathematics, mathematics education, or the mathematical sciences) or for employment in high-tech and bio-tech industries, where mathematics-trained professionals with interdisciplinary expertise (science and business) are increasingly sought after.

### **CI Mission-Based Student Learning Outcomes:**

CSU Channel Islands' 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, cultures and nations (when appropriate); and analyze issues, and develop and convey to others solutions to problems using the methodologies, tools and techniques of an academic discipline.

Following the above mission statement, we have developed program specific **MS in Mathematics Program Learning Outcomes:**

1. Provide students with the opportunity to earn a Master degree in Mathematics from the California State University.
2. Prepare students for employment in a variety of highly sophisticated and complex high-tech and bio-tech industries, businesses, education systems, military and local and federal government
3. Prepare students for further study in graduate or professional schools.
4. Equip students with the depth, flexibility and mathematical skills that apply to variety of fields and offer various career opportunities, including consulting, scientific and technical positions in business and industry, research and development, national and industrial security or teaching positions.
5. Offer all CSUCI students the opportunity to broaden their knowledge and learn mathematical skills and computer technology that can be applied to various professional and personal situations.

**Student Learning Outcomes:**

Students will:

1. Demonstrate critical thinking, problem solving, and advanced mathematical skills by identifying, evaluating, analyzing, synthesizing and presenting fundamental and advanced mathematical and computer science issues and their applications.
2. Demonstrate the knowledge of current mathematical theories and broad technology use in industry, including a working knowledge of software development techniques in an industrial setting.
3. Be knowledgeable of emerging new technologies and industrial practices connected to the computer industry and demonstrate understanding of computing technologies in society.
4. Demonstrate cooperation skills by working effectively with others in interdisciplinary group settings – both inside and outside the classroom.

5. Demonstrate independent working and thinking skills by completing a graduate project and/or master thesis.
6. Demonstrate a sense of exploration that enables them to pursue rewarding careers in high-tech industries, bio-tech industries, businesses, education systems, military and local and federal government
7. Demonstrate flexibility, transferability and adaptability of their life-learning skills that are so important in fast changing national and international economy.

### III. Developing and Applying Resources to Ensure Sustainability

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#### A. ACADEMIC PROGRAM

##### *Summary of the program degree requirements for Master of Science Program in Mathematics*

Our Master of Science program is designed to prepare students for careers in the mathematical sciences. Our program is designed to accommodate various student schedule and most courses start after 5pm. About 50% of our graduate students are working professionals looking to augment their education and 50% are full-time students committed to finishing the program in two full years. Accordingly, we have designed our curriculum and teaching program to serve three principle career paths. First, we train future California community college teachers. Second, we prepare our graduates to enter Ph.D. programs in Mathematics. Third, we train students in applied areas (including statistics and engineering) as some of our students do enter industry directly upon graduation, often accepting employment at technology or finance companies. Recent data from AY 14-15 show that 30% of our graduates get positions at Community Colleges, 20% go on to Ph.D. programs, and 50% find industrial employment.

MS in Mathematics Program Description from the CI catalog: Our MS in Mathematics program is interdisciplinary and innovative in nature and offers a flexible schedule with highly qualified faculty. The program is a result of cooperation between mathematics, computer science, and physics faculty and is designed to address the global need for people with advanced mathematical, analytical, and computational skills. Students are provided with a strong background in mathematics and its applications as well as skills necessary to conduct independent research. The program incorporates interdisciplinary applications such as bioinformatics, actuarial sciences, cryptography, security, image recognition, artificial intelligence, mathematics education, and the philosophy of mathematics. Students' specializations depend on the electives chosen and on the final thesis/project conducted under the

supervision of an advisor/mentor. An individual study plan can be designed to meet entry requirements for Ph.D. programs in mathematics or the mathematical sciences.

Graduate Curriculum: Our course work is designed to cover and enhance the material outlined in our program student learning outcomes.

Prerequisites for the program: The majority of the students admitted into the MS program have a bachelor's degree in mathematics or a closely related discipline. It is recommended that you have completed at least one semester in each of the following topics: real analysis, probability and statistics, and abstract algebra. Students lacking recommended prerequisites may be admitted conditionally and advised to take undergraduate courses necessary to prepare fully for the program.

Requirements for the Master of Science in Mathematics: - 32 units

Core Courses - *11 units of*

MATH 511 Functional Analysis (3)  
MATH 512 Probabilistic Methods and Measure Theory (3)  
MATH 513 Advanced Algebra (3)

*And required two units of:* MATH 599 Graduate Seminar (1)

Electives - *15 units\**, Choose *at least two electives from the following list:*

MATH 570 Combinatorics (3)  
MATH 582 Number Theory and Cryptography (3)  
MATH 584 Algebraic Geometry and Coding Theory (3)  
MATH 587 Markov Chains and Markov Processes (3)  
MATH 588 Stochastic Analysis (3)  
MATH 590 Graduate Topics in Mathematics

*Choose at most three electives from the following list:*

MATH 555 Actuarial Sciences (3)  
MATH 565 Research in Mathematics Education (3)  
PHYS 510 Advanced Image Analysis Techniques (3)  
PHYS 546 Pattern Recognition (3)  
COMP 554 Algorithms (3)  
COMP 569 Artificial Intelligence (3)  
COMP 571 Biologically Inspired Computing (3)  
COMP 572 Neural Networks (3)  
COMP 575 Multi-Agent Systems (3)  
COMP 578 Data Mining (3)



*\*MATH 594 (Independent Study) and other graduate courses from mathematics or the mathematical sciences may be included with the graduate advisor's approval.*

Master's Thesis Concentration: 6 units

MATH 597 Master Thesis (1-6)    *or*    MATH 598 Master Project (1-6)

\*Math 597/598 may be taken for a maximum of 9 units.

Before registering for the first unit of thesis (or project), full admission to the program must be obtained, at least one core course must be completed with a B- or better, a faculty thesis advisor arranged, and a thesis topic chosen for which the student is prepared to do research. Students are strongly advised to obtain the proper background in a relevant area of graduate-level mathematics before registering for any thesis units. A thesis committee of 2 to 3 faculty members must be formed before registering for the final unit of thesis. A non-faculty scientist or professional with relevant expertise may serve in place of a faculty member on a thesis committee (but not as a thesis advisor), subject to both the Director's and thesis advisor's approvals. A signed Thesis Units Request Form is required for registering for thesis units and is available on the Program webpage. Successful completion of the thesis requirement also requires (1) an oral thesis defense to the thesis committee, (2) a presentation of the thesis results to the campus community, (3) a signature page with signatures of acceptance from all thesis committee members, and (4) electronic submission of the thesis to the University Library for archiving.

Graduate Writing Assessment Requirement: Writing proficiency prior to the awarding of the degree is demonstrated by successful completion of at least **two** credits of MATH 597 (Master's Thesis) or MATH 598 (Master's Project) with a grade of B or higher.

Note that three core 500 level courses are required as they cover much of the classical advanced material in mathematics: analysis, algebra, and probability. These core courses are offered every third semester (hence the shortest possible time to graduate is three semesters). The seminars Math 599 are offered every semester and serve as project and presentation venues, with many outside speakers invited. All graduating students present their thesis at the end of the semester during the seminar.

MS Thesis Projects or Master's Thesis Emphasis - 6 units: All graduate students have to write thesis by taking Math 597 or 598. These courses may be taken for a maximum of 9 units. Before registering for the first unit of thesis or project, full admission to the program must be obtained, at least one core course must be completed with a B- or better, a faculty thesis advisor arranged, and a thesis topic chosen for which the student is prepared to do research. Students are strongly advised to obtain the proper background in a relevant area of graduate-level mathematics before registering for any thesis units. A thesis committee of 2 to 3 faculty members must be formed before registering for the final unit of thesis. A non-faculty scientist or professional with relevant expertise may serve in place of a faculty member on a thesis committee (but not as a thesis advisor), subject to both the Director's and thesis advisor's approvals. A signed Thesis Units Request Form is required for registering for thesis units and is available on the Program

webpage. Successful completion of the thesis requirement also requires (1) an oral thesis defense to the thesis committee, (2) a presentation of the thesis results to the campus community, (3) a signature page with signatures of acceptance from all thesis committee members, and (4) electronic submission of the thesis to the University Library for archiving.

Teaching Associate Program: Most of our students are offered positions as Teaching Associates (Graduate Student Instructors). Our ability to offer these is dependent on the number of basic and intermediate algebra courses we offer. The TA program is the major source of financial support for mathematics graduate students. We normally assign one course per semester to per students. Second year students offer teach additional Math 399 labs. The fact that we hire our graduate students as Teaching Associates where they are responsible for every aspect of their assigned course is a distinct advantage for them during their later job searches as the experience they gain from running entire courses on their own is a powerful resume enhancement. We have no doubt that our teaching program significantly impacts our job placement record. Comments from alumni regarding our TA program are very positive. There are one-day long training meetings during the week prior to the beginning of every semester run by the course coordinators and the department chair. The tutoring center (LRC) provides additional training on first Friday of classes. The program has plans to improve the TAs training in the future. More information about the MS in Mathematics degree can be found at this link <http://ext.csuci.edu/ms-mathematics/thesis.htm>

### **Course Learning Outcomes**

All of our courses have learning outcomes that are available on the detailed course outlines under Mathematics: <http://facultydevelopment.csuci.edu/assessment.htm>

They are shared with faculty teaching courses and are placed on every syllabus. These outcomes are communicated to students either directly or on Blackboard or as hyperlink in syllabi.

### **Process used to revise and update curricular content**

Major changes to core curricula always go through our program review and discussion. Recommendations are made and voted on. Detailed course outlines for lower-division service courses that are mostly taught by lecturers are very prescriptive on content, textbook, follow the CSU system and various accreditation requirements.

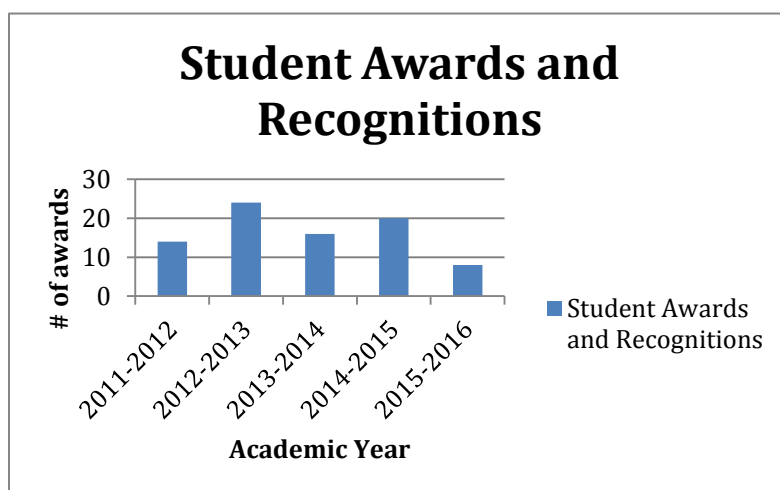
### **Co-Curricular Activities**

Student Research Projects: Since majority of our faculty carry grants mathematics students have numerous opportunities to participate in research projects. Recent projects include imaging, sleep modeling, voting modeling, study and visualization of algebraic surfaces, and mathematics education projects. Every second year CSUCI Mathematics offers an 8-week summer research program (NSF REU) recruits students from our campus, nationally and internationally. Many of these projects lead to research projects, poster presentations at regional meetings of the MAA, and occasionally, published articles. Math faculty also leads projects for

ACCESO, and other campus wide grants. Graduate students all spend at least one year working on research or projects with faculty advisor before writing their thesis. Over all in the last six years we have between around 50 undergraduate and 35 graduate students working on research projects with mathematics faculty members.

Mathematical Competitions: CSUCI graduate students have two opportunities to participate in mathematical competitions. We had students competing in IEEE, MAA. AMS research project competitions.

Almost all graduate students compete at least once in MAA Student Research Poster Competition and typically win awards for their research projects (last year 2 graduate prizes won). The following graph summarizes student award recognitions in the field of mathematics over the five years (graduate and undergraduate combined). These include prizes at student competitions, best research poster awards and distinguished student paper recognitions. For example last year students won 4 prizes at received



Math Club: At CSUCI, we have an officially recognized Math Club that has been active in organizing social events for our math students and friends. Several times each year they arrange picnics, hikes, movie nights, game nights, soccer and Frisbee annual student/faculty games. They have run many different types of fundraisers including quarterly book and T-shirt sales. Many of the Math Club officers help out for math department events such as Open Houses, Career Days and local schools. Our Math Club collaborates with other Clubs on campus organizing events (especially with CS Girls Club, Physics Club, and CS Club).

Employment Opportunities during Studies: The department hires graduate students as teaching assistants (GSIs), as graders, tutors, lab assistant, research assistants and workshop facilitators. Local industry, government and education systems employ some of our students as well.

### Summary and Reflection

In summary, offering a program with small core and interdisciplinary choices has been successful and students get involved in research projects of their interests. We revised schedule for the MS program, added stability to our course offerings and only small curricular changes to

help improve the scope of our graduate offerings are considered. Additionally, we have the capacity to grow our graduate program, but we need to plan carefully to make sure that we continue to recruit highly qualified applicants. Our survey data show that our BS and MS students easily find mathematics related position shortly after graduation.

## B. FACULTY

We have 9 permanent mathematics faculty and 24 lecturers (majority of them with Ph.D. degrees) and we offer about 20 TA- teaching assistant positions (GSIs) per semester (based on 4-5 WTUs). All permanent faculty teach selected courses in the graduate program depending on the course offerings. Lecturers with Ph.D. degrees also teach some courses in their fields of specializations. TAships usually are based on teaching developmental or introductory courses, or supplementary labs. Here is the list of the mathematics Faculty with degrees, research areas and contact information:

### Tenure line faculty

Sellenne Bañuelos, PhD USC, Mathematical Modeling, Linear Algebra  
Assistant Professor, Math Lab Coordinator  
Office: Bell Tower East 2811 Phone: (805) 437-3715 Email: "[sellenne.banuelos@csuci.edu](mailto:sellenne.banuelos@csuci.edu)"

Geoffrey Buhl, PhD UC Santa Cruz, Infinite-Dimensional Lie Algebras Vertex Operator Algebras  
Associate Professor, General Education Chair  
Office: Bell Tower East 2776 Phone: (805) 437-3122 Email: "[geoffrey.buhl@csuci.edu](mailto:geoffrey.buhl@csuci.edu)"  
URL: "[ciapps.csuci.edu/FacultyBiographies/geoffrey.buhl](http://ciapps.csuci.edu/FacultyBiographies/geoffrey.buhl)":<http://ciapps.csuci.edu/FacultyBiographies/geoffrey.buhl>

Geoff Dougherty, PhD U of , Imaging, Pattern Recognition, Physics  
Professor of Applied Physics and Medical Imaging  
Office: Bell Tower East 2848, Phone: (805) 437-8990 Email: "[geoff.dougherty@csuci.edu](mailto:geoff.dougherty@csuci.edu)"  
URL: "[faculty.csuci.edu/geoff.dougherty/](http://faculty.csuci.edu/geoff.dougherty/)":<http://faculty.csuci.edu/geoff.dougherty/>

Jesse Elliott, PhD UC Berkeley, Algebra, Integer-Valued Polynomials  
Professor, MS Director  
Office: Bell Tower East 2758, Phone: (805) 437-2768 Email: "[jesse.elliott@csuci.edu](mailto:jesse.elliott@csuci.edu)"  
URL: "[ciapps.csuci.edu/FacultyBiographies/jesse.elliott](http://ciapps.csuci.edu/FacultyBiographies/jesse.elliott)":<http://ciapps.csuci.edu/FacultyBiographies/jesse.elliott>

Cynthia Flores, PhD UCSB, Differential Equations  
Assistant Professor, Graduate Seminar Coordinator  
Office: Bell Tower East 2762, Phone: (805) 437-3716 Email: "[cynthia.flores@csuci.edu](mailto:cynthia.flores@csuci.edu)"  
URL: "[faculty.csuci.edu/cynthia.flores/](http://faculty.csuci.edu/cynthia.flores/)":<http://faculty.csuci.edu/cynthia.flores/>

Jorge Garcia, PhD U of Madison-Wisconsin  
Professor, Developmental Mathematics Coordinator  
Office: Bell Tower East 2754, Phone: (805) 437-2769 Email: "[jorge.garcia@csuci.edu](mailto:jorge.garcia@csuci.edu)"  
URL: "[faculty.csuci.edu/jorge.garcia/](http://faculty.csuci.edu/jorge.garcia/)":<http://faculty.csuci.edu/jorge.garcia/>

Ivona Grzegorzczuk, PhD UC Berkeley, Algebraic Geometry, Vector Bundles, Math Education  
Professor & Program Chair, Advisor  
Office: Bell Tower East 2756, Phone: (805) 437-8868 Email: "[ivona.grzegorzczuk@csuci.edu](mailto:ivona.grzegorzczuk@csuci.edu)"  
URL: "[ciapps.csuci.edu/FacultyBiographies/ivona.grzegorzczuk](https://ciapps.csuci.edu/FacultyBiographies/ivona.grzegorzczuk)":<https://ciapps.csuci.edu/FacultyBiographies/ivona.grzegorzczuk>

Alona Kryshchenko, PhD USC, Applied Mathematics, Statistics  
Assistant Professor

Office: Bell Tower East 2814 Email: "[alona.kryschchenko@csuci.edu](mailto:alona.kryschchenko@csuci.edu)"

Kathryn Leonard, PhD Brown U, Imaging, Shape and Pattern Recognition  
Associate Professor, Interdisciplinary Center Director  
Office: Bell Tower East 2782, Phone: (805) 437-3127 Email: "[kathryn.leonard@csuci.edu](mailto:kathryn.leonard@csuci.edu)"  
URL: "[faculty.csuci.edu/kathryn.leonard/](http://faculty.csuci.edu/kathryn.leonard/)"

Cynthia Wyels, PhD UCSB, Combinatorics  
Professor, LSAMP Coordinator  
Office: Bell Tower East 2780, Phone: (805) 437-3260 Email: "[cynthia.wyels@csuci.edu](mailto:cynthia.wyels@csuci.edu)"  
URL: [ciapps.csuci.edu/FacultyBiographies/cynthia.wyels](https://ciapps.csuci.edu/FacultyBiographies/cynthia.wyels)

## Full-time lecturers

Roger Roybal, PhD UCSB Functional Analysis, Moment Problems  
Lecturer, Math Club Advisor  
Office: Bell Tower East 1796, Phone: (805) 437-2741 Email: "[roger.roybal@csuci.edu](mailto:roger.roybal@csuci.edu)"  
URL: "[faculty.csuci.edu/roger.roybal/](http://faculty.csuci.edu/roger.roybal/)"

Brian Sittinger, PhD UCSB, Number Theory, Algebra  
Lecturer  
Office: Bell Tower East 2840, Phone: (805) 437-2751, Email: "[brian.sittinger@csuci.edu](mailto:brian.sittinger@csuci.edu)"  
URL: "[faculty.csuci.edu/brian.sittinger/](http://faculty.csuci.edu/brian.sittinger/)"

Matthew Wiers, MS U of Ohio, Statistics and Applications  
Lecturer, Business Statistics Coordinator  
Office: Bell Tower East 2840, Phone: (805) 437-2751 Email: "[matthew.wiers@csuci.edu](mailto:matthew.wiers@csuci.edu)"

## Part-time Lecturers

Aidas Banaitas, MS UCLA, Mathematics Education  
Lecturer, Elementary Mathematics Coordinator  
Office: Bell Tower East 1778, Phone: (805) 437-2741 Email: "[aidas.banaitis@csuci.edu](mailto:aidas.banaitis@csuci.edu)"

Dylan Attwell-Duval, PhD McGill U, Algebraic Geometry  
Bell Tower East 2762, Phone: (805) 437-8897 Email: "[dylan.attwell-duval@csuci.edu](mailto:dylan.attwell-duval@csuci.edu)"

Jennifer Brown, PhD U of Colorado, Boolean Algebra  
Lecturer  
Office: Bell Tower East 2762, Phone: (805) 437-8897 Email: "[jennifer.brown@csuci.edu](mailto:jennifer.brown@csuci.edu)"

William "Bruce" Chaffee, MS UCSD, BS Princeton, Math Education  
Bell Tower East 2762, Phone: (805) 437-8897 Email: "[william.chaffee@csuci.edu](mailto:william.chaffee@csuci.edu)"

Brooke Ernest, PhD UCSB, Math Education  
Lecturer  
Office: Bell Tower East 2215, Phone: (805) 437-2784 Email: "[jessica.ernest@csuci.edu](mailto:jessica.ernest@csuci.edu)":

Benjamin Greenspan, MS UCLA, Statistics  
Lecturer, Statistics Labs  
Office: Bell Tower East 1145, Phone: (805) 437-2784 Email: "[benjamin.greenspan@csuci.edu](mailto:benjamin.greenspan@csuci.edu)":

Phuoc Ho, PhD U of Kentucky, Differential Equations  
Lecturer  
Office: Bell Tower East 2844, Email: "[phuoc.ho@myci.csuci.edu](mailto:phuoc.ho@myci.csuci.edu)"

Delil Martinez, PhD U of Warrick, Statistics, Actuarial Sciences  
Lecturer  
Email: [delil.martinez@csuci.edu](mailto:delil.martinez@csuci.edu)

James McDonough, MS CSUCI, Algebra  
Lecturer  
Office: Bell Tower East 2816, Phone: (805)437-3751 Email: "[james.mcdonough@csuci.edu](mailto:james.mcdonough@csuci.edu)":

Jessica Nasr, MS CSUN, Mathematics Education  
Lecturer, Math 95 Coordinator  
Office: Bell Tower East 2816, Phone: (805) 437-2740 Email: "[jessica.nasr@csuci.edu](mailto:jessica.nasr@csuci.edu)"

Jarmila Nguyen, U of Palacky, Mathematics and Physics Education  
Lecturer  
Office: Bell Tower East 2816, Phone: (805)437-2740 Email: [jarmila.nguyen@csuci.edu](mailto:jarmila.nguyen@csuci.edu)

Nathaniel Reid, MS U of Colorado, Analysis  
Lecturer  
Office: Bell Tower East 2816, Phone: (805) 437-2740  
Email: "[nathanael.reid@csuci.edu](mailto:nathanael.reid@csuci.edu)"

Ronald Rieger, MS UCLA, Operation research, Algorithms  
Lecturer  
Office: Bell Tower East 2807, Email: "[Ronald.Rieger@csuci.edu](mailto:Ronald.Rieger@csuci.edu)"

Mamerta Santiago, MA CSUN , Mathematics Education  
Lecturer  
Office: Bell Tower East 2803, Phone: (805) 427-6058 Email: "[mamerta.santiago@csuci.edu](mailto:mamerta.santiago@csuci.edu)"

James Sayre, PhD UCLA, Statistics  
Statistics Visiting Professor  
Office: Bell Tower East, Phone: (805) 437-2785, Email: "[james.sayre@csuci.edu](mailto:james.sayre@csuci.edu)"

Dennis Slivinski , PhD Vanderbilt, Logic, Philosophy  
Lecturer  
Office: Sage Hall 2152, Phone: (805) 437-2785 Email: "[Dennis.Slivinski@csuci.edu](mailto:Dennis.Slivinski@csuci.edu)"

Christina Soderlund, PhD UCLA, Topology, Fixed Point Theory  
Lecturer  
Phone: (805) 437-3751, Email: "[christina.soderlund@csuci.edu](mailto:christina.soderlund@csuci.edu)"

Anna Tivy, MS CSUN, Math Education  
Lecturer, Early Childhood Math Education  
Office: Bell Tower East 2762, Phone: (805) 437-8897 Email: "[anna.tivy@csuci.edu](mailto:anna.tivy@csuci.edu)"

Philip West, MS CSUCI, Number Theory.  
Lecturer  
Office: Bell Tower East 2815, Phone: (805) 437-2784  
Email: "[phil.west711@myci.csuci.edu](mailto:phil.west711@myci.csuci.edu)"

Peter Yi, PhD UCLA, Topology, Fixed Point Theory  
Lecturer  
Office: Bell Tower East 2836, Phone: (805) 437-2741 Email: "[peter.yi@csuci.edu](mailto:peter.yi@csuci.edu)"

Aleksandra Stuczynska, MS U of Warsaw, Statistics



Statistics Lecturer

Office: Bell Tower East 2816, Phone: (805)437-3751 Email: "[aleksandra.stuczynska@csuci.edu](mailto:aleksandra.stuczynska@csuci.edu)"

Alfonso Zamora Saiz, PhD U Complutense de Madrid, Algebraic Geometry

Lecturer, Undergraduate Seminar Coordinator

Office: Bell Tower East 2844, Phone: (805) 437-3995 Email: "[alfonso.zamorasais@csuci.edu](mailto:alfonso.zamorasais@csuci.edu)"

There are broadly four distinguished areas of specialization within our department. They are pure mathematics (comprising several sub-disciplines), probability/statistics, applied mathematics and mathematics education. The current composition is 7 permanent faculty in pure mathematics (14 including all lecturers), 2 (5 including lecturers) in probability/statistics, 5 in applied mathematics (7 including lecturers) and one (4 including lecturers) interested in Mathematics Education. The program has no permanent faculty in mathematics education with 6 lecturers working in this area. Lack of mathematics educators causes problems with student-teacher supervision, grant applications, communications with the Commission on Teacher Credentialing and our School of Education.

Our faculty is also quite diverse: we have 60% females (60% including all lecturers), which is much above the national average in mathematics or sciences, 30% Hispanic tenure-track faculty (over 20% including all lecturers, which is much above the national average and reflects well our campus location). We have an international representation having faculty with roots in Poland, Ireland, Czech Republic, Spain, Lithuania, Russia, Korea, Iran, Philippines, Mexico and Guatemala. Additionally, some of our TAs come from China, Japan, Chile, Hungary, India, Kazakhstan. We also have various religions and orientations represented in the program. This diversity serves well our collaborations and our students.

### **Need for future faculty hires**

The Mathematics Program has acute needs in the advanced areas of probability, statistics, analysis, applied mathematics, and mathematics education: qualified lecturers in these areas are very hard to find. Our 8 tenure track (TT) faculty are very active, generating grants and working on various university projects (that includes for example Early Start Math Program, EOP Math, CCTC Teacher Preparation and internships, MS in Mathematics, STEM Center and Center for Interdisciplinary Studies). However, this further constrains the undergraduate and graduate programs in terms of TT faculty availability for program needs. Note that our graduate courses have typically 10-20 students in them, hence program is able to support itself.

A four-year plan for hiring in our department was requested by the provost in 2014 to improve the overall faculty to student ratio across the campus (that is currently the highest in the CSU system). The following table shows the projections for the mathematics department based on the program FTES (which are close to 10% of the campus FTES). The plan predicted that in years 2014-2017 campus will hire 9 mathematicians. However, the expectations were not met and we hired two faculty in 2014 and one in 2016. Therefore, with the campus growth the faculty indicators for the mathematics program are among the worst on the campus. The 'Needed Hires' column shows what is the numerical shortage of positions in the Mathematics program, 'Requested New Faculty' shows the actual number of positions requested for specific years. Last

column shows the actual number of hires from two approved searches. The current difference between the plan and the hires is 6 positions (taking into the account the fact that no new position was assigned to the mathematics program for 2017).

Hiring Plan Mathematics 2014-2018													
MATH	0.09 Fraction of Total CI FTES												
	FTES	FTES			TT		Number of						
	CI	A&S	MATH	WTUs	WTU	% TT	Hires						
AY2010				200	24	12	0						
AY2011				225	24	11	0						
AY2012	4500	3415	364	251	25	11	0						
AY2013	5000	3700	400	275	25	9	0	Requested		Program			
							Needed	New TT	New	Intergrated	Intergrated	Actually hired	
PLAN 2014-2018							Hires	WTU	Faculty	WTU	Faculty		
AY2014	5500	4125	444	305	45	25	7.8624	20.00	3	20.00	9	2	
AY2015	6000	4500	490	337	60	30	7.1243	14.0	2	34.00	11	0	
AY2016	6500	4875	548	377	132	35	6.3703	14.0	2	48.00	13	1	
AY2017	7000	5250	600	413	165	40	5.8182	14.0	2	62.00	15		
										Difference		6	

The table predicts that in years 2014-2017 campus will hire 9 mathematicians. However, the expectations were not met and we hired two faculties in 2014 and one in 2016. Therefore, with the campus growth the faculty indicators for the mathematics program are among the worst on the campus.

The majority of our lecturers hold Ph.D. degree and many of them teach graduate and upper division curriculum offerings and work on advanced student projects. However, Math Program employs 35-40 lecturers each semester (including about 20 TAs). Relative to our 9 TT faculty – several engaged in external-to-Mathematics responsibilities, this is arguably the most unbalanced situation among CI's Arts & Sciences programs.

Graduate student advising is done by Program Director, Mathematics Chair as well as student thesis advisors (chosen in the second or third semester). MS Mathematics Program has typically around 40 students and graduates around 15 students per year.

We hired a statistician who will start in Fall 2016 and we hope she will take over coordination of statistics courses and supervision of thesis in this areas part of her duties. We are in an acute need for Mathematics Educators, as with the growth of CI campus the number of students interested in teaching collage level mathematic increased, hence demand for math education courses and thesis in math education is growing.

## Faculty Workloads



All our faculty are very busy and they dedicate a lot of their time to scholarship and working with students. Each semester every faculty is accounted for 12 WTUs, where typically 6 WTUs come from teaching undergraduate or graduate courses, and the rest is associated with administrative functions, grants and buyouts. In the program base funding we have Developmental Mathematics Coordinator (3 WTUs per semester), Graduate Program Director (3 WTUs per semester), Lab and Lab assistants Supervisor (3 WTUs per semester), CCTC coordinator (1.5 Wtu per semester), and Chair (6 WTUs per semester). These release time is not satisfactory and we fund from the program funds 94 and 95 course coordinators (2 WTUs per semester), statistics, pre-calculus and calculus coordinators (1-2 WTUs per semester depending on the faculty other duties).

### **Faculty Scholarship and Professional Engagement, Teacher-Scholar Model**

Our department's definition involves accomplishments in scholarship (with and without student coauthors), successful grant applications, undergraduate research, professional development activities, student research projects, and presentations at professional conferences.

### **Faculty scholarship and professional development**

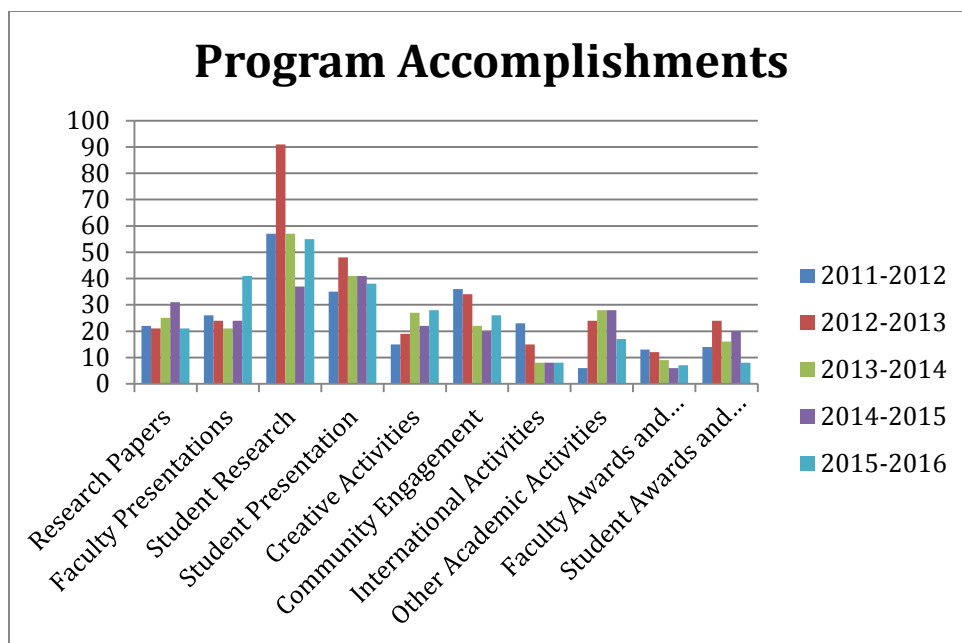
See also Appendix A

Our faculty members are very active in various areas of research and majority of them can involve undergraduate and graduate students. The entire TT faculty hired came to us with a track record of successful professional scholarship. They regularly present their research at professional conferences nationally and internationally, conduct research and consulting activities, publish in mathematical journals. The program has several long-term grants, some of them interdisciplinary and/or collaborative. Majority of our lecturers hold Ph.D. degrees and we strongly support their scholastic activities, research projects (especially involving students) and publishing efforts. Many of them are involved in research, applies for grants, present their results at conferences and some of their student projects were awarded recognitions (including for achieving interesting results with lower division students). All eligible math faculty apply for campus mini-grants and UNIV 492 Student Research courses.

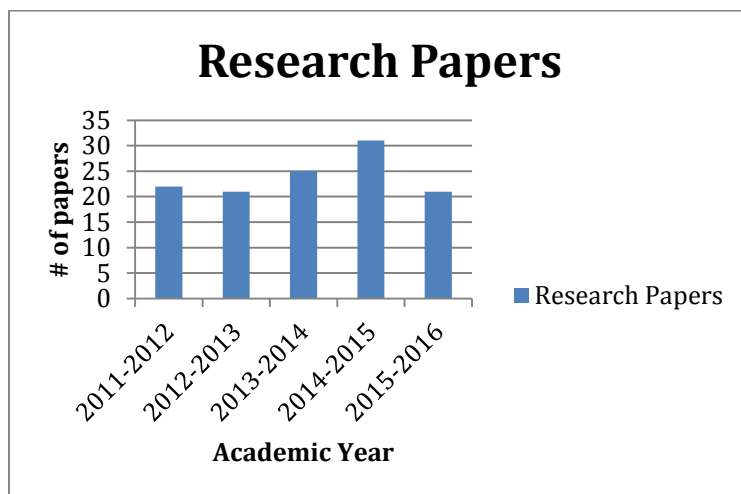
To meet demand for graduate research projects every semester we offer thesis or project units Math 597 and 59 supervised by various faculty.

Faculty can use grant funding for course buyouts as well. This way they can dedicate more of their time to their scholastic activities. For example, our faculty served as PIs or Co-PIs on the following grants: NSF Carrier, NSF Noyce, NSF REU, Keck grant, GATES, CURM, CI professional development Mini-grants, LSAMP, PUMP, HIS, ASSESSO and other campus-wide grants (such as HIS- STEM). Supported by the campus policy, we offer each faculty member \$1,200 per year in professional travel support. This can be used for conferences or collaborations. Program supports additional faculty activities through CERF funding and grants' overhead.

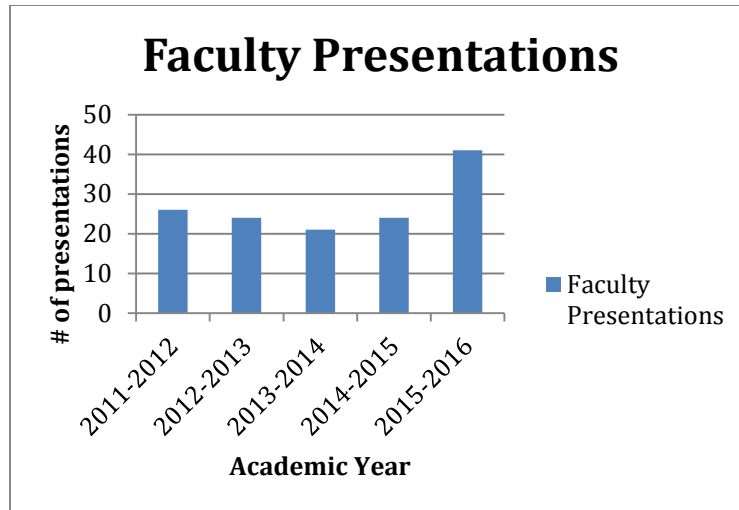
The following represents overall faculty accomplishments in various categories over the last five academic years. Many of the research activities involve students.



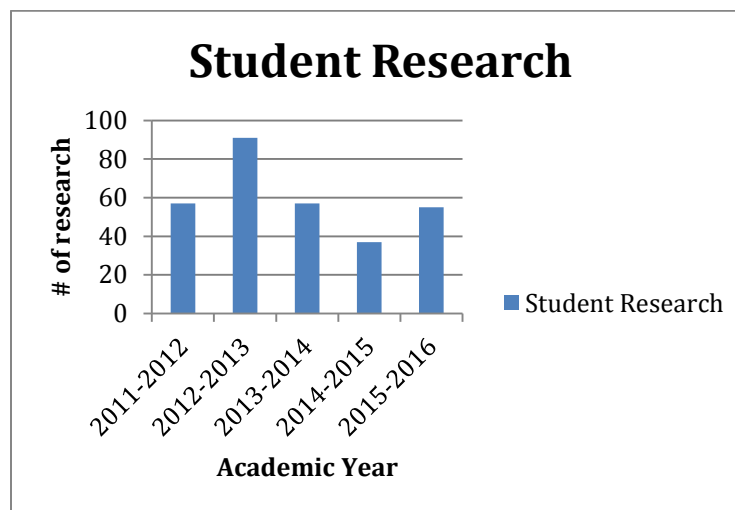
The next graph shows the number of research papers published by faculty in professional journals over the last five years. The areas of research include number theory, algebra, algebraic geometry, differential equations, mathematical modeling, and mathematics educations. Some of the publications involved student collaborations.



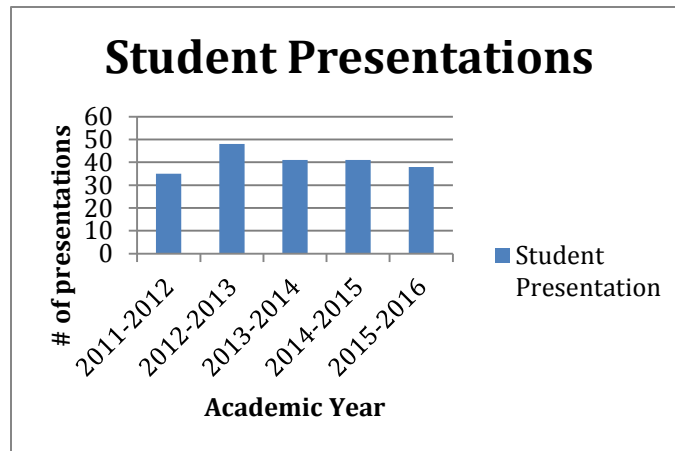
Additionally, our faculty actively disseminates their research results through seminar talks, presentations (national and international conferences) and other activities. The following graph presents number of professional presentations in the last five years.



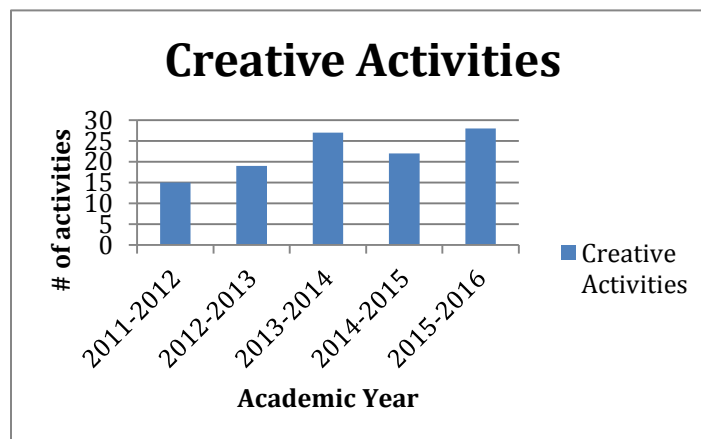
Following the CSUCI mission, the program is supporting hands-on experiential learning through various activities. The following chart presents numbers of faculty supervised undergraduate and graduate student research projects, many of which were accepted for presentation at various conferences (including SAGE Research Student Conference on CI campus, Mathematical Association of America Student Research Poster Competition, American Mathematical Society Student Research Competition at JMM, Posters at Capitol for young researchers, SACNAS for young Chicano/Hispanic and Native American scientists as well as other professional conferences (some of them at international venues, such as Italy, Mexico and Canada).



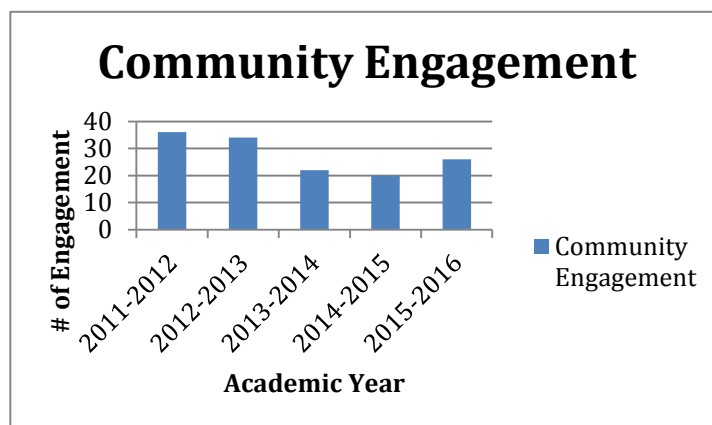
The following graph summarizes the number of total number of student presentations at local, national and international conferences. Typically, about 60% of them are given by our graduate students.



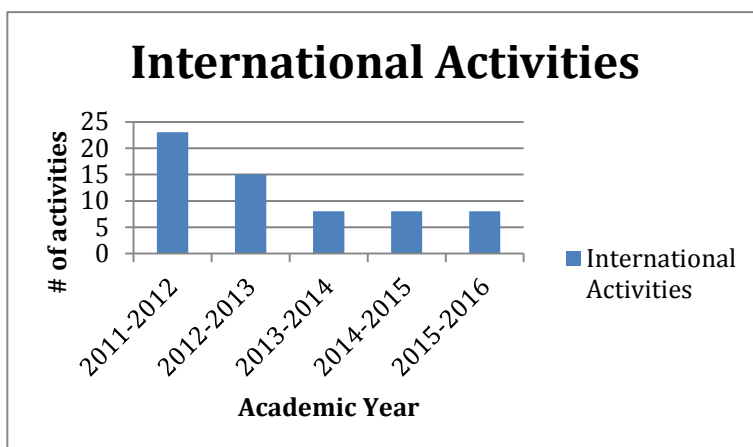
Every semester our faculty is involved in various other creative activities that include for example serving on professional boards, scholarship boards, on journal review boards, collaborations on industrial projects and leading math clubs or delivering workshops for teachers in local schools. For example, faculty collaborates with the University Preparatory School, Pleasant Valley and Thousand Oaks High Schools Districts and schools. One faculty worked with film studios on synchronous programming of 400 small drones for an artistic presentation. For example, three math faculty have participated in the university-wide Critical Friends Group since its inception in S'07, one participated in a university-wide Teaching Circle during S'07, majority regularly carry out Mini-Grant projects, and four are members of the regional NExT program. All attend workshops and sessions at conferences designed to further their teaching and/or their scholarship.



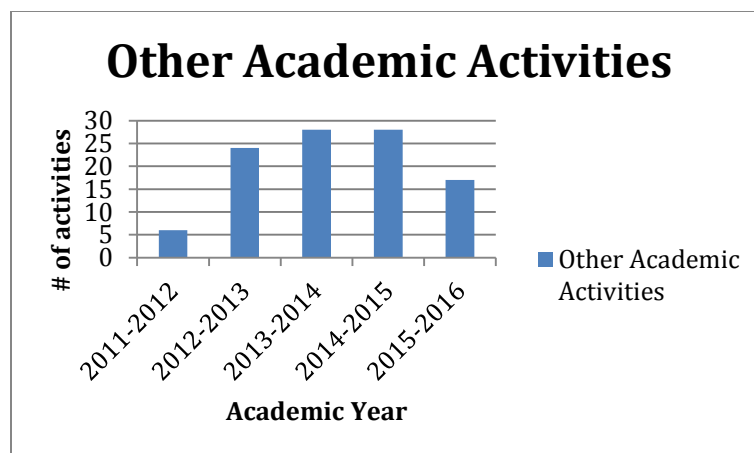
Our faculty is involved in local community Faculty community engagements (serving on academic panels, business boards, school boards, committees, giving popular lectures and concerts, collaborating with community colleges, publishers, government, etc.) For example our faculty served as reviewers for International Journal of Mathematics, Psychology of Mathematics Education, SIAM publications, and as the chief editor for Teaching Children Mathematics. They collaborated with Ventura, Oxnard, Moorpark, Santa Barbara and Pierce community colleges, with local navy, and Ventura County offices.



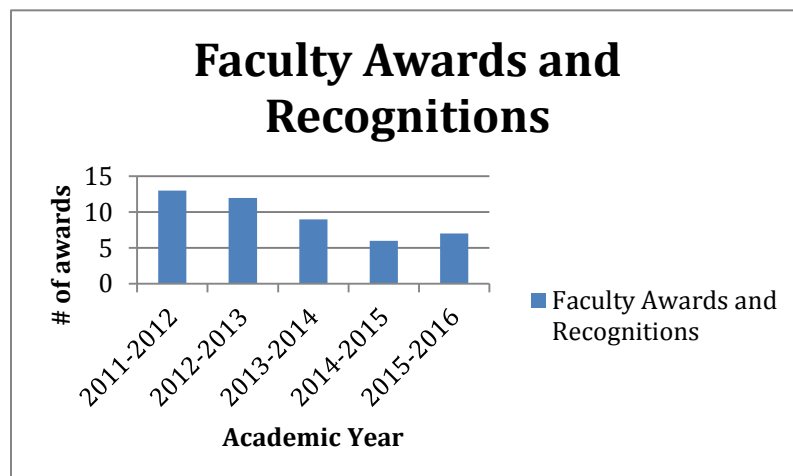
Several of our faculty has professional international ties that include collaborations, conference organizing, facilitating international student internships and conference participation, and similar international activities that are summarized below. For example, for the past four years 4 of our students visited and presented at the University Roma Tres in Italy, 3 math majors participated in a conference at University of Canberra, Australia. Note that number of student international activities has declined over the past several years due to the decreased connections with Mexico (travel there is restricted by the US State Department) as well as decline of the university funding for these activities. The chart below display reported faculty international activities.



Other academic activities displayed below include organizing conferences, serving as reviewers for journals, judging competitions, collaborations with teachers, math clubs at local schools, mathematical game design, etc. Faculty served on various scientific boards and positions of responsibility including: the board of California Section of Mathematical Association of America (1 Chair, 1 Secretary), 1 is on board of local IEEE, 2 are on board of B&PT, 1 serves as Senate vice-Chair.



Research, mentoring and teaching activities of our mathematics faculty attract awards and recognitions locally, nationally and internationally. For example in the past six years, our faculty has won two national MAA teaching awards, several SAGE mentoring awards, two Business and Technology Leadership Award recognition of papers, mentions on grants awarded, etc. The graph shows the numbers for the past five years. For student awards see chapter IVB.



## Hiring Process

CSUCI is using a cohort hiring process described here. Once awarded a position for the administration each program forms Disciplinary Search Committee, which screens candidates and interviews selected group on SYPE. Then only three candidates are chosen to visit campus. Campus visits are organized by administration and include candidates from all disciplines at the same time. All candidates and campus community meet at meals and everyone is invited to the job presentations. There is an interdisciplinary activity that puts 4-5 candidates from various disciplines together in a room with a task of designing an interdisciplinary, undergraduate course for students. The rest of the time is spend on interviews and with the program faculty. The system is very rigid and does not give programs any flexibility, often resulting with loosing excellent potential faculty.

## **Mentoring and Professional Development**

Our department does not have a formal mentoring program for new faculty, however all of them are included and advised from day one. The chair meets with new faculty to explain aspects of the job related to RPT and policies and procedures related to instruction. In the first semester of employment faculty develop their Personal Development Plans following the approved programs standards.

Department staff also serves as a resource. All new full-time faculty are given offices in the same building that houses all of the other full-time faculty, so new faculty are in close proximity to more seasoned department members.

Evaluation of faculty follows program standards based on the university-established procedures. This is in accordance with collective bargaining agreement found here:

[http://www.calstate.edu/LaborRel/Contracts\\_HTML/CFA\\_CONTRACT/2014-2017/](http://www.calstate.edu/LaborRel/Contracts_HTML/CFA_CONTRACT/2014-2017/).

## **Professional Development Plans (PDPs)**

All probationary faculty develop and annually update their professional plans as part of the RPT process following the Mathematics Program Standards, which expect excellent performance in teaching, research and certain level of service. Three research publications are expected for tenure. Faculty under review have their professional plans vetted by departmental RPT (sub)committees, the department chair, and the dean of the college. Recommendations are part of the review process. Associate professors update their plans and are reviewed after year 3 in rank and every 5 years after that. Full professors undergo post-tenure review every 5 years.

## **Recruiting and retaining diverse faculty**

Currently, our tenure-track consists of 3 men and 5 women. For perspective, the latest 2013 data compiled by the American Mathematical Society on new US citizen PhDs in Mathematics reports a ratio of 73% men, 27% women. This ratio has been stable over the last decade. In our last tenure-track search, the applicant pool consisted of 95 applicants. 17% of the applicants were women. From that pool, we selected 31 applicants to look at more carefully. Of those candidates, 40% were women. We further narrowed the pool to a list of 12 phone interview candidates. 33% of the phone interview candidates are women. We requested on-campus interviews with 3 candidates, 2 of which were women. In the end, we made an offer one woman, which she has accepted.

We do not have any special programs within the department to recruit or retain diverse faculty beyond those required or provided by the University. However, our previous search resulted with hiring two Hispanic female mathematicians. Our department has very good diversity record, see chapter III B.

## **Summary and Reflection**

In general, the needs for tenure track instructions in our program are not being met and majority of our courses are taught by lecturers and TAs. Note that campuses compatible in size to CSUCI typically employ around 20 tenure track mathematics. In addition, many of our faculty are getting significant grant/service/research buyouts of their teaching responsibilities. It is often

difficult to find qualified substitute lectures to replace this loss in teaching on an intermittent basis.

## **C. DEPARTMENT STAFF AND ADMINISTRATION**

### **Staff**

Currently, we have one full-time staff positions shared with the Computer Science, Physics and IT programs. Our Business Analyst Ms. Jacky Connell (permanent position) is in charge of all the office issues, including faculty support, scheduling, purchasing, travel approvals, etc. While some of the graduate student issues are handled by the graduate office, many of the faculty and students issues come to the math office, which is overwhelmed with demands. The collaboration with the graduate school office is efficient and positive.

### **Program organization and procedures**

Mathematics Program is organized by bylaws that describe program procedures and voting schemas, RTP process, committees, etc. The duties of the following officers are described in the document as well.

1. Chair of Mathematics and Applied Physics (elected)
2. Coordinator of Applied Physics Program
3. Director of Master of Science in Mathematics
4. Program Advisor
5. Developmental Math Coordinator
6. Lab Coordinator

Program faculty meets at least three times a semester (before each semester starts, at the end of each semester, and in sometimes the middle). However, faculty meets more often to address specific issues as needed (for example to work on program modifications, hiring committees, major grant discussions, etc.) Chair sends weekly/bi-weekly updates by email, and faculty has numerous discussions on-line. We also use Google docs for team document editing. For bylaws see Appendix F.

The Mathematics and Applied Physics Department holds departmental meetings to discuss major decisions. The Department will make every effort to achieve consensus. If consensus is impossible, a simple majority vote will institute Robert's Rules of Order. Announcement of an upcoming meeting involving an official vote is circulated in advance, and any faculty unable to attend may communicate his or her vote in advance of the meeting.

The MS in Mathematics Program Director uses the program meeting to discuss graduate issues or calls for separate meeting depending on the needs.

### **Summary and Reflection**

Our office is under-staffed. We recently reviewed our office staff structure and made a proposal for new positions. We hope that the restructure achieves our goals of providing more efficient functioning of the department office, as well as a reinforced team-spirit environment where administrative responsibilities are more equitably distributed.



## D. Facilities, Equipment, and Information Resources

Not much changed in the last six years. The undergraduate mathematics program was assigned six classrooms and we try to schedule our graduate courses there, as they have the necessary infrastructure. Mathematics has now permanent laptops labs and one PC lab, but we already have problems with course scheduling and testing in these spaces. We successfully collaborate with graduate school office on the scheduling.

### **Equipment and technology vs. program needs**

As the current economy demands highly skilled, technology based mathematical thinking our mathematics courses rely heavily on technology. To assure the quality of instructions we need more computer labs. Especially our numerous statistics and business sections need access to professional software to deal with data analysis and mathematical modeling. Since everything is relatively new, existing spaces are adequately provisioned right now, with several white boards in each room. Funds to maintain the spaces are handled at the university level.

### **Information and technology resources**

Mathematicians need access to scientific journals and software and at this time our library has provided sufficient support. We ask to keep the on-line access to scientific journals and sites intact in the future.

### **Summary and Reflection**

Currently, our program biggest issue is the shortage of computer labs. We are lacking in collaborative space for faculty/student research as well as extra office space to temporarily house visiting scholars.

## D. FUNDING AND EXPENDITURES

MS in Mathematics program is self-funded and we operate through CI Extended Education office and meet the required funding standards. Most of the faculty teaching graduate courses are assigned WTUs as buyouts to the undergraduate programs.

We have not been engaged in significant fundraising efforts as a department, although individual faculty groups have had meeting with our director of advancement with ideas for specific fundraising initiatives. Success in the area has been limited. We'd like to extend and enhance this program with additional private outside support.

### **Summary and Reflection**

The program generates enough funding to operate successfully. We would like to start some fundraising efforts in collaboration with the university foundation.

## IV. Achieving Educational Outcomes

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### A. STUDENT LEARNING ASSESSMENT

#### **Masters Program assessment**

Each student at our graduate mathematics under a supervision of an advisor has to write thesis, that include an original element (such as a proof, new example, data analysis, experiment calculations). Graduating students are required to make presentations to the entire department and answer questions. Presentations are scheduled at the end of each semester and are attended by faculty, students and their family and friends. In special sessions, thesis committees review students' papers, discuss them, ask for improvements and approve final versions. This process assures the quality of students work and evaluates students' performance on program learning outcomes. All TAs are evaluated **on their teaching performance** by faculty visiting their classrooms.

#### **Meaningful results from assessments**

All our graduate students are involved in research work with a faculty advisor. This seems to be an excellent way to get them into advanced mathematical thinking and prepare them for employment. All our students find mathematics related positions shortly after obtaining their MS degrees. Their research presentations are often accepted for conference presentations and/or publications, which testifies to the quality of our program.

Our TAs are attending one day training session on program standards and interactive learning at the beginning of each semester and are supervised by a faculty member throughout the semester. The assessment done on teaching skills of our TAs in this review period yields good results, supporting our philosophy of interactive, activity-based pedagogy. The Math 399 Labs often run by TAs turned out to be effective at every level, hence we plan to continue offering them.

#### **Recommended improvements**

We have to rely exclusively on IR for data and this often causes delays and not very useful data points. We need to build an internal ability to analyze departmental data to help with assessment. We have also begun to use Internet survey tools, which allowed us to solicit wider input. The biggest challenge is that high quality assessment activities require significant time and a consistency of those in the department conducting assessment.

#### **Summary and Reflection**

Our assessment shows that our teaching strategies are effective, the supplementary labs are helpful and the program meets and exceeds student outcomes. We are planning on conducting regular assessment activities to implement changes that will have positive impact on our program.

## **B. STUDENT SUCCESS: ENROLLMENT, RETENTION, AND GRADUATION**

The average percentage of enrolled URM students in graduate program in mathematics from 2010 to 2014 is 40% (which is also the percentage of URM students at CSUCI) with 5% of total being black, and the majority being Hispanic. The average percentage of enrolled Female students at CSUCI from 2010 to 2014 is 64% and 47% of math majors are female. Whereas the average percentage of enrolled Female students in graduate mathematics for the same period is 60%.

### **Summary and Reflection**

Our diversity rates among students are above campus and nation averages. We need more stability in our FTF cohorts so that scheduling the lower and upper-division curriculum becomes more predictable.

## **C. STUDENT ENGAGEMENT AND SATISFACTION**

The graduate program has a social our right before the graduate seminar that is generally well attended by faculty and students. Informal comments about the program are solicited there. We often involve the math club and its officers in the campus events for new students, open houses, and parent and family weekend. The department chair meets occasionally with groups of graduate students, the math club president to solicit feedback on issues of student interest. Recently, student feedback has helped with the design of the new graduate student area. Student input has also been instrumental in vetting proposals related to the possible restructuring of the capstone experiences. Sometimes we survey our students asking for their perspectives on the program.

### **Summary and Reflection**

Students seem to be satisfied with their experience at CSUCI. The previous program review supported this finding as well. Students are involved in departmental activities and are consulted when their input is needed. Based on student feedback, we have made the math minor more flexible and we have added or modified some of the options.

## **D. GRADUATE SUCCESS**

### **Employment and Further Education**

Typically our students find position in local community colleges, companies in their second year of the graduate program or decide to continue to further their mathematics studies in PhD programs. A Southern California median starting salary of \$75,000 for MS mathematician and shortage of employees with analytical skills makes it easy for our students to find positions within three month from graduation. About 40% of our students teach at community colleges or as lecturers at universities (for example California Lutheran University, Loyola Marymount University, Pepperdine University, CSUCI), 5% choose PhD programs, and 55 % take jobs (it is based on information for years 2010-14). Our MS students often take community college positions (40%), others find employment in government, software industry, finance, banking and

engineering.

### **Feedback from alumni.**

We organized Facebook and Linked-in groups for all our students and alumni. We update them on the program issues and invite them to talks and events. Occasionally, we invite alumni to campus to give presentations to our students in Math 599 Graduate Seminar to talk about their professional experiences and research. Lately, we have averaged around two visits to the class by alumni each year. As examples, one of our most recent alumni visits were from a graduate who is just graduated from a Ph.D. program in mathematics in differential geometry, and another alumni who works as a mathematician for the Navy base.

### **Summary and Reflection**

Our students stay in touch with the campus, but we need a better mechanism to contact and survey our alumni.

## **V. Creating an Organization Committed to Learning and Improvement.**

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### **A. FUTURE OF THE FIELD AND CAREER OPPORTUNITIES**

The Mathematics Department sees itself serving in a similar role within CSUCI for the next 15 years – as a core program for all science and engineering programs, supporting social sciences and statistics related majors and minors, as well as a vital player in research, interdisciplinary collaborations and students activities. However, it is expected that the number of mathematics students at all levels will increase in a manner commensurate with the projected growth in overall enrollment at CSUCI and the demand for STEM majors by industry. We expect some expansion of the Master's Program, as the demand for highly mathematically trained employees is predicted to increase. In the long term, the Bureau of Labor Statistics predicts that the entry-level degree for mathematics professionals will eventually be the Master's degree. The increasing prominence of data science, computers, applications to medicine and sciences, as well as financial applications may require us to rethink aspects of our applied mathematics concentration.

### **B. PROGRAM CAPACITY**

At this point in time, we are meeting the needs for resources to meet demand for our graduate program. At this time we need more faculty with PhDs in certain fields. Moreover, expected enrollment growth and increased demand for STEM professionals, including college faculty, will require additional resources. Right now, we can increase the size of our Master's degree program

with little additional cost. However, our ability to offer financial support in the form of TA appointments is becoming more limited. Increasing our Master's degree program will require targeted recruitment efforts to attract qualified applicants.

## **VI. Conclusions**

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### **A. SIGNIFICANT FINDINGS**

#### **Program Strengths**

1. We have a strong and comprehensive graduate curriculum in mathematics. Our core, flexible electives and thesis units provide opportunity for more focused training in pure and applied mathematics as well as mathematics education.
2. Our graduate program produces graduates who have done very well in getting teaching positions and industry positions.
3. We are currently able to offer most graduate students TA positions, which give them “learn-by doing”, experience in the classroom as well as needed financial support.
4. We have been able to hire and retain high-quality faculty who are talented teachers and successful researchers and professionals. All recent eligible hires have been successful at attaining tenure and promotion.
5. Students' activities and research are currently supported.
6. We have good collaborative working relationship with graduate school and other offices and constituencies on campus, which enables CSUCI to most effectively meet the needs of our students.

#### **Areas for Improvement**

1. Our ability to offer more resources for faculty to be successful in the area of scholarship needs to be augmented.
2. Our program needs to integrate some of the newer growth areas of applied mathematics such as data science and engineering applications.
3. We should focus additional attention to the graduate program in the near future so that we are prepared to meet the expected increase in demand for Master's degrees in mathematics.

### **B. LOOKING FORWARD: STRATEGIC THINKING ABOUT MS PROGRAM IN MATHEMATICS**

#### **Goals for the next six years**

1. Work with administration on improving the computer lab situation.
2. Provide faculty of all ranks more time to focus on professional and scholarly activities.
3. Focus on improving and expanding our graduate program.
4. Continue to work with other constituencies on campus in developing targeted programs to improve student success in mathematics using strategic data.

5. Find additional space to facilitate faculty/student collaboration and research activities.

**Issues to be addressed in the action plan**

1. Improve assessments of the program using embedded questions and student presentations and use it as a basis of a discussion of graduate curriculum.
2. Create a GRE workshop for students intending to go to PhD programs.
3. Develop a viable plan to provide faculty of all ranks more time to focus on professional and scholarly activities.

## **VII. Appendices**

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- A. Program by-laws
- B. Faculty CVs