Self-Study for Program Review

# Department of Mathematics & Statistics
# CSU, Long Beach
# F03

**Fall 2016**

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# *Section 1. Mission, Goals, and Environment*

***A. Briefly describe the program's mission and goals, and note any changes since the last program review. Identify areas of distinction or special competence.***

## Mission Statement

Mathematics and statistics are responses to the fundamental human endeavor to understand the world. Furthermore, modern technological society relies on developments in these disciplines. Consequently, the Department of Mathematics and Statistics at California State University, Long Beach (CSULB), as in most universities, plays a vital and indispensable role in the lives of the students and faculty. Nationally, it is predicted that 80% of new jobs will require at least some mathematics, science, and engineering, and 50% of the technical workforce will retire soon, making it more important than ever to inspire students in these fields (Wolfram Institute, 2012).

The Department's mission is two-fold: (1) to assist in integrating students into society by educating them in these fields, and (2) to build and foster an excellent faculty, which contributes to the development of mathematics, mathematics education, and statistics and serves as a resource of mathematical expertise for the people of this state. This Department aims to fulfill this mission by performing the following major functions:

1. Provide superior General Education instruction for every student on campus;

2. Deliver quality instruction via a large collection of service courses to a significant variety of departments and majors;

3. Sustain a considerable and qualified group of undergraduate majors in the areas of general mathematics, applied mathematics, mathematics education, and statistics;

4. Maintain vibrant graduate programs in the fields of general and applied mathematics, mathematics education, and applied statistics;

5. Enrich the intellectual life of the campus, the general mathematical, and statistical, and mathematics education communities (including local school districts) by providing expertise and time, and practicing scholarly activity.

In order to fulfill these functions the department should do the following (our goals):

① Constantly seek ways to improve its teaching methods thereby deepening student understanding, including the use of new technology as a teaching tool, and maintain a diverse and modern curriculum at all levels;

② Convey to all students a sense of the relevancy of mathematics and statistics, and of the importance of analytical and quantitative skills in contemporary society;

③ Provide placement and advising tools for students so as to promote a high level of success among the many students taking its courses;

④ Make available intervention tools to maintain a high level of success among all its students;

⑤ Schedule appropriate classes at the appropriate times to try to meet the diverse needs of the various communities of students that attend CSULB;

⑥ Maintain communication with the departments whose majors are served by its courses in order to ensure that the courses are providing the knowledge and skills needed, within the constraints of usefulness to all students in those courses and of the maintenance of mathematical integrity;

⑦ Foster an environment for its students in which the excitement and vivacity of mathematical and statistical activity is apparent, and in which students carry that enthusiasm back to their professional lives regardless of whether they are secondary school or community college teachers, applied mathematicians or statisticians in commerce and industry, or graduate students pursuing higher degrees;

⑧ Impart appropriate training in mathematics, mathematics education and statistics for graduate students who will use that training professionally as mathematicians, statisticians or as teachers of mathematics while also providing adequate preparation for the students who will pursue doctoral studies;

⑨ Encourage faculty to remain active in their discipline by reading and learning new mathematics or statistics, attending and participating in conferences related to these subjects, sharing the results of successful teaching approaches, writing for appropriate journals or textbooks, or developing original mathematics or statistics or their applications.

These goals have remained consistent since our last self-study in 2006, although we slightly modified some of the wording to better capture the complexity within our Department. We have worked diligently to balance our large commitment to freshmen and service courses, which requires much communication and collaboration with other departments and local community colleges and school districts, with our desire to foster relevant and timely experiences for our majors, minors, and graduate students. The Department prides itself in always making sure we offer enough sections and schedule courses at the appropriate times so as to allow all students flexibility, particularly given that many of our students work on or off campus.

### *B. Describe how the program's mission, goals, and environment reflect or align with the State of California economic, workforce and civic needs.*

The Department's mission, goals, and environment are well aligned to the current economic and workforce needs within the State of California. This alignment is evident in both our existing and developing programs. Three examples of this alignment are presented below:

1. National Teacher Shortage: "Across the country, districts are struggling with shortages of teachers, particularly in math, science and special education…." (NY Times, 8/9/2015). In California, the number of people entering teacher preparation programs dropped by more than 55% from 2008 to 2012; nationally, the drop was 30%. California prepares 10% of the nation's teachers. The CSU system continues to prepare the majority of teachers for California and CSULB prepares the second largest number of elementary and secondary teachers in the system. Our Department takes our vital role in the preparation of teachers quite seriously. We have an undergraduate major that is specifically designed to prepare secondary mathematics teachers, and these students represent over 40% of our majors (Table 2 in Section 2.B.). Additionally, we have math content courses that are specifically designed for prospective elementary teachers; these students, who are Liberal Studies majors, are required to take four of these courses (MTED 110, 205, 211/312, 402). Furthermore, we have capstone courses for both of these groups of prospective teachers that not only integrate and review critical areas of mathematics content, including the new Common Core State Standards for Mathematics (CCSS-M), but they also intentionally help students to bridge to practice; standard course outlines for these capstone courses are included in Appendix A.

   All of these courses highlight and attempt to model teaching practices that are aligned with the Standards for Mathematical Practice included in the CCSS-M (Appendix B). Additionally, we oversee and staff the secondary candidates' methods and seminar courses, which are part of the required courses for the credential program, as well as the student teaching experience (i.e., placement and supervision). We also contribute to the coursework and processes housed in the College of Education. For example, one of our mathematics education faculty members helped to develop a special section of the *Reading and Writing in Secondary Schools* course (EDSE 475B) to include a special focus on STEM (science, technology, engineering, and mathematics).

   To support teacher recruitment and help alleviate this growing demand, one of the mathematics education faculty members in our Department directs our *Mathematics Science and Teacher Initiative* (MSTI) funding provided by the Chancellor's Office (see Section 7). Recent initiatives include providing incentive stipends to prospective teachers, supporting outreach efforts, and aligning pathways with local school districts and community college. This same faculty member garnered additional external funding, resulting in a program that provided specially-designed content and methods courses for non-STEM or elementary teachers to add on a secondary

credential in math or science; this additional licensure then expanded job opportunities for successful participants and helped to meet the demand for math and science teachers in middle and high schools (Appendix C).

Our faculty devote much time and expertise to preparing our teachers, and their work that extends outside of the classroom has resulted in both CSU and other external funding (e.g., S.D. Bechtel, Jr. Foundation, NSF, California Department of Education) to help sustain and advance our work in mathematics education. More than half of our secondary credentialed teachers are not math majors–they satisfy subject matter competency via exams (CSET); thus, our math education faculty devote much time to garnering funds for and facilitating professional development with teachers in local school districts, as well as publishing materials that can support teachers' work, particularly for those who have weak mathematical understandings. Furthermore, this sub-discipline has been working on a possible new graduate program to support such teachers (see Section 2.D.).

2. Demand for Statisticians: According to the U.S. Bureau of Labor Statistics, employment of statisticians is projected to grow 34 percent from 2014 to 2024, much faster than the average for all occupations, which is only 7 percent. Growth is expected to result from more widespread use of statistical analysis to make informed business and healthcare decisions. Our Department has both an undergraduate major in statistics and a graduate program in applied statistics. The graduate program (M.S. in Applied Statistics) has the largest enrollment of all of our graduate programs. In addition to many traditional courses in statistics, the program has several very practical and hot courses such as STAT 574 (Data Mining), STAT 576 (Data Informatics), STAT 590 (Statistical Analysis of Medical Data), and a newly developed course, STAT 592 (Advanced Methods in Biostatistics), which focuses on the science that applies statistical theory to research in medicine and biological sciences. Occupations in the healthcare industry are expanding and there is high demand for statisticians who have medical/healthcare expertise (U.S. Bureau of Labor Statistics). Furthermore, students in this program have the opportunity to participate in a Statistical Consulting Group (SCG), which is housed in FO-5 and is directed by a member of our statistics faculty (Appendix D). The SCG, which was founded in 2006, provides statistical help to CSULB faculty, staff, and students, and external investigators unaffiliated with the university.

3. Demand for Computationally Trained Mathematicians: According to the U.S. Bureau of Labor Statistics, "Despite the strong competition for formal mathematician positions, many candidates with a background in advanced mathematical techniques and modeling will find good job opportunities in other, closely related fields. Those with a graduate degree in mathematics, very strong quantitative and data analysis skills, and a background in a related discipline, such as business, computer science, or statistics, should have the best job prospects. Computer programming skills also are important to many employers." The Big Data report published by the McKinsey Global Institute (June 2011) echoes this projection; as they state, "By 2018, the United States alone could face a shortage of 140,000 to 190,000 people with deep

analytical skills as well as 1.5 million managers and analysts with the know-how to use the analysis of big data to make effective decisions." To meet this demand we have newly developed a degree program, *B.S. in Computational Mathematics* (Appendix E), which is still in the review process. This degree is designed to prepare students for academic and industrial careers by providing rigorous training in both computational and theoretical uses of modern mathematics. It focuses on mathematical principles in computing with an emphasis on the design, analysis and implementation of algorithms and numerical methods. Extensive laboratory time and computer applications/programming are integrated throughout the curriculum.

Since our last self-study in 2006, to meet the increasing demand of computationally trained mathematicians, we also created five new courses in computational mathematics: MATH 520 (Finite Element Method), MATH 521 (Matrix Method in Data Analysis and Pattern Recognition), MATH 573 (Advanced Scientific Computing), MATH 578 (Numerical Linear Algebra), and MATH 579 (Advanced Mathematical Modeling), which all emphasize computer coding and/or real world applications.

***C. Briefly describe changes and trends in the discipline, and what the program is doing to respond. Describe, if relevant, how external changes (e.g., community needs for graduates in the discipline) have affected academic offerings.***

Mathematics Education: New Common Core State Standards (CCSS-M)

There have been exciting changes within mathematics education since the 2010 adoption by California of the national CCSS-M. These new required standards demand shifts in both what is taught and how the learning of students is both facilitated and assessed. Consequently, our Department has examined both program and course offerings within teacher preparation and development. We have been implementing this effort in phases since 2009:

- 2009-10: We integrated discussion of newly drafted standards, national reaction, and possible implications for mathematics education within our M.S. in Mathematics, Option in Mathematics Education for Secondary Teachers program courses (i.e., MTED 511, 512, 540, 550, 560, 580) and capstone course for undergraduates in our B.S. in Mathematics Education (MTED 411).

- 2011-2012: We integrated elaborated discussion of newly adopted standards, challenges of K-12 implementation, and developing implications for mathematics education, as well as assessments that facilitate examination and approaches to implementation, into our M.S. in Mathematics, Option in Mathematics Education for Secondary Teachers program courses (i.e., MTED 511, 512, 540, 550, 560, 580), capstone course for undergraduate B.S. in Mathematics Education (MTED 411), and capstone course for Liberal Studies majors (MTED 402). We also developed and offered a new, special topics course (MTED 590) focused on a new content area within the new standards, *Mathematical Modeling*, for our M.S.

in Mathematics, Option in Mathematics Education program, as well as examined and adopted a new standards-aligned text for the required MTED 4-course sequence for Liberal Studies majors (i.e., MTED 110, 205, 211/312, 402) and revised topics and sequence of topics within the first two of these courses; all of these courses have the same required text that covers all content areas, yet all of the courses supplement with additional resources (e.g., manipulatives) and technology, as appropriate.

- 2013-2014: We revised topics and sequence of topics to support a new standards-aligned text for the remaining two of the required MTED 4-courses sequence for Liberal Studies majors. We also examined, and in some cases revised, course content for the B.S. in Mathematics Education program to support the new standards–the matrix we submitted to the California Commission on Teacher Credentialing (CCTC) is provided in Appendix F; it is worth highlighting that CSULB's submission was the first to be approved by the CA Department of Education. This task required us to look across all courses taken as part of this degree, as well as illustrate alignment between each course and embedded assignments. As part of this process, we also integrated the *Standards for Mathematical Practices*, which are the pedagogical component to the new standards (Appendix B), into the syllabi for all required MATH and MTED courses for the B.S. in Mathematics Education program (per discussion within our Spring 2014 Department meeting, followed by a vote of the Department's Executive Committee).

- 2014-2016: We have and are continuing to work with local school districts, primarily Long Beach Unified (LBUSD), and local community colleges (e.g., Long Beach CC, Cerritos CC) to more carefully align pathways and curricula now that the new standards have been implemented and assessed in school districts (K-12). As noted earlier, we have also revised our Standard Course Outlines and Common Assessment for the capstone courses for both the Liberal Studies majors (MTED 402) and math education majors (MTED 411).

General Education & Service Courses

In an era when more and more emphasis is being placed on the ability to process, manipulate, and convey information—especially quantitative information—the Department recognizes the importance of instilling in all students the ability to think analytically when required and make intelligent decisions when confronted with quantitative information. We are not concerned here with those students for whom intense training in mathematics is required in their major, but with those students whose exposure to mathematics is generally limited to one or two lower-division courses.

Specifically, within our General Education courses, we have examined alternative course offerings/sequences, as well as software, to enhance the curricula. For example, following the Fall 2006 recommendations of the Mathematics Association of America's Curriculum Foundation (and, immediately following our last self-study), we redesigned our 3-unit College Algebra course (MATH 112), and replaced it with MATH 109

(Modeling with Algebra) for students whose mathematics course requirements are limited to General Education; the syllabus is provided in Appendix G. This course seeks to support students in understanding that algebra is a useful tool and can be used to model real-life phenomena. At the same time we redesigned our 4-unit MATH 117 (Precalculus Mathematics) and MATH 101 (Trigonometry) courses and replaced them with MATH 111 (Precalculus Trigonometry) and MATH 113 (Precalculus Algebra); select course materials are also provided in Appendix G. MATH 113 then became the prerequisite for MATH 119A (Survey of Calculus I), which is required for Biology majors. MATH 113 is also the prerequisite for courses in other majors such as Chemistry 111A and Physics 100A. Both MATH 111 and MATH 113 are now the prerequisites of MATH 122, the standard Calculus I course that is required of our majors and minors, as well as some other majors on campus (e.g., Chemistry, Physics, Electrical Engineering). This redesign made it possible to separate out trigonometry for certain majors that do not really need it (e.g., Biology), thereby reducing time to degree for multiple programs.

Additionally, we are working to coordinate all of our general education/service courses to better allow all students to have a similar learning experience. As we will also discuss in Section 3, almost all of these courses have a course coordinator and have numerous common elements (e.g., homework, syllabi). For example, everyone teaching MATH 109 is provided all of the needed course materials, including quizzes and exams, and the coordinator for the course facilitates group meetings/grading and observes each instructor to provide suggestions for improvement. Furthermore, since all of our TAs (graduate students in our masters programs) teach either general education and/or pre-baccalaureate classes, we have expanded our TA training. In addition to attending a full day of training during the week prior to classes beginning (Appendix H), all new TAs are also required to take a new 3-unit course that was designed this past summer by a math education faculty member; this course is being offered for the first time this fall (MTED 590: Introduction to College Mathematics Teaching, Appendix H). Taking this course will also benefit these graduate students in their future careers, as many of them pursue community college faculty positions and some become lecturers in our Department.

New Courses

In response to new trends within the disciplines/field, the expanding research expertise of faculty, and learning needs of our students, we have generated and offered 31 new courses within the Department, at both the undergraduate and graduate levels, since our last self-study in 2006. With the exception of the special topics courses, these courses are now part of our regular course offerings. These include:

- MATH 109: Modeling with Algebra (GE)
- MATH 303: Reflections in Space and Time (GE)
- MATH 309: Complexity and Emergence
- MATH 456: Dynamics and Geometry of Chaos
- MATH 473: Scientific Computing
- MATH 474: Mathematics of Financial Derivatives
- MATH 495/695: Topics in Modern Math (Knot Theory)
- MATH 495: Topics in Modern Math (Combinatorics and Graph Theory)–to be

offered Fall 2016
- MATH 520: Finite Element Method
- MATH 521: Matrix Method in Data Analysis and Pattern Recognition
- MATH 541: Elliptic Curves
- MATH 542: Algebraic Geometry
- MATH 573: Advanced Scientific Computing
- MATH 578: Numerical Linear Algebra
- MATH 579: Advanced Mathematical Modeling
- MATH 590: Selected Topics in Math (Codes, Lattices, and Groups)
- MATH 695: Topics in Modern Math (Algebraic Number Theory)
- MTED 500: Advanced Perspectives of Concepts Foundational to Algebra for Teachers [offered as service course for M.A. in Education, Focus in Math Education in CED]
- MTED 590: Special Topics in Math Education (Mathematical Modeling)
- MTED 590: Special Topics in Math Education (Leadership in Mathematics Education)
- MTED 590: Special Topics in Math Education (Introduction to College Mathematics Teaching)
- STAT 118: Introductory Business Statistics (GE)
- STAT 485: Actuarial Science: Financial Mathematics
- STAT 544: Statistical Consulting
- STAT 572: Computational Statistics
- STAT 576: Data Informatics
- STAT 590: Statistical Analysis of Medical Data
- STAT 592: Advanced Methods in Biostatistics–to be offered for the first time in AY 17-18
- MAPB 1: Elementary Algebra
- MAPB 7: Basic Intermediate Algebra
- MAPB 11: Enhanced Intermediate Algebra [MAPB 1 & 11 replaced MATH 10]

Although many courses have been developed due to workforce demands, course sequence needs, adjustments to program curricula, course renumbering, and changes in faculty, along with these additions we have also "retired" 11 courses. These include:

- MATH 10: Intermediate Algebra
- MATH 101: Trigonometry
- MATH 112: College Algebra
- MATH 114: Finite Mathematics
- MATH 117: Precalculus Mathematics
- MATH 120: Calculus for Technology
- MATH 222: Intermediate Calculus
- MATH 487/587: Statistical Simulation
- MATH 560B: Functional Analysis II
- MTED 403: Connections, Integration, and Reasoning in Mathematics for Teachers of Foundational Mathematics

- MTED 695: Seminar in Mathematics Education

### *D. Identify the program's priorities for the future. Indicate how the program arrived at these priorities.*

Our Department re-examines course offerings, program pathways, and student success within all of our programs on an on-going basis. Moving forward, the Department has **seven main priorities**:

(1) Continue to support faculty in demonstrating, and implementing with fidelity, the Standards for Mathematical Practices (Appendix B) within all required MATH and MTED courses for the B.S. in Mathematics Education program and make sure our undergraduate and graduate programs continue to reflect what is needed today in teacher preparation – This effort is in response to the movements within mathematics education (described previously in Section 1.B.), and will be led by our Mathematics Education Committee in collaboration with other faculty in the Department. For example, in Spring 2017 we will pilot a new course on mathematical modeling for our majors that will model effective pedagogy and will seek to bridge their university math coursework with essential concepts that students learn in K-12; this course will be co-taught by math education and applied mathematics faculty.

Additionally, faculty will continue to develop ways and seek funding to help expand prospective and practicing teachers' content and pedagogical content understandings. For example, the Mathematics Education Committee has been developing a possible new M.A. program for the Department, *Master of Arts in Middle Years Mathematics Education* (Appendix I), which emphasizes math content, but also includes coursework in effective pedagogy, teacher leadership, and current mathematics education research. The target audience consists of grade six through ten teachers, who are either already teaching mathematics at this level or desiring to earn added certification for this level. Nationwide there are pathways to teaching secondary mathematics, which do not require extensive pre-service coursework in mathematics. The Center for the Future of Teaching and Learning in Santa Cruz (CFTL, 2005) reported that, in California, among middle school teachers of Algebra I (presumably the most qualified among the middle school mathematics faculty) about 40% do not have a subject matter credential in mathematics and may lack the background and preparation necessary to effectively teach the subject. Although this program is desperately needed, our Department will need to evaluate our ability to begin such a program, given that the number of our math education faculty has decreased and it is difficult to hire in this area.

(2) Continue to increase the percentage of students completing remediation before they begin coursework and the success of those placed into remediation upon beginning coursework at CSULB – In the California State University (CSU) System in 2008, approximately 56% of all entering freshmen required remediation in mathematics and/or English (Johnson, 2010); in 2011, over 30% of first-time freshmen needed to

do so specifically in mathematics (CSU, 2012). In a study done in Nevada in 2006/7, more than one-third (37.6%) of students entering an institution of higher education (2- and 4-year) required remediation in mathematics (Fong, Huang, & Goel, 2008). Furthermore, 80% of 1st-year college students taking a developmental course at public, four-year institutions in 2000 needed to do so in mathematics (Duranczyk & Higbee, 2006). As we know, remediation increases the cost and time to degree for students, and can even cause students to develop negative attitudes toward mathematics and/or prevent them from pursuing majors requiring mathematics beyond general education. Furthermore, students who need remediation are less likely to complete a degree (Baily, 2009). This is clearly a concern for not just for CSULB, or even California, but the entire nation.

The positive news is that from 2007 to 2013, the percentage of our incoming freshmen at CSULB needing remediation decreased from 33.6% to 16.6% (CSULB Student Affairs Assessment website). Data for our pre-baccalaureate courses (i.e., MAPB 1, 7, and 11) since the time of our last self-study are presented in Appendix J. The average passing rates for MAPB 1, 7, and 11 over the past two years are approximately 62.5%, 67,8%, and 56.2%, respectively. As also discussed in Appendix J, passing rates expectedly decreased beginning 2012 when the CSU-mandated Early Start program began. This summer serves as a third semester for many pre-baccalaureate math students. Approximately 30-40% of Early Start math students advance one math level during the summer, and many of these students therefore complete remediation before enrolling in CSULB courses, thereby reducing cost and their time to degree. Thus, the students with the weakest skills are still taking MAPB math courses during the academic year, which in turn partially explains the low passing rates in our pre-baccalaureate courses in recent years.

Following remediation, students only pursing a single general education mathematics course do very well; for example, 85% of the students who passed MAPB 7 in Spring 2014 and then took either MATH 103, MATH 109, or STAT 108 (typical courses for students following MAPB 7) in Fall 2014 passed (Appendix J), suggesting that the MAPB 7 curriculum is effectively preparing students for their general education math requirement.

It is worth highlighting that we conducted a study on our remedial mathematics program in 2007; two publications resulting from this study (co-authored by two math education faculty and two graduate students in the math education-focused masters program) that include findings are provided in Appendix K. Since 2007, there have been numerous changes to our pre-baccalaureate program; a brief overview of these changes with resulting program benefits is included in Appendix J. For example, we increased the number of units of Elementary Algebra from 3 to 4, which has resulted in higher passing rates.

Although our efforts over the past 10 years to support students needing remediation are noteworthy, in terms of preventing and expediting time to complete it, as well as increasing the percentage of those successfully completing remediation, we desire

to seek additional ways to support student success. We intend to focus on analysis of placement criteria and curricula, on-going instructor training, and further development of pathways with LBUSD and LBCC. To support this work one of our math education faculty has worked collaboratively with the Long Beach Promise since 2007, and currently she and one of our full-time lecturers (who coordinates the developmental program) are part of the Governor's Innovation Award Pathways Groups (Appendix L).

Moving forward we intend to continue to explore new approaches to preventing remediation. For example, one such approach has been to offer a specially designed section of a general education course (MATH 103) that is aligned with the new CCSS-M; it has been offered the past two summers for LBUSD high school students who have successfully completed their second year algebra course (Appendix L). This course was co-developed by two faculty members (one math education and one applied math) in our Department and was taught by the applied mathematician. Passing this math course has provided these high school students not only the experience of taking a CSULB math course on our campus, but it has also made them transfer-ready in mathematics.

Additionally, one of our faculty members is working collaboratively with mathematics and education faculty at CSU San Bernadino, multiple other universities, and representatives from multiple local education agencies on a newly awarded externally-funded grant project for which they will create a new mathematics course that will be offered in the high schools. The goal for this course is to help bridge students, and thus ideally preventing them from needing remediation. The content of this course will focus on engaging students in authentic mathematical activity in order to strengthen and extend their mathematical knowledge.

(3) Continue to implement ALEKS for calculus placement and explore other ways to use ALEKS as a support for our programs – After a year of research on math placement products by a group of our faculty, we began to use ALEKS PPL to place students into MATH 119A (Calculus for Biology) and MATH 122 (Calculus I) in Summer 2014 for the Fall 2014 incoming freshmen cohort. ALEKS PPL is proving to be successful at helping us determine which students are ready for these two courses. For example, for the Fall 2015 incoming freshmen cohort, we started with 318 first semester freshmen enrolled in MATH 122. Of those, 263 were qualified by virtue of an ALEKS score between 80 and 99; the remaining 55 qualified by a variety of other means (e.g., SAT scores, ACT scores, AP scores). The 263 first semester freshmen in MATH 122 based on ALEKS scores had a C or better pass rate average of 77.0% and an A rate average of 27.8%, which implies that 202 of these 263 students have shortened their years to degree by at least one semester. The 55 other freshmen in MATH 122 had a pass rate of 70.9% and an A rate of 16.4%, for an overall freshman pass rate of 75.8% and an A rate of 26.1%. By contrast, the 131 non-freshmen (mostly continuing students, who were in MATH 122 by a means other than ALEKS placement) in the class had a pass rate of 64.9% and an A rate of 11.5%. While ALEKS has proven to help us more accurately determine who is ready for calculus,

this has meant that some students who would have traditionally been placed into MATH 111 or 113 based on previous courses taken are now being directly placed into MATH 119A or MATH 122, thus possibly lowering passing rates in MATH 111 & 113 as the more skill proficient students are no longer in the classes.

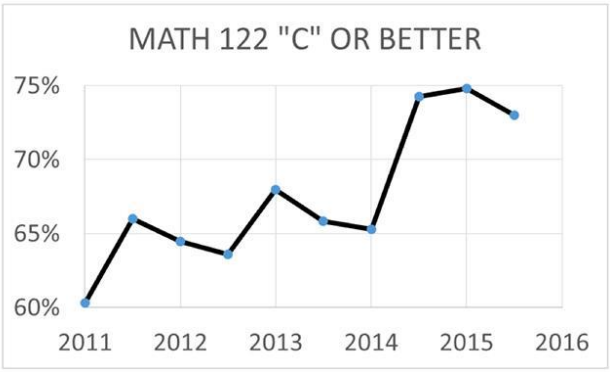
ALEKS PPL consists of five ALEKS Assessments and an ALEKS Prep and Learning module. After a student finishes the initial ALEKS Assessment, ALEKS PPL will automatically configure a short course based on the student's performance on the initial assessment using the built-in ALEKS Prep and Learning module. The learning module will guide the student to go through the short course by working on the student's weak areas to refresh and improve the student's math skills. Upon completion of the learning module, the student takes the second ALEKS Assessment and then the student works on the learning module, which has been reconfigured based on the second ALEKS Assessment. The process repeats until the student reaches the 5$^{th}$ ALEKS assessment. By the common setting in ALEKS PPL, it usually takes more than ten days to finish the whole Calculus Placement Test. A wonderful by-product of the placement test is that it also refreshes and improves the student's math skills before they come to campus, regardless of which course the student will be eventually placed into.

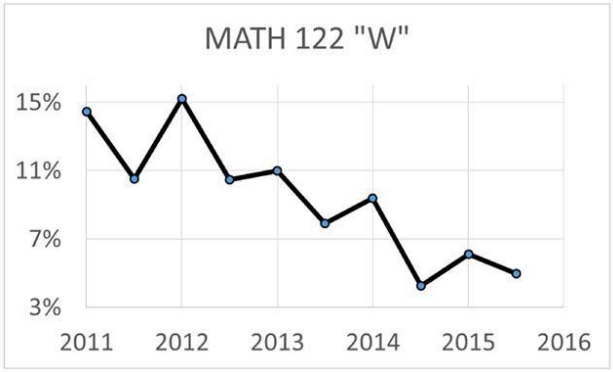
(4) Continue to increase and maintain passing rates of students within our calculus sequence – We have been working on new initiatives the past few years to support student success for this critical sequence (MATH 122 & 123) within the Department, which is required for many majors on campus. Our impetus was lower than ideal passing rates in some sections; data showing our progress with passing rates are included in Appendix M. Our average passing rate across all sections of MATH 122 has increased from approximately 66% during the two-year period of AY 2012-14 to 75% in the following two-year period of AY 2014-16 (after our redesign), and the number of sections with a passing rate of below 60% decreased from 12 to 3. In MATH 123, our average passing rate across all sections has increased from approximately 65% during the two-year period of AY 2012-14 to 72% in the following two-year period of AY 2014-16 (after our redesign), and the number of sections with a passing rate of below 60% decreased from 13 to 6. Furthermore, with a few "outlier" sections removed, our passing rates are within expectation.

We implemented four primary changes as part of this Chancellor's Office-funded redesign project: (1) we attempted to reduce the turnover of faculty teaching MATH 122 and 123 to build a collaborative cohort and first assign those faculty who had taught the courses before, (2) our redesign team coordinated all participating sections and developed a common syllabus, common pacing, common online WebAssign homework, common "Show Your Work" homework, and common benchmark exams that support students in preparing for the three midterms, (3) we identified at-risk students based on a number of factors starting at the beginning of the semester (e.g., grades in immediately previous math courses like MATH 111/113, score on placement exam, ongoing scores on exams) and then as a semester progressed we monitored students who had a current grade C- or below in

the classes, and (4) our redesign team created Supplemental Activity (SA) sessions (group tutoring with a graduate assistant) for these at-risk students. The average size of the SA sessions is about ten students. Many students wrote on their student evaluation forms that SA sessions contributed mostly to their success in the classes.

Although not all faculty teaching MATH 122 during this time participated in all aspects of the redesign, this standardization has been a boon for many of our newer instructors, giving them a ready scaffold around which to organize their instruction. A few years ago, the College of Engineering introduced the "timely progress rule," with increasingly vigorous enforcement, that freshmen engineering majors must complete MATH 122 within their first year to remain in the program. As the graphs below illustrate, our calculus redesign, coupled with the COE endeavor, greatly contribute to reducing the "W" rate and increasing the "C" or better rate in Math 122, thereby decreasing time to degree.




For any changes made in education, one common question is whether the changes lower the quality of student learning. We looked at the data for the Fall 2015 incoming freshmen cohort. Two interesting measures are overall GPA and the average *change* in grade experienced by students moving from MATH 122 to MATH 123; this latter number is always negative and typically quite large (close to 1 grade point historically). Table 0 shows the grade-point average and average change in grade from MATH 122 to MATH 123 that students experienced. It illustrates that students in participating redesigned MATH 122/123 sections did better as a whole than students in non-participating MATH 122/123 sections; and in fact, those students for whom neither class had a participating section fared the worst on both measures.

**Table 0**: MATH 123 GPA with the Average Change in Grade from MATH 122 to 123

| | Math 123 participating | Math 123 non-participating |
|---|---|---|
| Math 122 participating | 2.41 (-0.54) | 2.28 (-0.57) |
| Math 122 non-participating | 2.34 (-0.44) | 2.18 (-0.58) |

In the Department, we have a lot of excellent instructors, especially in the ranks of tenured and tenure-track faculty. At the onset of our Calculus Redesign, we decided to not mess up their great teaching and instead to gradually involve them in the redesign version of Calculus when they felt comfortable with some or all components of the redesign. All instructors are encouraged to participate in the redesigned version of the Calculus, but we allow some instructors to opt not to fully utilize the coordinated course materials. Moving forward, our goal is to maintain and perhaps expand this progress for MATH 122 and now more closely examine how to yet further improve our students' success in MATH 123. We intend to continue to analyze data on an on-going basis.

It is worth noting that passing rates for fall sections for both MATH 122 and MATH 123 are historically always a bit lower than in spring. One of the major contributing factors is that it's very hard to predict how many sections of classes we need in fall semester and we often have to hire lecturers last minute; these late hires are not always experienced with teaching our version of the calculus sequence, and are often not our strongest lecturers due to the fact that most of the strong ones are already committed for fall teaching by spring prior.

(5) Carefully examine and make improvements to our trigonometry course, MATH 111 and continue our work in MATH 113 – As discussed in Section 1.C., since the time of our last self-study we redesigned our 4-unit MATH 117 (Precalculus Mathematics) and MATH 101 (Trigonometry) courses and replaced them with MATH 111 (Precalculus Trigonometry) and MATH 113 (Precalculus Algebra). Passing rate data and materials for MATH 111 and 113 are provided in Appendices N and G, respectively. Although lower than ideal, they are not far below many of our sister CSU institutions (see CSU Dashboard data in Appendix N). As we noted earlier in this self-study, using ALEKS for placement into calculus has meant that some students who would have traditionally been placed into MATH 111 or 113 based on previous courses taken are now being directly placed into MATH 119A or MATH 122, thus possibly lowering passing rates in MATH 111 & 113 as the more skill proficient students are no longer in the classes.

With external funding from the Chancellor's Office, we have been redesigning MATH 113 (algebra). It has moved to a large lecture format. All sections have a common text, course outline, common online WebAssign homework, and common lecture notes; in 2012, we added a new course coordinator, who facilitated adding common test dates and common Web Assign homework. All of this restructure has supported a more common experience for students, as well as an opportunity for instructors to share tasks/assessment items. ALEKS now supports individualized intermediate algebra remediation very early on in the course (starting in the first week)–instructors then receive feedback early relative to students' content gaps.

We chose to focus on MATH 113 first, as based on Departmental data, we determined that the difficulty gap between MATH 111 and MATH 122 (typical next course) is small, with grades declining by less than half a grade point (Appendix O).

And, these grades typically go down just because the students earning DFW grades in MATH 111 are removed from the 122 pool. However, the difficulty gap between 113 and 122 is quite large, averaging over a full grade point.

The passing rates for MATH 111 course is lower than ideal and we hope to make improvements by adapting the scheme established by our Calculus I & II redesign. We have started to introduce a common syllabus, common teaching pace, common online WebAssign homework, common benchmark tests, and Supplementary Activity sessions in MATH 111 the past two semesters.

(6) Continue to consult with other departments to provide best service courses to their majors – As a service department providing a wide range of GE and service courses for majors across all the spectrum of the university, we strive to meet the needs of every department on campus and provide the best service courses to their majors. For example, after consulting with the College of Business Administration and with more than one year of collaborative effort of a group of faculty members from CBA and our Department, we created the course STAT 118 Introductory Business Statistics, which was specially tailored for students in CBA. The course was first offered in fall 2014. Recently, to meet the need of the newly created Biomedical Engineering B.S. degree program in COE, we created the new course MATH 249 (Linear Algebra and Differential Equations). The course is currently in the process of review/approval by the University. Last year, the Department of Biological Sciences dropped the requirement of MATH 119B Survey of Calculus II for their B.S. degree programs; however, this year the Department of Chemistry and Biochemistry decided to allow their students in a newly created major to take either MATH 119B or MATH 123. This creates the need to reexamine the content of MATH 119B to better serve this new student population. Most of our service courses were created a long time ago (e.g., MATH 247 Linear Algebra and MATH 370A Applied Mathematics). It is time to rethink their contents and redesign the courses to better serve our students.

(7) Support the college in efforts to create partnerships and learning communities for identified lower division courses in which student success is critical to pursuing STEM-related fields – Over the past two years CNSM has been collaborating both across our college and with COE to create learning communities for identified lower division STEM courses that are critical to both persistence and success of our students (Appendix P). Early results on the first pilots of these communities (e.g., CHEM 90/MATH 113/NSCI 190A and CHEM 90/MATH 119A/NSCI 190A) suggest that the collaboration across instruction, specialized supplementary instruction, and team collaboration that is built on early success and a growth mindset can support students in passing freshman year courses critical to them succeeding in STEM disciplines….and, with enhanced confidence and interest! This effort has been particularly effective for our underrepresented and first generation students. Moving forward, we will work to continue to support the College with this endeavor.

***E. If the program is offered in a self-support mode, describe how it is included in the mission, goals, and priorities of the department (e.g., new student groups regionally, nationally or internationally; new delivery modes, etc.)***

N/A. Our Department does not offer any self-support programs.

## *SECTION 2. EDUCATIONAL PROGRAMS*

***A. Briefly describe the existing program, any new programs (degrees, majors, minors, options, certificates) developed since the last program review, and any programs that have been discontinued. Include self-support programs. Include in this section any discussion related to regional and state workforce trends, career outcomes, economic and civic needs. Address workforce demand projections and other relevant data as applicable.***

For the students with majors and minors in the Department, the programs that the Department supports are as follows:

Four options for the Bachelor of Science in Mathematics degree:

- General
- Applied Mathematics–2 sub-options (*Area of Application in Science and Engineering, Area of Application in Economic and Management)*
- Mathematics Education
- Statistics

Three possibilities for minors:

- Minor in Mathematics
- Minor in Applied Mathematics
- Minor in Statistics

The single subject credential:

- Single Subject Credential in Mathematics

Four Master of Science degree programs:

- Master of Science in Mathematics
- Master of Science in Mathematics, Option in Applied Mathematics
- Master of Science in Mathematics, Option in Mathematics Education for Secondary School Teachers
- Master of Science in Applied Statistics

The curriculum for each of the programs is regularly examined versus the curriculum in other similar universities. We have not discontinued any programs since the time of our last self-study (2006), however we did move our statistics program from the M.S. in Mathematics, Option in Applied Mathematics degree to being it's own degree, M.S. in Applied Statistics in 2010 (Appendix Q). This degree title more completely captures the

nature of the coursework and better situates our graduates for the industry marketplace, as more statistics courses are taken (moving it away from an Option allowed the program to no longer have a minimum number of units in pure/applied mathematics). During this change to a separate graduate degree program, we developed new statistics courses (e.g., STAT 544, 576), which both enhanced the program and made it more responsive to current workforce demand. The graduate curriculum of our four programs is designed to prepare students for careers as professional mathematicians, statisticians, or teachers of mathematics at both the K-12 and college levels; additionally, they prepare them for further graduate study at the doctoral level.

Within our MS in Mathematics program, which focuses on pure mathematics, we made changes to the required course sequence. The core cores (e.g., MATH 540) used to be numbered as "A" and "B" to indicate sequence and level of complexity. However, all of these courses have been renumbered and labeled as either "Topics" or "Elements" courses; this change has allowed the more advanced, second semester course to vary in specific content based on the research expertise of the instructor and market demand. For example, MATH 540A and MATH 540B are now MATH 540 (*Elements of Abstract Algebra*) and MATH 545 (*Topics in Abstract Algebra*). The second semester course, MATH 545, which has 540 as a pre-requisite, varies in terms of advanced algebra content based on year offered; in Spring 2016, for example, the content of MATH 545 was commutative algebra, and in Spring 2017 it will be polynomial rings, fields, and Galois theory. Additionally, we added a one-course geometry requirement that can be satisfied by a number of upper division undergraduate and graduate courses in the Department (subject to Graduate Advisor approval).

As noted in Section 1.B., we are working to complete development of a new bachelor's program in Computational Mathematics (Appendix E); the proposal is still under revision, based on feedback at the university. We are hoping to have this degree approved during the AY 2017-18.

***B. Using the university and department data reports accessible on the Institutional Research and Assessment web site, with optional supplemental data from the program, department, or college, discuss student demand for the program's offerings and any problematic areas, such as over- or under-enrollment, retention, graduation, time to degree, impaction, or low completion rate courses; see instructions for Table 1 for Department Overview in Appendix A and Tables 2-6 for undergraduate degree programs in Appendix B and Table 7 for General Education in Appendix C and Tables 8-11 for Graduate/Post-baccalaureate in Appendix D and Table 12 Tenured & Tenure-Track Faculty in Appendix E.***

The Department of Mathematics and Statistics is a quite large department, which amounts for nearly half (42.5% in Fall 2012) of the total FTES for the College of Natural Sciences and Mathematics (Table 1); our Department is the largest on campus in FTEF. Our enrollments have remained fairly consistent since 2010, however how the enrollments between 2010 and 2014 are distributed between undergraduate non-major

and grad/postbac somewhat changed–graduate modestly decreased, and undergraduate increased (although both have increased since 2014).

**Table 1**: Department of Mathematics and Statistics FTES by Student Enrollment

| Fall Term | Department FTES | Undergraduate Major (% FTES) | Undergraduate Non-major (% FTES) | Grad/PostBAC (% FTES) |
|---|---|---|---|---|
| 2014 | 1,857.53 | 6.41 | 87.87 | 5.72 |
| 2013 | 1,870.93 | 6.34 | 87.70 | 5.96 |
| 2012 | 1,942.00 | 6.68 | 86.98 | 6.34 |
| 2011 | 1,864.83 | 6.84 | 86.18 | 6.98 |
| 2010 | 1,669.85 | 7.06 | 85.25 | 7.69 |

## Undergraduate Programs

As can be seen in Table 2, the total headcount for our four B.S. degree options has fluctuated each year since 2010; while the number of majors within the Applied and Statistics options has remained approximately the same, the number of majors has modestly decreased in both the General and Mathematics Education options. The primary reason for this trend is likely the job market (e.g., strong industry job market; decrease in number of teaching positions 5-6 years ago, although this trend has now reversed, so enrollments are beginning to again rise).

It is worth noting that the Math Ed Option majors consistently represent one-third to one-half (37–47%) of the overall number of B.S. majors. Students taking this option usually enter the post-baccalaureate Single Subject Credential Program, for which the Department offers on-going advising, student teaching supervision, and the required core courses (i.e., EDSS 300M, EDSS 450M, EDSS 472M, EDSS 473M).

**Table 2**: Headcount of Undergraduate Majors for the B.S. in Mathematics

| Fall Term | Headcount General Option | Headcount Applied Option | Headcount Math Ed Option | Headcount Statistics Option | **Total** |
|---|---|---|---|---|---|
| 2014 | 84 | 59 | 97 | 20 | 260 |
| 2013 | 82 | 59 | 121 | 19 | 281 |
| 2012 | 108 | 60 | 154 | 28 | 350 |
| 2011 | 127 | 56 | 171 | 20 | 374 |
| 2010 | 126 | 41 | 165 | 17 | 349 |

Tables 3A-3D illustrate the graduation rates for native juniors for all four of our B.S. options (Fall 2005-10 cohorts). These rates vary greatly by option. Within the B.S. in Math (General Option, Table 3A), in most years around almost a third of our students graduate within 6 years. When we surveyed our majors back in 2005, most indicated that they were happy with the program. And, each year our “persist” and “retention” rates within this option are at or above those of the College. Reasons why students do not graduate likely vary (e.g., switch major, unable to afford).

**Table 3A**: B.S. in Mathematics (General Option)
Native Junior Students Graduation Rates Beyond Year 3

| Freshman Admit Term (Fall) | Initial Cohort of Native Juniors | Year(s) after 3rd Year Snapshot (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year (Year 4) | 2-year (Year 5) | 3-year (Year 6) | 4-year (Year 7) |
| 2010 | 21 | 9.52% | -- | -- | -- |
| 2009 | 11 | 18.18% | 27.27% | -- | -- |
| 2008 | 30 | 6.67% | 13.33% | 13.33% | -- |
| 2007 | 30 | 3.33% | 10.00% | 16.67% | 23.33% |
| 2006 | 22 | 9.09% | 22.73% | 27.27% | 27.27% |
| 2005 | 23 | 13.04% | 26.09% | 26.09% | 26.09% |

Within the Applied Option (Table 3B), our numbers until 2009 were quite low (≤5), and therefore the statistics are somewhat skewed. With that said, in all but one year, at least one-third of students graduated within 6 years and with three of the cohorts it was 50-100% within 5 years. As presented in Table 2, the numbers selecting this option for the major have increased over the past few years.

**Table 3B**: B.S. in Math: Applied Option
Native Junior Students Graduation Rates Beyond Year 3

| Freshman Admit Term (Fall) | Initial Cohort of Native Juniors | Year(s) after 3rd Year Snapshot (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year (Year 4) | 2-year (Year 5) | 3-year (Year 6) | 4-year (Year 7) |
| 2010 | 8 | 0.00% | -- | -- | -- |
| 2009 | 6 | 33.33% | 50.00% | -- | -- |
| 2008 | 4 | 25.00% | 50.00% | 50.00% | -- |
| 2007 | 3 | 0.00% | 0.00% | 0.00% | 0.00% |
| 2006 | 4 | 25.00% | 100.00% | 100.00% | 100.00% |
| 2005 | 3 | 0.00% | 0.00% | 33.33% | 33.33% |

As noted earlier, one-third to one-half, depending on the year, of our majors are in the Math Education Option (Table 3C). As with the General Option (many courses overlap), rates vary by year. Anywhere from 13 and 25 percent graduate within 6 years.

**Table 3C**: B.S. in Math: Math Education Option
Native Junior Students Graduation Rates Beyond Year 3

| Freshman Admit Term (Fall) | Initial Cohort of Native Juniors | Year(s) after 3rd Year Snapshot (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year (Year 4) | 2-year (Year 5) | 3-year (Year 6) | 4-year (Year 7) |
| 2010 | 23 | 8.70% | -- | -- | -- |
| 2009 | 24 | 8.33% | 25.00% | -- | -- |
| 2008 | 30 | 3.33% | 6.67% | 13.33% | -- |

| | | | | | |
|---|---|---|---|---|---|
| 2007 | 31 | 3.23% | 12.90% | 16.13% | 16.13% |
| 2006 | 21 | 4.76% | 23.81% | 23.81% | 23.81% |
| 2005 | 24 | 8.33% | 16.67% | 16.67% | 20.83% |

The Statistics Option (Table 3D) has the least amount of students, although the numbers have significantly increased in the past five years (see Table 2). For cohorts with more than 1 student, at least half of the students are graduating within 6 years.

**Table 3D**: B.S. in Math: Statistics Option
Native Junior Students Graduation Rates Beyond Year 3

| Freshman Admit Term (Fall) | Initial Cohort of Native Juniors | Year(s) after 3rd Year Snapshot (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year (Year 4) | 2-year (Year 5) | 3-year (Year 6) | 4-year (Year 7) |
| 2010 | 1 | 0.00% | -- | -- | -- |
| 2009 | 2 | 0.00% | 0.00% | -- | -- |
| 2008 | 4 | 25.00% | 50.00% | 50.00% | -- |
| 2007 | 3 | 0.00% | 66.67% | 66.67% | 66.67% |
| 2006 | 1 | 0.00% | 0.00% | 0.00% | 0.00% |
| 2005 | 1 | 0.00% | 0.00% | 0.00% | 0.00% |

Similar to the native juniors, more of the community college transfers select the general or math education options, and until recently, there were only a few students selecting the applied and statistics options (see Tables 4A-4D). Approximately 50% of the community college transfer majors graduate within 3-4 years of transfer. Relatively few of these students graduate within the first two years following transfer, which is not surprising given their varied content backgrounds. Although advised to complete the calculus sequence prior to transfer, many do not. Therefore, the first year in the major necessitates calculus, thereby requiring a minimum of 7 semesters to complete the major (many courses are sequenced, and cannot be taken out of order).

**Table 4A**: B.S. in Mathematics (General Option)
Community College Transfer Students Graduation Rates

| Transfer Semester of Entry (Fall) | Initial Number of Transfer Juniors | Year(s) after Transfer (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year | 2-year | 3-year | 4-year |
| 2013 | 7 | 0.00% | -- | -- | -- |
| 2012 | 8 | 0.00% | 25.00% | -- | -- |
| 2011 | 14 | 0.00% | 7.14% | 14.29% | -- |
| 2010 | 15 | 0.00% | 0.00% | 40.00% | 46.67% |
| 2009 | 8 | 0.00% | 0.00% | 12.50% | 37.50% |
| 2008 | 17 | 0.00% | 11.76% | 41.18% | 47.06% |

**Table 4B**: B.S. in Math: Applied Option
Community College Transfer Students Graduation Rates

| Transfer Semester of Entry (Fall) | Initial Number of Transfer Juniors | Year(s) after Transfer (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year | 2-year | 3-year | 4-year |
| 2013 | 8 | 0.00% | -- | -- | -- |
| 2012 | 7 | 0.00% | 0.00% | -- | -- |
| 2011 | 11 | 0.00% | 9.09% | 36.36% | -- |
| 2010 | 1 | 0.00% | 0.00% | 0.00% | 0.00% |
| 2009 | 7 | 0.00% | 0.00% | 0.00% | 42.86% |
| 2008 | 4 | 0.00% | 25.00% | 50.00% | 50.00% |

**Table 4C**: B.S. in Math: Math Ed Option
Community College Transfer Students Graduation Rates

| Transfer Semester of Entry (Fall) | Initial Number of Transfer Juniors | Year(s) after Transfer (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year | 2-year | 3-year | 4-year |
| 2013 | 12 | 0.00% | -- | -- | -- |
| 2012 | 15 | 0.00% | 6.67% | -- | -- |
| 2011 | 8 | 0.00% | 25.00% | 62.50% | -- |
| 2010 | 15 | 0.00% | 6.67% | 13.33% | 26.67% |
| 2009 | 19 | 0.00% | 0.00% | 21.05% | 57.89% |
| 2008 | 13 | 0.00% | 0.00% | 15.38% | 38.46% |

**Table 4D**: B.S. in Math: Statistics Option
Community College Transfer Students Graduation Rates

| Transfer Semester of Entry (Fall) | Initial Number of Transfer Juniors | Year(s) after Transfer (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year | 2-year | 3-year | 4-year |
| 2013 | 4 | 0.00% | -- | -- | -- |
| 2012 | 4 | 0.00% | 0.00% | -- | -- |
| 2011 | 2 | 0.00% | 0.00% | 50.00% | -- |
| 2010 | 2 | 0.00% | 0.00% | 50.00% | 50.00% |
| 2009 | 0 | -- | -- | -- | -- |
| 2008 | 1 | 0.00% | 0.00% | 100.00% | 100.00% |

Table 5 illustrates the total number of degrees granted by year for the B.S. in Mathematics programs. These numbers are congruent with the graduation rates presented above, and have been increasing over the last few years, in spite of our overall headcount for the major decreasing.

**Table 5**: Undergraduate Degrees Granted for the B.S. in Mathematics Programs

| Academic Year | Number of Degrees Granted |
|---|---|
| 2014-2015 | 74 |
| 2013-2014 | 67 |
| 2012-2013 | 65 |

| | |
|---|---|
| 2011-2012 | 42 |
| 2010-2011 | 57 |

Table 6 illustrates the average time to degree and total undergraduate units earned at graduation for both first-time freshmen and transfers in our B.S. in Mathematics programs. For transfers, the average time to degree ranges from 3.0 to 4.4 years, with a recent trend showing a slight decrease. For first-time freshmen, the average time to degree ranges from 4.9 to 6.2, with close to 5.5 being more typical. The average number of units at graduation has remained fairly consistent for both types of graduates (~156 for transfers and ~144 for first-time freshmen).

**Table 6**: Average Time to Degree and Total Undergraduate Units Earned at Graduation
Department of Mathematics and Statistics

| Academic Year | Transfer | | First-time Freshmen | |
|---|---|---|---|---|
| | Average Time (Years) | Average Total Units | Average Time (Years) | Average Total Units |
| 2014-2015 | 3.44 | 156.72 | 5.46 | 144.22 |
| 2013-2014 | 3.65 | 159.53 | 6.17 | 142.77 |
| 2012-2013 | 3.72 | 156.25 | 5.33 | 143.18 |
| 2011-2012 | 3.00 | 153.94 | 4.88 | 145.08 |
| 2010-2011 | 4.43 | 159.87 | 5.42 | 145.88 |

Table 7 provides the total undergraduate FTES for our Department, as well as what percentage of the FTES is for general education (GE) instruction for both lower and upper division course. In our Department, we do not have upper division courses that are identified as GE and are offered in fall semester (there is only one upper division GE course MATH 303 which is usually offered in spring semester only), and therefore all of our GE FTES comes from lower division courses in the table. It is also worth noting that some courses identified as GE are also "service" courses for other majors, and in some cases these same courses are those required for our majors and minors; for example, MATH 123, which has high enrollment, is required for our majors and minors, is a service course that is required for other majors, and also satisfies the GE requirement.

**Table 7:** Undergraduate FTES in General Education
Department of Mathematics and Statistics

| Fall Term | Dept. Undergraduate FTES | General Education Instruction | | | | |
|---|---|---|---|---|---|---|
| | | Lower Division | | Upper Division | | Total |
| | | FTES | % FTES | FTES | % FTES | % FTES |
| 2014 | 1,751 | 1,173 | 67% | 0 | 0% | 67% |
| 2013 | 1,759 | 1,228 | 70% | 0 | 0% | 70% |
| 2012 | 1,819 | 1,192 | 65% | 0 | 0% | 65% |
| 2011 | 1,735 | 1,080 | 62% | 0 | 0% | 62% |
| 2010 | 1,541 | 946 | 61% | 0 | 0% | 61% |

## Graduate Programs

As is at the undergraduate level, we have four graduate programs, three of which are options within our M.S. in Mathematics degree (pure, applied, math education), and one

is a M.S. in Applied Statistics. The core course requirements in each of the graduate options in mathematics involve both breadth and depth requirements. The depth requirement prepares students for further graduate study. The breadth requirement gives students an advanced viewpoint for many of the mathematics topics needed in applied fields, Ph.D. programs, and community college teaching, thus preparing them to be knowledgeable and versatile as mathematicians, statisticians, and teachers. The Option in Applied Mathematics and the M.S. in Applied Statistics prepare students for jobs in industry and government as well. In addition, graduate students employed as Teaching Associates (TAs) gain valuable experience for future teaching careers at community colleges and secondary schools.

Tables 8A-D show the application, admission, and enrollment data for our graduate programs. Note: in 2009 we changed statistics study from being part of the Applied Math option within the M.S. in Math degree to it's own degree, M.S. in Applied Statistics. The data from the IR website still has this data integrated for years 2010 and 2011; thus the numbers for 2010 and 2011 in Table 8B include the numbers for both the "applied" and "statistics" students, which is why 2010 and 2011 indicate "0" for the M.S. in Applied Statistics.

Admission and enrollment percentages vary widely by year and also across program, with percent admitted ranging from 44% to 100%, although the average from the last three years is 81%. Of those admitted, the percentage that enrolls is also quite varied, ranging from 32% to 100%, with the average across the last three years being 76%. The math education option (Table 8C) typically enrolls a larger percentage of admitted students.

**Table 8A**: M.S. in Mathematics (General Option)
Graduate Program Applications, Admissions, and New Enrollment

| Fall Term | # Applied | #Admitted | % Admitted | # Enrolled | % Enrolled |
|---|---|---|---|---|---|
| 2014 | 25 | 20 | 80% | 13 | 65% |
| 2013 | 14 | 14 | 100% | 14 | 100% |
| 2012 | 33 | 23 | 70% | 13 | 57% |
| 2011 | 30 | 16 | 53% | 6 | 38% |
| 2010 | 57 | 38 | 67% | 25 | 66% |

**Table 8B**: M.S. in Math: Applied Option
Graduate Program Applications, Admissions, and New Enrollment

| Fall Term | # Applied | #Admitted | % Admitted | # Enrolled | % Enrolled |
|---|---|---|---|---|---|
| 2014 | 29 | 22 | 76% | 14 | 64% |
| 2013 | 18 | 18 | 100% | 18 | 100% |
| 2012 | 42 | 32 | 76% | 17 | 53% |
| 2011 | 116 | 80 | 69% | 41 | 51% |
| 2010 | 121 | 87 | 72% | 55 | 63% |

**Table 8C**: M.S. in Math: Math Education Option
Graduate Program Applications, Admissions, and New Enrollment

| Fall Term | # Applied | #Admitted | % Admitted | # Enrolled | % Enrolled |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 2014 | 11 | 9 | 82% | 8 | 89% |
| 2013 | 4 | 4 | 100% | 4 | 100% |
| 2012 | 11 | 10 | 91% | 10 | 100% |
| 2011 | 16 | 15 | 94% | 11 | 73% |
| 2010 | 10 | 6 | 60% | 2 | 33% |

**Table 8D**: M.S. in Applied Statistics
Graduate Program Applications, Admissions, and New Enrollment

| Fall Term | # Applied | #Admitted | % Admitted | # Enrolled | % Enrolled |
|---|---|---|---|---|---|
| 2014 | 47 | 25 | 53% | 8 | 32% |
| 2013 | 23 | 23 | 100% | 23 | 100% |
| 2012 | 59 | 26 | 44% | 13 | 50% |
| 2011 | 0 | 0 | % | 0 | % |
| 2010 | 0 | 0 | % | 0 | % |

Table 9 highlights that the enrollments in these four programs vary by year and across the programs, with the applied and statistics programs currently enrolling the most students; this trend is not surprising given the current demand for careers that necessitate training in the more applied areas of mathematics, as discussed earlier in this study.

**Table 9**: Headcount of Graduate Majors for the Master of Science programs
Department of Mathematics and Statistics

| Fall Term | # Declared Majors M.S. in Math (General Option) | # Declared Majors M.S. in Math (Applied Option) | # Declared Majors M.S. in Math (Math Ed Option) | # Declared Majors M.S. in Applied Statistics | **Total** |
|---|---|---|---|---|---|
| 2014 | 37 | 45 | 27 | 44 | **153** |
| 2013 | 37 | 48 | 29 | 53 | **167** |
| 2012 | 34 | 47 | 35 | 53 | **169** |
| 2011 | 35 | 48 | 34 | 53 | **170** |
| 2010 | 43 | 49 | 24 | 44 | **160** |

Tables 10A-D illustrate that graduation rates also vary by year and program, with the pure program (Table 10A) having the lowest rates and math education program the highest (Table 10C). Looking at the programs as a collective whole, more than half graduate within 4 years, and all programs appear to be showing an increase with the more recent cohorts.

**Table 10A**: M.S. in Mathematics (general option)
Graduate Student Graduation Rates

| Fall Term | Initial Cohort Count | Year(s) after Admission (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year | 2-year | 3-year | 4-year |
| 2013 | 14 | 0.0% | -- | -- | -- |
| 2012 | 13 | 0.0% | 7.7% | -- | -- |

| | | | | | |
|---|---|---|---|---|---|
| 2011 | 6 | 0.0% | 16.7% | 33.3% | -- |
| 2010 | 25 | 0.0% | 24.0% | 40.0% | 48.0% |
| 2009 | 17 | 0.0% | 17.6% | 23.5% | 29.4% |
| 2008 | 9 | 0.0% | 22.2% | 33.3% | 44.4%% |

**Table 10B**: M.S. in Mathematics: Applied Option
Graduate Student Graduation Rates

| Fall Term | Initial Cohort Count | Year(s) after Admission (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year | 2-year | 3-year | 4-year |
| 2013 | 18 | 0.0% | -- | -- | -- |
| 2012 | 17 | 0.0% | 11.8% | -- | -- |
| 2011 | 15 | 0.0% | 6.7% | 53.5% | -- |
| 2010 | 24 | 0.0% | 25.0% | 54.2% | 66.7% |
| 2009 | 16 | 0.0% | 12.5% | 37.5% | 50.0% |
| 2008 | 10 | 10.0% | 30.0% | 60.0% | 60.0% |

**Table 10C**: M.S. in Mathematics: Math Education Option
Graduate Student Graduation Rates

| Fall Term | Initial Cohort Count | Year(s) after Admission (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year | 2-year | 3-year | 4-year |
| 2013 | 4 | 0.0% | -- | -- | -- |
| 2012 | 10 | 0.0% | 30.0% | -- | -- |
| 2011 | 11 | 0.0% | 18.2% | 72.2% | -- |
| 2010 | 2 | 0.0% | 0.0% | 100% | 100% |
| 2009 | 12 | 0.0% | 8.3% | 75% | 75% |
| 2008 | 10 | 0.0% | 30% | 30% | 50% |

**Table 10D**: M.S. in Applied Statistics
Graduate Student Graduation Rates

| Fall Term | Initial Cohort Count | Year(s) after Admission (Percent Graduated) | | | |
|---|---|---|---|---|---|
| | | 1-year | 2-year | 3-year | 4-year |
| 2013 | 23 | 0.0% | -- | -- | -- |
| 2012 | 13 | 0.0% | 46.2% | -- | -- |
| 2011 | 26 | 0.0% | 34.6% | 69.2% | -- |
| 2010 | 31 | 3.2% | 29.0% | 41.9% | 54.8% |
| 2009 | 31 | 0.0% | 29.0% | 38.7% | 41.9% |
| 2008 | 15 | 0.0% | 26.7% | 40.0% | 40.0% |

The number of degrees granted (Table 11) is about what one would expect, given our current program enrollments and graduation data highlighted in Tables A-D.

**Table 11**: Graduate Degrees Granted for the M.S. Programs
Department of Mathematics and Statistics

| Academic Year | Number of Degrees Granted |
|---|---|
| 2014-2015 | 50 |
| 2013-2014 | 66 |
| 2012-2013 | 45 |
| 2011-2012 | 58 |
| 2010-2011 | 42 |

***C. Comment on the program's enrollment trends since the last program review based on information concerning enrollment targets [FTES (Full Time Equivalent Student)], faculty allocation [FTEF (Full Time Equivalent Faculty)], and student-faculty ratios. For post-baccalaureate programs, comment on whether there is sufficient enrollment to provide a community of scholars in terms of formal and informal sharing of ideas, experience and knowledge, and whether graduate students have sufficient exposure to graduate-only coursework.***

The Department of Mathematics and Statistics is a quite large department, which amounts for nearly half (42.5% in Fall 2012) of the total FTES for the College of Natural Sciences and Mathematics (Table 1, Section 2.B.); our Department is the largest on campus in FTEF. Our enrollments have remained fairly consistent since 2010, however how the enrollments between 2010 and 2014 are distributed between undergraduate non-major and grad/postbac has somewhat changed–graduate modestly decreased, and undergraduate increased.

Table 7 (Section 2.B.) provides the total undergraduate FTES for our Department, as well as what percentage of the FTES is for general education (GE) instruction for both lower and upper division course. In our Department, we do not have upper division courses that are identified as GE and are offered in the fall, and therefore all of our GE FTES comes from lower division courses. It is also worth noting that some courses identified as GE are also "service" courses for other majors, and in some cases these same courses are those required for our majors and minors; for example, MATH 123, which has high enrollment, is required for our majors and minors, is a service course that is required for other majors, and also satisfies the GE requirement.

We have four graduate programs, three of which are options within our M.S. in Mathematics degree (pure, applied, math education), and one is a M.S. in Applied Statistics. As noted in the previous Section (2.B.), Table 9 (presented again below) highlights that the enrollments in these four programs vary by year and across the programs, with the applied and statistics programs currently enrolling the most students; this trend is not surprising given the current demand for careers that necessitate training in the more applied areas of mathematics, as discussed earlier in this study.

**Table 9, Section 2.B.**: Headcount of Graduate Majors for the Master of Science programs
Department of Mathematics and Statistics

| Fall Term | # Declared Majors M.S. in Math (General Option) | # Declared Majors M.S. in Math (Applied Option) | # Declared Majors M.S. in Math (Math Ed Option) | # Declared Majors M.S. in Applied Statistics | **Total** |
|---|---|---|---|---|---|
| 2014 | 37 | 45 | 27 | 44 | **153** |
| 2013 | 37 | 48 | 29 | 53 | **167** |
| 2012 | 34 | 47 | 35 | 53 | **169** |
| 2011 | 35 | 48 | 34 | 53 | **170** |
| 2010 | 43 | 49 | 24 | 44 | **160** |

Using CS-Link data, we present in Table 12 the headcount for the last two years for our masters programs. Currently, the headcount in our graduate programs currently represents approximately 35% of the total masters student population in CNSM. Thus, our graduate programs are quite robust, and our numbers have begun to increase again in the past couple of years. In spite of our size, we have maintained a positive and supportive graduate culture. We have a Graduate Advisor for each of our four programs, and they devote much time and attention to our students' success. The advisors' job duties range from recruiting students, advising students, preparing graduate studies paperwork, mentoring students, overseeing comprehensive exams, chairing the sub-discipline committee and serving on the Graduate Committee, all the way to helping students' job hunting. All but three of our graduate course offerings are graduate-only (STAT 510/410, STAT 550/450, and STAT 595/495).

**Table 12**: Fall 2015 & 2016 Headcount of Graduate Majors for the Master of Science programs
Department of Mathematics and Statistics

| Fall Term | # Declared Majors M.S. in Math (General Option) | # Declared Majors M.S. in Math (Applied Option) | # Declared Majors M.S. in Math (Math Ed Option) | # Declared Majors M.S. in Applied Statistics | **Total** |
|---|---|---|---|---|---|
| 2016 | 41 | 52 | 23 | 66 | **182** |
| 2015 | 37 | 44 | 21 | 60 | **162** |

The class size for our undergraduate courses varies from 34 students in lower division classes to 30 students in upper division classes, except for courses with large-lecture format (MATH 103, MATH 113, MATH 115, STAT 108, STAT 118); their class size is typically 120–200 students. Graduate courses (500/600 level) are usually caped at 20 students. Our student-faculty ratio was approximately 32 to 1 in Fall of 2015, which was far greater than the rest of our college (Table 13), which has an overall average of 23 to 1. Given that our enrollments have increased since Fall of 2015, it is currently at least as great. Table 13 also illustrates that this ratio has increased as our student populations has increased, likely because the size of our faculty has not.

**Table 13:** Student-faculty Ratio by Department for CNSM

| | F11 | S12 | F12 | S13 | F13 | S14 | F14 | S15 | F15 |
|---|---|---|---|---|---|---|---|---|---|
| Biology | 19.89 | 20.06 | 18.88 | 19.81 | 18.06 | 16.29 | 21.98 | 21.88 | 22.41 |
| Chemistry | 19.27 | 19.69 | 20.73 | 19.58 | 21.08 | 17.89 | 18.73 | 17.1 | 19.42 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Geology | 17.58 | 16.41 | 16.87 | 17.90 | 16.95 | 17.18 | 18.36 | 16.81 | 19.46 |
| Science Education | 12.10 | 12.04 | 14.56 | 10.30 | 9.27 | 12.36 | 15.48 | 10.68 | 17.26 |
| Mathematics & Statistics | 28.06 | 23.04 | 29.46 | 23.88 | 29.19 | 26.11 | 32.11 | 25.69 | 31.74 |
| Physics | 20.69 | 20.99 | 21.69 | 20.62 | 22.03 | 19.29 | 32.38 | 29.67 | 26.62 |

As we illustrate in Table 17 (Section 6.C.), many of our undergraduate and graduate students engage in research and/or independent study with our faculty. Additionally, we have scholarly colloquia talks approximately twice each month. Finally, all of our graduate students who serve as TAs in the Department have office space, which not only supports their office hours, but also becomes a place where they can collaboratively study and form learning communities.

***D. Briefly describe any plans for curricular changes in the short (up to three years) and long (seven year) term, such as expansions, contractions, or discontinuances. Relate these plans to the priorities described in Section I.C. above.***

In the next seven years there are only two possible major curricular changes that we anticipate:

> (1) Possibly moving forward during this academic year (AY 2016-17) with a revised version of the proposed new B.S. in Computational Mathematics program (Appendix E), which was discussed earlier in this self-study; and,
>
> (2) Possibly moving forward over the next 2-3 years with a proposed new graduate program that is content driven, yet has as its audience practicing teachers who were not math majors and seek professional development in mathematics, particularly as it relates to the new CCSS-M (Priority #1 & Appendix I).

Both of these possible plans are dependent upon final drafts and department vote. The first possible change supports our mission, as well as what is needed to address current work force demands. The second supports our mission, first priority, and also what is needed to support work force demands. In spite of the need for these programs, both will require careful attention to availability of sufficient, appropriate faculty to both direct and teach these new programs.

***E. Include information on any self-support programs.***

N/A. Our Department does not offer any self-support programs.

***F. The Chancellor's Office files represent the primary source of data as reported by the Office of Institutional Research and Assessment (IR&A) for the CSULB program reviews. The data submitted to the Chancellor's Office includes only***

***those students generating FTES for the purpose of budget allocation as of census date. In order to generate FTES, a student must be matriculated into a state-support academic program and be enrolled in state-support courses for unit credit.***
***The CSU-Long Beach campus has developed a secondary reporting utility, CS-Link. The parameters for these data reports are quite different than those transmitted to the Chancellor's Office, as they include all "current" students (those eligible to enroll without having to reapply to the University); for example, these reports do not include students enrolled for zero units (e.g., GS 700), students on leave, students with a double major, students studying abroad, and students who have not registered for the current semester.***

***Although for longitudinal continuity and alignment the reports generated by IR&A will be the primary source for all program review and assessment, as well as accreditation analyses, you are welcome to briefly include data here from CS-Link that contributes to an understanding of your educational programs.***

Throughout this document we have added some additional data, both embedded in this primary report and in appendices. When not presenting IR&A data, we have clearly indicated as such.

## *SECTION 3. GENERAL EDUCATION*

### *A. Describe your department's role in the college and university in offering courses that satisfy General Education (GE) relative to the department, college, and university mission.*

The Department offers a variety of courses that satisfy the General Education requirement, as well as pre-baccalaureate courses (MAPB 1, 7, 11) to prepare students to take a math course at the college level. We present here a brief description of our GE-designated courses most often taken, how they help to fulfill the mission described above (Section 1), and the student demographic that is most likely to take these courses.

MATH 103 (Mathematical Ideas)—The vast majority of students who take this course are liberal arts majors. The purpose of this course is twofold: to teach the students some interesting and practical topics, but also to help them appreciate, at least to some extent, the beauty and utility of mathematics. MATH 103 includes an introduction to the mathematics of finance, and a section on probability and statistics. These topics enhance the student's ability to deal with the quantitative analyses that must be made in daily life.

MATH 109 (Modeling with Algebra)–This course explores data, functions and their representations (verbal, numerical, graphical, algebraic), and how these ideas relate to real-life phenomena like rate of change, profit, and growth and decay. For most students taking MATH 109, additional math courses are not required for their majors.

This course emphasizes real-life applications, which help to support students in future careers and daily life.

MATH 111 (Precalculus Trigonometry) & 113 (Precalculus Algebra)–These courses are usually taken by students who are relatively comfortable with their ability to perform algebraic manipulations, and they are more often chosen by majors in fields that either require it (such as life or social sciences) or by students who are tentatively considering majors in more mathematically intensive subjects, but feel that their algebraic skills need strengthening. The content in these courses includes significant components in algebraic reasoning, problem analysis, and the relationship across multiple representations. MATH 113 is the prerequisite of MATH 119A; MATH 111 and 113 are the prerequisites of MATH 122.

MATH 115 (Business Calculus)–MATH 115 covers a broad variety of business-related problems which calculus is uniquely adept at analyzing. Although the vast majority of the students who take this course are business majors, there is some enrollment from students who have sufficient confidence in their mathematical skills that they are comfortable taking a more challenging, algebra-rich course.

MATH 122 & 123 (Calculus I and II)–This course sequence is required for some science-focused majors, as well as all of the majors/minors in our Department. It integrates both theory and applications of differentiation and integration, needed for most STEM fields. In addition, the Department regularly offers sections of these courses for the University Honors Program.

MATH 303 (Reflections in Space and Time)–This is an F-Capstone course with emphasis in intensive writing. The course investigates the mathematical nature of symmetry and patterns and considers the pervasive appearance and deep significance of symmetry and patterns in both arts and sciences.

STAT 108 (Statistics for Everyday Life)–This course is usually taken by students in a variety of majors including those that traditionally require a substantial background in statistical analysis. The course is designed to give students the key statistical and probability tools that are used in analyzing data, as well as the ability to recognize when statistical information is being used erroneously. In addition, the Department began offering one section of this course for the University Honors Program last year.

STAT 118 (Introductory Business Statistics)–This course was separated from STAT 108 and was specifically designed for students in the College of Business Administration. It was first offered in Fall 2014. The course gives students key statistical and probability tools needed for Business majors and uses a broad variety of business-related problems.

MTED 110 (The Real Number System for Elementary and Middle School Teachers)–This course is typically taken by Liberal Studies majors, and is required for those desiring to pursue an elementary teaching credential. It provides an introduction to problem solving processes and strategies, as well as reviews the development and

analysis of structure, properties, and operations of the real number system. Concept and process development using appropriate models, manipulatives, and activities. The focus on problem solving, exploration and analysis of the foundations of number sense are critical to K-8 teaching, as well as many decisions made in real life.

***B. Describe the criteria employed by the department to assign faculty to teach General Education courses. Note, in table format, the percentage of your department's total FTES's that are lower division and upper division GE instruction. See instructions for Table 7 Department FTES in General Education in Appendix C.***

Our Department utilizes course coordinators (either a faculty member or a committee) for most of our general education courses. Having a course coordinator ensures coordination of all aspects of a course to support a common experience for all students, regardless of section. For example, all sections of MATH 109 have a common syllabus, textbook, homework, pacing, and exams; the instructors meet regularly, often grade collaboratively, and the coordinator provides additional support to the course instructors as needed (e.g., shares lesson plans). Furthermore, the coordinator for MATH 109 observes each instructor one time during the semester and holds a post-observation conference to offer feedback. Similarly, there is tight course coordination for MATH 122 & 123, as well as MATH 113 & 115, which have common topic sequences, homework, textbook, and exam items; MATH 122 and 123 have undergone a redesign/alignment for the past two years, an effort which was led by a committee of faculty members. The remaining courses that require coordination/alignment are MATH 103 (if more than one instructor begins teaching this course), MATH 111, and STAT 108; as noted in Section 1.D., MATH 111 will be the next course to be address in our immediate priorities.

Table 7 (Section 2.B., presented again in this section) provides the total undergraduate FTES for our Department, as well as what percentage of the FTES is for general education (GE) instruction for both lower and upper division courses. In our Department, we do not have an upper division courses that are identified as GE and are offered in fall semesters, and therefore all of our GE FTES comes from lower division courses. It is also worth noting that some courses identified as GE are also "service" courses for other majors, and in some cases these same course are those required for our majors and minors; for example, MATH 123, which has high enrollment, is required for our majors and minors, is a service course that is required for other majors, and also satisfies the GE requirement.

As Table 7 (Section 2.B.) illustrates, a large majority of our FTES comes from courses identified as GE, with most of the students being neither major nor minors in our Department. For this reason, improving the content and coordination for these courses has become a high priority since our last self-study.

**Table 7 (Section 2.B.):** Undergraduate FTES in General Education
Department of Mathematics and Statistics

| | Dept. | General Education Instruction | | |
|---|---|---|---|---|
| Fall Term | Undergraduate | Lower Division | Upper Division | Total |

| | FTES | FTES | % FTES | FTES | % FTES | % FTES |
|---|---|---|---|---|---|---|
| 2014 | 1,751 | 1,173 | 67% | 0 | 0% | 67% |
| 2013 | 1,759 | 1,228 | 70% | 0 | 0% | 70% |
| 2012 | 1,819 | 1,192 | 65% | 0 | 0% | 65% |
| 2011 | 1,735 | 1,080 | 62% | 0 | 0% | 62% |
| 2010 | 1,541 | 946 | 61% | 0 | 0% | 61% |

Anyone desiring to teach one of our GE-designated courses must be approved by the Chair. Furthermore, they must be willing to follow the coordinated plan. Many teaching the GE courses that are not required for our major/minor are lecturers or teaching assistants (TAs), and therefore are eager to utilize Department provided materials and support. For example, some of our TAs teach MATH 109 and MATH 115 (activity sections); in addition to receiving materials and support from the course coordinators (Appendix G), they receive further support and instruction from the TA Supervisor, and TAs who are new to their role are required to take a 3-unit course, which is offered every fall; this course (MTED 590: Introduction to College Mathematics Teaching) was developed, and is currently taught by, one of our math education faculty. Sample materials from this course are included in Appendix H. Finally, all TAs have training prior to the semester (Appendix H), all TAs are observed, and all lecturers are both observed and evaluated regularly (Appendix R). It is worth noting that we try to keep the same cohort of instructors for our primary service courses so that they can know the curriculum and develop particular pedagogical expertise.

***C. Describe how the department's student learning outcomes (SLOs) are aligned with the General Education SLOs. How does the department ensure that course coordination occurs across multiple sections with respect to disciplinary and GE SLOs?***

As noted in the previous section, all but two of our GE courses are coordinated and have numerous common components, ensuring course coordination across multiple sections. Furthermore, the Department's SLOs are periodically reviewed to ensure alignment to the GE SLOs.

## *SECTION 4. STUDENT LEARNING OUTCOMES AND ASSESSMENT*

***A. For each degree/credential/certificate program offering described in Section II A above, list the expected student learning outcomes. Describe how the program assessment process and results are aligned with institutional learning outcomes (ILOs).***

The Department has four options <u>for the Bachelor of Science in Mathematics degree (general/pure, applied, mathematics education, statistics).</u> For all four of these options, we have a set of core SLOs. <u>All</u> majors should be able to:

1. Demonstrate mastery of basic mathematical ideas and techniques, ranging across the following fields – single and multivariate calculus, linear algebra, real

analysis, probability/statistics, basic differential equations, and mathematical modeling;
2. Demonstrate an understanding of the nature of proof;
3. Demonstrate the ability to think analytically and critically and to formulate problems, solve them, and interpret their solutions, both collaboratively and individually;
4. Demonstrate the ability to use technological tools (e.g., algebraic and visualization software, statistical packages, a high-level programming language)
5. Demonstrate the ability to apply knowledge from one branch of mathematics to another and from mathematics to other disciplines;
6. Demonstrate the ability to communicate mathematics both orally and in writing.

For the general (pure) majors, all majors should additionally be able to:

7p. Demonstrate an understanding of the foundational ideas in abstract algebra, including groups, rings, and fields.

8p. Demonstrate an understanding of foundational ideas in real analysis.

For the applied option, all majors should additionally be able to:

7a. Demonstrate an understanding of numerical analysis, differential equations, and computer programming in MatLab.

8a. Demonstrate an understanding of fundamental knowledge either in engineering (Sub-option I) or in economics and management (Sub-option II)

For the statistics option, all majors should additionally be able to:

7s. Demonstrate an understanding of fundamental knowledge in regression analysis, multivariate statistical analysis, and data analysis with SAS.

8s. Demonstrate the ability to use the statistical software package SAS.

For the mathematics education option, all majors should additionally be able to:

7e. Demonstrate mastery of foundational geometric concepts and aspects of the history of mathematics;

8e. Demonstrate the ability to bridge understandings of components of their major coursework to issues and content in secondary mathematics.

9e. Demonstrate the mathematical processes as articulated in the Standards for Mathematical Processes (Appendix B).

For those students additionally pursuing a Single Subject Credential in Mathematics, our outcomes are outlined in the CCTC Matrix (Appendix F).

The Department also has three options for the Master of Science in Mathematics degree (general/pure, applied, mathematics education) and a Master of Science in Applied Statistics degree. For all four of these graduate programs, we have a set of core content SLOs. All majors should be able to:

1. Demonstrate the ability to think analytically and critically and to formulate problems, solve them, and interpret their solutions, both collaboratively and

individually;
2. Demonstrate expanded/deepened mathematical/statistical content understandings;
3. Demonstrate the ability to communicate mathematics/statistics both orally and in writing.

For the general/pure masters degree, all majors should additionally be able to:

4p. Demonstrate the advanced ability to write and read proofs;
5p. Demonstrate mastery of advanced abstract algebra and geometry concepts, as well as master of advanced analysis and/or topology.

For the applied masters degree, all majors should additionally be able to:

4a. Demonstrate mastery of numerical analysis, ordinary differential equations, and/or partial differential equations.
5a. Demonstrate the ability to apply their mathematical knowledge to model and solve real world problems.
6a. Demonstrate the ability to computer program in Matlab.

For the mathematics education masters degree, all majors should additionally be able to:

4e. Demonstrate an understanding both orally and in writing of current recommendations at both the state and national levels for mathematics education and how they compare to other countries;
5e. Demonstrate an ability to analyze research in mathematics education;
6e. Demonstrate an understanding of the historical perspective of mathematics education;
7e. Demonstrate an understanding of pedagogical and assessment practices appropriate to facilitate the learning of mathematics for all secondary students, including students engaging in mathematics in ways aligned with the Standards for Mathematical Practices (Appendix B).

For the M.S. in Applied Statistics, all majors should additionally be able to:

4s. Demonstrate an understanding of the theoretical foundation of the methods and techniques of statistical inference;
5s. Demonstrate a thorough knowledge of design of experiments to permit efficient analysis of sources of variation with application to quality assurance, and demonstrate the ability to adapt these methods to the solution of a given real-world problem;
6s. Demonstrate a working knowledge of the use of statistical software such as SAS and SPSS in applications of statistics, including the ability to analyze data and interpret program output.

As we illustrate in Table 14, each of our programs' SLOs (PLOs) are aligned to the CSULB ILOs. The alignment of the Single Subject Credential (accredited through the CCTC) can be gleaned from Appendix F; subject matter competency for students pursuing a secondary credential is verified by them being in our B.S. in Math, Option in

Math Education program (thus, SLOs 1-6, 7e, 8e, and 9e apply) or by taking CSET exams; these students then take the credential program courses, of which we oversee EDSS 300M, 450M, and 473M.

**Table 14:** Alignment of PLOs to ILOs for B.S. and M.S. Programs

| ILO | Aligned PLOs–B.S. programs | Aligned PLOs–M.S. programs |
|---|---|---|
| Oral Communication | 6,9e | 3,4e |
| Written Communication | 1,2,3,5,6,7p,8p,7a,8a,7s,8s,7e,8e,9e | 1,2,3,4p,5p,4a,5a,4e,5e,6e,7e,4s,5s,6s |
| Quantitative Reasoning | 1,2,3,4,5,7p,8p,7a,8a,7s,8s,7e,8e,9e | 1,2,4p,5p,4a,5a,7e,4s,5s,6s |
| Critical Thinking | 1,2,3,4,5,7p,8p,7a,8a,7s,8s,7e,8e,9e | 1,2,4p,5p,4a,5a,6a,4e,5e,6e,7e,4s,5s,6s |
| Civic Responsibility–Global/local issues | 5,8a,7s,8s,8e,9e | 1,5a,4e,5e,6e,7e,5s,6s |
| Knowledge/Respect of Diversity | 3,8a,8e,9e | 3,5a,4e,5e,6e,7e,5s |
| Disciplinary/Professional Competencies | 1,2,3,4,5,7p,8p,7a,8a,7s,8s,7e,8e,9e | 1,2,4p,5p,4a,5a,6a,4e,5e,6e,7e,4s,5s,6s |
| Collaborative Problem Solving, Research/Creative Activity | 1,2,5 | 1 |
| Information Literacy | 1,2,3,4,5,7p,8p,7a,8a,7s,8s,7e,8e,9e | 1,2,3,5p,4a,5a,6a,5e,6e,5s,6s |

***B. Describe the assessment of student learning outcomes for each program, including the methods or techniques used and how the information is analyzed. Within this description, be sure to include assessment relative to the department's GE skills and GE discipline-specific content (if/how applicable).***

To determine assessment of the SLOs for our programs, we look across multiple factors: alignment of courses across sections, evaluation of performance in courses, and for our graduate programs, also alignment of expectations for and performance on comprehensive exams and thesis/project.

All 200-level MATH/STAT/MTED courses are usually taught by T/TT faculty and very experienced lecturers. Our 300/400-level MATH/STAT/MTED courses (except for MATH 370A and MTED 301) are usually taught by T/TT. Usually 2-5 faculty members take turns to teach a course, which ensures the quality and consistency of SLOs for each course.

All 500- and 600-level courses are taught exclusively by T/TT faculty (except for a rare emergency). Usually 3 faculty members take turns to teach any particular course, especially the comprehensive exam courses. Each graduate student needs to pass the comprehensive exam of two fundamental areas in his/her discipline. Three faculty members who have taught a comprehensive exam course serve on the comprehensive exam committee of the course, which ensures the quality and consistency of SLOs of the courses and the learning goals and level of difficulty expected for the comprehensive exams, thereby the quality of our graduate programs.

As described earlier in this report, we have been working to coordinate all of our GE courses with multiple common elements (Sections 1.B.–1.D.). The impetus for this redesign was based on assessment that students' learning experiences were not uniform (e.g., students were not being uniformly assessed) and in some courses, passing rates were less than we desired. Typically, for most GE classes in the department, there are 3 midterm exams (some 4 midterm exams), one final exam, weekly homework, weekly quizzes (some bi-weekly quizzes), and sometimes a project and/or other collaborative activities. A group of faculty discussed and picked the questions of online homework, which ensures the uniformity of the course content for all sections of a course.

***C. Describe how department members are involved in the assessment process.***

The Executive, Undergraduate and Graduate Committees, with input from the discipline committees (i.e., pure, applied, stat, and math education), are responsible for assessing program-level outcomes. These committees are comprised of both tenured and tenure-track faculty; faculty who also serve as academic advisors are required to serve on either the Undergraduate or Graduate Committee, as appropriate, and the Graduate Advisors serve as the chairs of the discipline committees. Furthermore, faculty comprise the thesis and comprehensive exam committees; these committees, under the leadership of the Graduate Committee, work to ensure alignment of curricula and assessment. We intend to revisit our program learning outcomes this spring (2017) and will begin to more formally assess them in AY 17-18.

***D. Describe the results of the assessment of student learning outcomes for each program since the last program review. Within this description, be sure to include results of assessment relative to the department's GE skills and GE discipline-specific content (if/how applicable) and relationship to ILOs. & E. Describe the process for using the results of assessment for program improvement in the degree/credential/certificate program and general education, and provide at least two examples since the last review of changes in programs that were made on the basis of the results of assessment.***

These outcomes are newly developed since our last review in 2006. Therefore, until this self-study, they were reviewed within the committees, as discussed above. The Chair and Associate Chair also regularly review passing rates and other Departmental course data and then suggest revisions where needed.
As described earlier in this report, we have been working to coordinate all of our GE courses with multiple common elements (Section 1.B.–1.D.). The impetus for this redesign was based on assessment that students' learning experiences were not uniform (e.g., students were not being uniformly assessed) and in some courses, passing rates were less than we desired. At this point, two faculty coordinate Math 122/123 with AT (funded by Chancellor's Office and CNSM), and one faculty member serves as our service course coordinator with AT from CNSM. Additionally, the Department has hired a former graduate from our M.S. in Math, Option in Math

Education program, who has also taught in our Department for many years, to support the coordinator for MATH 109.

***F. Include information on any Special Sessions self-support programs offered by the department or unit, with particular emphasis on the assessment of student learning outcomes in alternative delivery formats (on-line, off-campus, compressed schedule, etc.).***

N/A. Our Department does not offer any self-support programs.

***G. Attach all annual reports on assessment since the last program review as an appendix.***

All accessible annual reports on assessment since the last program review are included in Appendix S.

## SECTION 5. FACULTY

***A. Describe the changes in faculty resources for instructional delivery since the last program review in:***

***1. The full-time equivalent faculty (FTEF) allocated to the program. Include information on tenured and tenure track faculty lines (e.g., new hires, retirements, FERPs, resignations).***

***2. How these changes have affected the program's academic offerings.***

***3. Describe tenure density in the program and the distribution among academic ranks (assistant, associate, professor); see instructions for Table 12 in Appendix E.***

As noted earlier in this self-study, the Department of Mathematics and Statistics is a quite large department, which amounts for nearly half of the total FTES for the College of Natural Sciences and Mathematics (Table 1, Section 2.B.); our Department is the largest on campus in FTEF. The Department currently has 38 T/TT faculty (24 professors, 7 associate professors, 4 assistant professors, 3 FERP), 36 lecturers (5 full-time, 31 part-time), and 20 teaching assistants (TAs); all contribute to the instructional delivery for the Department.

Using IR&A data, Table 15a illustrates our tenure density in the Department from 2008 to 2014; additionally, we generated the data for Table 15b, which illustrates where our numbers were at the time of our last self-study (2006) and where they are currently. This data illustrate that while our numbers did increase from 2006 to 2013, since 2013 they have begun to decrease; and, at the same time, our student enrollment at both the undergraduate and graduate levels are increasing. Furthermore, from 2006 to 2013 the number of faculty at full professor rank also increased; yet, since 2013 this number has paralleled the decrease in total number of faculty, as they are retiring. Table 16 illustrates that in addition to our 3 faculty on FERP, we have many other senior faculty who are near retirement, and three of these faculty (2-math education, 1-statistics) have

already announced that they will retire at the end of the next academic year. Thus, in spite of our current search in math education, all areas within our Department (pure, applied, stat, math education) are in need of hiring new faculty. Complicating this soon-to-be dire staffing situation, it keeps getting more difficult to find competent lecturers and available graduate students to serve as TAs (many of our graduate students work full time during the time of day that many of our courses are offered). Finally, many of our senior faculty are less willing to teach evening courses, and thus staffing our graduate courses has become more difficult.

**Table 15a:** Tenured/Tenure-track Faculty Headcount (2008–2014)
Department of Mathematics and Statistics

| Headcount | Fall 2014 | Fall 2013 | Fall 2012 | Fall 2011 | Fall 2010 | Fall 2009 | Fall 2008 |
|---|---|---|---|---|---|---|---|
| Full Professor - Tenured | 28 | 29 | 27 | 25 | 23 | 20 | 20 |
| Associate Professor - Tenured | 8 | 7 | 6 | 7 | 7 | 11 | 9 |
| Assistant Professor - Probationary | 4 | 5 | 6 | 7 | 7 | 8 | 8 |
| Assistant Professor - Tenured | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Other | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Associate Professor - Probationary | 0 | 0 | 1 | 1 | 1 | 1 | 2 |
| Full Professor - Probationary | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **40** | **41** | **40** | **40** | **38** | **40** | **39** |

**Table 15b:** Tenured/Tenure-track Faculty Headcount (2006, 2015–2016)
Department of Mathematics and Statistics

| Headcount | Fall 2016 | Fall 2015 | | Fall 2006 |
|---|---|---|---|---|
| Full Professor - Tenured | 27 | 27 | | 19 |
| Associate Professor - Tenured | 7 | 8 | | 8 |
| Assistant Professor - Probationary | 4 | 4 | | 8 |
| Assistant Professor - Tenured | 0 | 0 | | 0 |
| Other | 0 | 0 | | 0 |
| Associate Professor - Probationary | 0 | 0 | | 1 |
| Full Professor - Probationary | 0 | 0 | | 0 |
| **Total** | **38** | **39** | | **36** |

**Table 16:** FERP and Near Retirement Faculty

| Name | Research Area | Year hired | Years of service | |
|---|---|---|---|---|
| Joseph Bennish | Applied Mathematics | 1988 | 28 | |
| Linda Byun | Pure Mathematics | 1984 | 32 | |
| Bruce Chaderjian | Applied Mathematics | 1989 | 27 | |
| Morteza Ebneshahrashoob | Statistics | 1990 | 26 | |
| Y. David Gau | Pure Mathematics | 1988 | 28 | |
| Melvin Lax | Applied Mathematics | 1977 | 39 | |
| Kent Merryfield | Pure Mathematics | 1988 | 28 | |
| Robert Valentini | Pure Mathematics | 1989 | 27 | |
| Ngo Viet | Pure Mathematics | 1989 | 27 | |
| William Ziemer | Applied Mathematics | 1989 | 27 | |
| | | | | |
| Norma Noguera | Math Education | 2001 | 15 | |
| Angelo Segalla | Math Education | 2001 | 15 | |
| | | | | |
| | | | | |
| Carl Dorn | Applied Mathematics | 1968 | 48 | FERP |
| Robert Mena | Pure Mathematics | 1988 | 28 | FERP |
| Lindsay Tartre | Mathe Education | 1985 | 31 | FERP |

***B. Discuss the issue of "faculty sufficiency" in the department relative to the department's mission, degrees, development of curricula, courses, and program delivery. Your response should account for decision making regarding the faculty mix based on type of degree programs (undergraduate, graduate, etc.) degree program size and scope (on-campus, off-campus, distance, traditional or non-traditional students, etc.) and scholarship focus.***

***1. Describe the role that tenured/probationary faculty play in the department's curriculum and program delivery.***

The Department has a broad range of young and experienced faculty in a wide variety of fields in mathematics, math education, and statistics. Appendix T has a list of the faculty, as well as their areas of expertise. Our faculty regularly attend local and national meetings of professional organizations (e.g., Mathematical Association of America, American Statistical Association, American Mathematical Society, National Council of Teachers of Mathematics, Society for Industrial and Applied Mathematics), so they are cognizant of national and local trends in curricular and professional matters. Most of our faculty are active in coordinating and developing new curricula, with many serving as mentors to probationary faculty and lecturers.

***2. Describe the role that lecturers, student assistants, and teaching assistants play in the department's curriculum and academic offerings. Indicate the percentage of courses taught by lecturers, student assistants, and teaching assistants (TA) since the last program review. Identify any***

***programs or curricula that are the responsibility of lecturers, student assistants, and teaching assistants***

Our lecturers and TAs play a vital role in the Department's curriculum and academic offerings. Most of our MAPB and MATH 109 classes are taught by our TAs (with monitoring from our TA Supervisor and course coordinators). Our TAs also teach most of the activity sessions of our redesigned course MATH 115 with structured teaching material provided by the course coordinator. We work very hard to train our TAs and monitor their progress to ensure the quality of their teaching and student learning outcomes. Consequently, our graduates with TA experience are regularly hired in both community colleges and K-12 settings and contribute to addressing the teacher shortage. With the number of tenured or tenure-track faculty members stagnating around 39 during the last ten years, it's increasingly difficulty to assign T/TT faculty to teach service courses since they have to cover higher level courses in the Department. Thus, our lecturers teach most of our service courses. Appendix U gives a visual picture of math courses taught by our lecturers in Fall 2014 and Spring 2015. Among those courses in these two semesters, 107 out of 176 classes were taught by our lecturers, which places our lecturer teaching rate at 61% among those courses.

***3. Evaluate the department's capacity to support its curricular offerings and whether the faculty is sufficient to accommodate the size and scope of existing and future curriculum and/or degree programs.***

As we discuss in Sections 5.A. and 5.B., we cannot staff all of our classes with only tenured or tenure-track faculty. Currently, we require the support of 36 lecturers (5 full-time, 31 part-time), and 20 TAs. In spite of our current search in math education, all areas within our Department (pure, applied, stat, math education) are in need of hiring new faculty. Complicating this soon-to-be dire staffing situation, it keeps getting more difficult to find competent lecturers and available graduate students to serve as TAs (many of our graduate students work full time during the time of day that many of our courses are offered). Furthermore, many of our senior faculty are less willing to teach evening courses, and thus staffing our graduate courses has become more difficult. Finally, it is worth noting that the College is continuing to reduce funding for coordination and advising due to the University's rule of maintaining total assigned time in each college at the level of 2013-2014 academic year; thus, moving forward, we will likely have to place more burden on committees, which may negatively effect course coordination and student success.

***C. Describe changes anticipated in the next program review cycle and indicate the program's priorities for future hiring.***

***1. Identify how these priorities and future hiring plans relate to relevant changes in the discipline, and the career interests/outcomes of students. Also describe how these hiring plans align with the strategic plans of the university, and regional, state, national or global developments.***

As discussed earlier in this self-study, the growing student populations within the Department are in applied mathematics, statistics, and math education; these increases parallel the job market trends outlined in Section 1. Furthermore, our plans for two possible new degree programs are supported by these trends. Thus, we plan to continue to address market developments and sustain current priorities and progress.

Currently, we are searching for a math education faculty member; we searched last year, but did not fill the position. The mathematics education group has not hired anyone since the AY 2008-09 (this increased the number of mathematics education faculty to seven); our most junior mathematics education T/TT faculty member is an Associate Professor. Since 2009, however, one of these seven faculty members has retired, another began FERP in Fall 2015, and a third faculty member accepted a part-time position in the Dean's Office in 2012, which now carries with it 6 units of reassigned time each semester. Thus, we only have the equivalent of 5 full-time mathematics educators. The teaching availability of the remaining mathematics education faculty is further reduced by advising duties, grant projects, and research activities that carry with it reassigned time. These activities typically account for 9-12 total units of reassigned time each semester. Furthermore, two more of our tenured faculty members have expressed intentions to retire within the next 1.5 years. Further complicating this issue is that demand for these courses is expected to increase. For example, the College of Education has begun to see increases in the number of Liberal Studies majors (~5% a year for the past two years), which is now resulting in our Department needing to offer more sections of MTED courses. And, as noted in Section 1, we are in the midst of a critical teacher shortage. *Across the country, districts are struggling with shortages of teachers, particularly in math, science and special education…*(NY Times, 8/9/2015). For example, LBUSD reports that they expect ~1500 LBUSD teachers to retire in the next 5-10 years.

As discussed earlier, all areas within our Department (pure, applied, stat, math education) are in need of hiring new faculty. Our enrollment is enormous and has, in fact grown recently, largely because of growth in the College of Engineering. We provide service courses for the rest of CNSM, the College of Engineering, the College of Business Administration, the College of Education, and the School of Nursing, as well as many pre-baccalaureate and general education courses for students across the University. And, naturally, we offer courses for our own minors, majors, and graduate students. Furthermore, the Department is also in the process of updating our applied math and statistics curricula to meet the demand from industry/government and creating a new degree (Bachelor of Science in in Computational Mathematics, Appendix E).

***2. Discuss the department's faculty diversity within the context of college, university, and academic discipline(s) goals for diversity, any efforts the department is making to maintain/increase faculty diversity, and how these efforts link to the overall hiring plans described in 1 (above).***

Our department is quite diverse. We have a healthy mix of ethnicity (e.g., Hispanic, Asian, white non-Hispanic, Middle Eastern, African American), gender, and research

foci (Appendix T) across the Department, as well as within each sub-discipline. With each of our faculty searches we have sought to expand this diversity, as well as have attempted to hire faculty with experience working with a diverse student population.

***D. Include information on all instructor participation in any self-support programs offered by the department.***

N/A. Our Department does not offer any self-support programs.

## *SECTION 6. STUDENT SERVICES*

***A. Briefly describe how the department advises its majors, minors, and graduate students.***

The Department maintains an extensive presence at the advising workshops for incoming students run by the SOAR program. At least one faculty member and at least one staff member are normally present at each workshop. The staff member is there to facilitate enrollment. Most incoming mathematics majors speak to a faculty member when they enter. Our pre-majors are also regularly advised by staff advisors in the CNSM Advising Center.

Continuing students declaring a mathematics major must speak to an advisor in order to make that declaration; the advisors use that conversation to outline the requirements and estimate the time needed to finish. The same applies to students declaring minors. Undergraduate advising (for majors, minors, and other undergraduates interested in mathematics courses) is primarily the responsibility of the Undergraduate Associate Chair and the Undergraduate Advisor. They both receive assigned time for their efforts. Other members in the Department also contribute greatly to advising, particularly two volunteer undergraduate/minor advisors in the applied and statistics options.

For post-baccalaureate students in the Single Subject Credential Program (secondary teaching), we have a Credential Advisor, who also receives assigned time. Additionally, we have a Credential Coordinator, who works collaboratively with the Credential Advisor and assists with all field placements, as well as the screening of the student teaching applications; this person also receives assigned time. For advanced undergraduates intending to pursue teaching careers, the responsibilities of the Credential Advisor and the Undergraduate Advisor overlap somewhat, and these advisors therefore maintain close contact and frequently discuss particular students. Furthermore, for students intending to pursue an elementary teaching credential, two faculty members receive summer salary for on-going advising. All of the funding for the credential-specific advising is supported by our MSTI funds, which we receive annually from the Chancellor's Office.

For the four graduate programs, one advisor is assigned to each program (pure, applied, statistics, math education). Each of these advisors also receives assigned time. These advisors meet regularly with other graduate advisors in CNSM, under the

leadership of our CNSM Director of Graduate Studies. The amount of assigned time for our graduate programs is commensurate with other Departments in CNSM (Appendix V).

Finally, all graduate advisors are required to be members and serve as the chair of their discipline committee and be members of the Graduate Committee, which serves as a mechanism by which advisors can coordinate and collaboratively make policy decisions in each discipline and at the department level.

***B. Discuss the program's efforts to support the academic success of diverse learners (this may include any relevant information regarding, for example, quality of learning, retention and graduation rates, advising, etc.).***

The Department supports (partially by the Kenneth E. Lindgren Endowment) the Mathematics Tutoring Center, which is open 9am-5pm on MTWTh and 9am-12pm on Fridays during the fall and spring semesters. Its purpose is to assist students who have questions in their courses. The Department also sponsors a center to tutor the Liberal Arts students enrolled in our MTED courses. Due to budget issues, the University/College made a decision this fall (2016) to divide tutoring services of various courses among different tutoring centers:

> The university's LAC (Learning Assistance Center located in HC 104, Horn Center) focuses on the tutoring of the following courses:
> MAPB 1, MAPB 7, MAPB 11, Math 103, Math 109, Math 115 and Stat 108
> Their drop-in tutoring is free.
>
> For our tutoring rooms, we now focus on the following courses (tutoring is free):
> LA5-345: Math 111, Math 113, Math 119A, Math 119B, Math 122, Math 123, Math 224, Math 233, Math 247, Math 361A, Math 364A, Math 370A, Math 380, Math 444, Stat 118, Stat 381
>
> LA5-249: MTED 110, MTED 205, MTED 211, MTED 312, and MTED 402

All of these tutoring options are open to all students, and there is not cost. All of our tutors are current undergraduate and graduate students, who have already taken and succeeded in the course(s) that they may be tutoring. We find the tutoring centers to be quite helpful to students–they appreciate feeling supported by and learning from their peers. The students tutoring in our centers also gain valuable teaching experience, and are consequently strengthening their own mathematical understandings.

We have discussed that our Department participates in our CNSM learning communities in this self-study (Appendix P), which particularly target at-risk students, who often include underrepresented and first generation students. This program has peer mentors; all of these mentors have specialized training, which includes attention to developing in students a growth mindset. All of our lecturers and TAs also receive

specialize training; this training addresses how to help expand students' mindset, which is critical for their academic successful and attitudes toward learning.

We also noted earlier that we have multiple advisors in the Department and require students to meet with them on a regular basis. Our advisors attend regular meetings that help them to support our diverse student body. Finally, as we have noted, we have been working to coordinate our general education courses, which then supports students in having equitable learning experiences, and a curriculum that emphasizes connections to the real world and effective pedagogical strategies to support students who may be weaker mathematically.

***C. Describe opportunities for students to participate in honors programs, undergraduate or graduate research, service learning, internships, and so forth, and how these opportunities are supported. List the number of faculty and students participating in each type of opportunity, and indicate plans for the future in these endeavors (expand, maintain, decrease).***

The Department has a broad range of young and experienced faculty in a wide variety of fields in mathematics, math education, and statistics. Appendix T has a list of the faculty, as well as their areas of expertise. In 2014 we conducted a survey of faculty's scholarly activity (Appendix T), which revealed that many members of the faculty have active research programs—in fact, all but a handful had a recent refereed journal paper, and many actively seek internal and/or external funding to support their work. The range of type of scholarly activity included making presentations, serving as a reviewer, writing for publication, and overseeing/garnering grants.

Table 17 provides the number of students engaging in scholarly activity (i.e., directed studies and/or thesis/project) for the past four years, with a comparison to the academic year of our last self-study (2006); these registrations were overseen by 27 faculty, which represents nearly 70% of the Department's faculty (Appendix W). As can be seen, most of our faculty engage in scholarly activity with students, and sometimes formally serve as advisors for directed studies (496, 497, 697) and/or thesis or projects (498H, 698); some (~25%) also co-author papers with current/former students. It is worth noting that while doing original mathematics research at the undergraduate level is quite difficult, two of our faculty are currently working with undergraduate students on innovative projects; one such student was just awarded the prestigious CSULB Graduate Research Fellowship, as she joined our MS in Mathematics program after completing her undergraduate degree in mathematics here at CSULB.

**Table 17:** Number of Students Engaging in Directed Study/Thesis with Faculty Department of Mathematics and Statistics

| | F16 | S16 | F15 | S15 | F14 | S14 | F13 | S13 | F12 | | S07 | F06 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATH 496 | 2 | | | | 1 | | | | | | | |
| MATH 498H (honors) | | | | 1 | | | | | 1 | | | |
| MATH/MTED/STAT 497 | 2 | 2 | 2 | 1 | 3 | 2 | 3 | 1 | 0 | | 1 | 2 |
| MATH/MTED/STAT 697 | 9 | 4 | 10 | 3 | 7 | 5 | 7 | 6 | 8 | | 1 | 4 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MATH/MTED/STAT 698 | 7 | 6 | 9 | 7 | 6 | 5 | 8 | 3 | 3 | | 2 | 3 |
| **Total** | **20** | **12** | **21** | **12** | **17** | **12** | **18** | **10** | **12** | | **4** | **9** |

As Table 17 shows, the number of students engaging in directed study/thesis with faculty has increased by over 100% since our last self-study. As the Department began seeing an increase in both how many faculty were leading such courses and the number of students per faculty member, a couple of years ago it was decided to begin awarding s-factor to faculty (in all years prior it did not reduce their teaching load). Thus, faculty earn approximately 2/3 of a unit per student enrolled in 697/698, up to a maximum of 3 units per semester. The Department also supports the Honors Program in various capacities. For example, some faculty have supervised Honors Thesis projects, and many of their students take courses in our Department (e.g., MATH 112 & 123).

The William Lowell Putnam Competition is the oldest and best know collegiate mathematical competition. Participants take a 12-question, proof-requiring examination in December; results are announced in March or April. Each year, about 4500 students from between 400 and 500 colleges and universities in the U.S. and Canada participate. Those numbers are heavily weighted towards MIT, Harvard, Stanford, Caltech, Carnegie Mellon, and a few other famous universities. CSULB participates in the Putnam, and the 1-unit course MATH 491 is devoted to helping students prepare for it. On the 2015 Putnam the CSULB team had a team rank of 138 (out of more than 400 colleges). Our top scorer, with a national rank of 640.5, was a freshman engineering major.

Three years ago, the department instituted an Honors Program for undergraduates in the major; this program requires extra units and an undergraduate thesis. Since then, about two students per year have taken advantage of this program. Most of these students have gone on to Ph.D. programs in mathematics. We plan to maintain this at approximately its current level, encouraging our best students to enter this program, as doing undergraduate research is quite rare in mathematics.

Our Department hosts an annual Math Day at the Beach event, which involves dozens of high schools sending students to compete in a mathematics competition. Many of our undergraduate and graduate students volunteer at this event alongside our faculty. The Mathematics and Statistics Student Association is quite active. The Association has organized and supported talks from former students about their job experiences, as well as academic talks from professors and graduate students about the mathematical-statistical experience.

In recent years, a handful of students attend REU programs every summer at various universities such as UCLA. Many students in applied math or statistics actively seek and gain summer internships at various companies and government agencies such as JPL, NASA, Naval Research, LLNL Institute for Scientific Computing Research. Information about REU, internships, and short-term job opportunities received by the

Department is usually passed over to our student association and advisors, as well as related faculty members.

***D. Include information on student services provided to students enrolled in any Special Sessions self-support programs.***

N/A. Our Department does not offer any self-support programs.

## *SECTION 7. RESOURCES AND FACILITIES*

***A. Identify any special facilities and/or equipment used by the program, such as laboratories, computers, large classrooms, or performance spaces. Identify any changes since the last program review and priority needs for the future.***

The Department has three computer labs for teaching purposes (located in LA5), two equipped with PCs and one with Macs. The computers in each lab are periodically upgraded, roughly every five years. In recent years, the University has purchased campus-wide licenses for major teaching software packages such as SAS, SPSS, Matlab, and Mathematica. The computer labs are heavily used by students in courses from math education, applied mathematics, and statistics, as well as pretests/benchmarks from MATH 111, 122, and 123. Due to the shortage of computer lab space for various teaching purposes, the Department purchased 48 Chromebooks last year to set up 2 mobile computer labs. We are planning to purchase an additional 24 Chromebooks this year. We plan to continue to use our *Mathematics and Science Teacher Initiative* (MSTI) funding from the Chancellor's Office to support purchasing any needed software and/or licenses for the math education courses.

***B. Describe the current library resources for the program, the priorities for acquisitions in the period until the next program review, and any specialized needs such as collections, instruction, etc.***

The library budget was severely restricted in the past few years, and the large increase in journal package prices presented some challenges. The Department has a faculty liaison to the library, who works closely with the Math Librarian and the Library Dean to communicate faculty's needs for Library books and services. As a result, we have been able to maintain an adequate level of resources, including the online journals and full-text subscriptions. Faculty can access the major databases such as MathSciNet, Academic Search Complete, etc. When the journal papers or books are not available in the library, we can use consortia borrowing through the library network "Beachreach", with availability within 24 hours for most requests.

Due to the unstable library budget, the priority in the coming years is to make sure that faculty needs are anticipated and communicated to the Library. A healthy pace of new book acquisitions and full-text article downloads in relevant research fields will be maintained. With a continued liaison between the Department and the Library, we

expect to ensure accessibility of new textbooks, as well as research and teaching journals.

## *SECTION 8. PLANNING*

***A. Summarize all the major changes planned in the period until the next review.***
***B. Summarize all new or additional resources needed to support the planned major changes.***

In Table 18 we briefly summarize our planned changes in the period until our next review, as well as any new/additional resources needed to support these intended major changes. For course coordination, one coordinator for each course is necessary for at least first three to five years to maintain and further improve the redesign of the course, especially for training the instructors and maintaining the constant cohort of instructors for a course with a large number of sections.

**Table 18:** Planned Changes w/Timeline and Needed Resources

| Planned Major Change | Timeline | Resources Needed |
|---|---|---|
| Redesign & Coordinate MATH 111 (Section 1.D.) | AY 17-18 | 3 units of assigned time per semester for both coordinator and 1 more faculty member (new) |
| Set up a long term course coordinator to maintain and improve the redesign of MATH 111 | AY 18-19<br><br>Coordinator needed every semester | 3 units of assigned time per year for the coordinator (new) |
| Set up a long term course coordinator to maintain and improve the redesign of MATH 122 | AY 17-18<br><br>Coordinator needed every semester | 3 units of assigned time per semester for the coordinator (currently have unofficially, but will need the funding to maintain) |
| Set up a long-term course coordinator to maintain and improve the redesign of MATH 123 (Section 1.D.) | AY 17-18<br><br>Coordinator needed every semester | 3 units of assigned time per semester for the coordinator (currently have unofficially, but will need the funding to maintain) |
| Continue SA sessions in MATH 122/123 and extend SA's to other critical courses such as Math 111/113 and 224 | Every year | At least two classrooms with seating capacity 20 students (currently in the vacant building PH2, need them every year to maintain) |
| Continue to utilize ALEKS PPL for placement into MATH 119A and MATH 122 | Every summer | ALEKS PPL licenses and two student assistants $40,000 per year (currently funded by HVDI, but will need funding to maintain) |
| Continue to utilize ALEKS for remediation in MATH 113 and | Every year | No additional |

| | | |
|---|---|---|
| explore how to integrate ALEKS as needed into other general education courses (Section 1.D.) | | Students pay for their own ALEKS license fees |
| Consult with COE and redesign MATH 247 Linear Algebra to better align with the needs of majors in COE | AY 17-19 | Assigned time or summer salary for a faculty member to redesign the course (new) |
| Consult with COE and redesign MATH 370A Applied Math to better align with the needs of majors in COE | AY 17-19<br><br>Coordinator needed in long term | Assigned time or summer salary for a faculty member to redesign the course<br>3 units of assigned time per year for the coordinator (new) |
| Consult with Biology and Chemistry Departments and redesign MATH 119B | AY 17-19 | Assigned time or summer salary for a faculty member to redesign the course (if needed) |
| Make sure our undergraduate and graduate programs continue to reflect the need in teacher preparation and the demand for statisticians and mathematicians (Section 1.D.) | Every year | No additional |
| Explore ways to increase the percentage of students completing math remediation before they begin coursework and the success of those placed into remediation upon beginning coursework at CSULB | AY 17-19 | No additional initially; may need additional funding for coordination |
| Many faculty retirements (Section 5.A.) | | New tenure-track faculty hires (additional) |
| New B.S. in Computational Mathematics (Section 1) | Possible start of program in AY 18-19 | One additional faculty member (additional) |

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