Program Performance Review January 2019
Department of Mathematics

EXECUTIVE SUMMARY

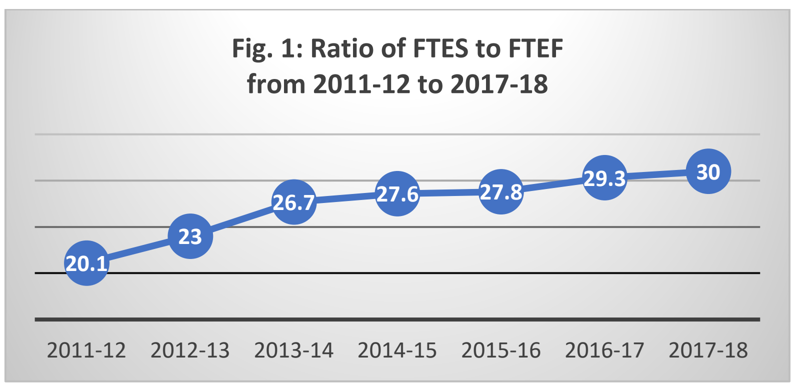
This PPR Self-Study identified five goals that the Department of Mathematics views as being of critical importance to its work over the next PPR cycle. They are:

Goal 1: Incorporating New Instructional Modalities
Goal 2: Elimination of Remedial Courses
Goal 3: Re-Alignment of Calculus Courses
Goal 4: Continued Emphasis on Undergraduate Research
Goal 5: Developing Student Leaders and Educators

Each of these goals supports the Department, College, University, and System priority of removing hurdles for students' time to graduation, and Project GI 2025. Specifically, CSUF aims to double the four-year graduation rate for native students and decrease the time to graduation for transfer students to no more than three years.

Specific goals from the previous PPR cycle were launching the M.S. in Statistics, an online/hybrid program; exploring the development of more online/hybrid courses across all sectors of the Department; and institutionalizing the SI program. Each of these goals has been realized. We are also on-track to complete the elevation of the Masters Program in Applied Mathematics from an M. A. to an M. S. program by the end of the AY 2018-19.

Enrollments in our service courses, major courses, and graduate courses have all grown substantially during this PPR cycle. Our FTES went from 1567 in AY 2011-12 to 1811 in AY 2017-18, an increase of 15%. During this time our FTEF went from 78 in AY 2011-12 to 60 in AY 2017-18, a decrease of 23%.



As the number of students enrolling in mathematics courses at CSUF has grown, together with increases in our undergraduate and graduate programs, so has the ratio of FTES to FTEF. In 2010-11, this ratio was 20.1; in 2017-18 the ratio had grown steadily to 30.0. Thus, in the seven years since our last PPR, the Department's ratio of FTES to FTEF ratio has grown by 9.9 students per faculty member, for a growth rate of 49.3% (Figure 1). This marked increased in the ratio of FTES to FTEF illustrates the need for the Department to continue to hire FTF to keep pace with student demand for math courses.

The Department has remained extremely active in its scholarly and creative activities, including federal and state grants, with well over ten million dollars in external funding awarded during this PPR cycle. Monies generated from indirect cost funds, as well as faculty and facilities support provided directly from the grant, may become increasingly important for the Department and the College if current budget trends continue. Department faculty members have been highly productive in their research programs and have disseminated their results in numerous journal articles and professional conference presentations. Much of this activity has included student collaborators. This productivity remains an ongoing part of the Department.

Program Performance Review
Department of Mathematics
January 2019

FULL REPORT

I. *Department/Program Mission, Goals and Environment*

A. Briefly describe the mission and goals of the unit and identify any changes since the last program review. Review the goals in relation to the university mission, goals and strategies.

Department Mission
The Department of Mathematics at California State University, Fullerton continues to strive for excellence in the execution of its responsibilities in three areas:

1. Undergraduate and graduate degree programs for mathematics and statistics majors.
2. Courses for science majors, majors within other Colleges that require a mathematical component for their degree and General Education requirements in mathematics.
3. Creative, professional and consulting activities performed by members of the Department for the mathematical, University, local, and global communities.

Department Goals
1. To maintain a commitment to excellence in the teaching and learning of mathematics.
2. To provide undergraduate and graduate programs in mathematics, which prepare students for careers in education, business, industry or government, and for graduate studies.
3. To cooperate with other departments in providing students with the concepts and skills in mathematics needed for success in their field of study.
4. To promote research and scholarship by the faculty and our students in pure and applied mathematics, mathematics education, statistics, and other areas of mathematics.
5. To provide exemplary professional service to the University and to the community.

Relation to University Mission, Goals and Strategies
The 2013-2018 Mission and Goals are as follows:

Goal 1: Develop and maintain a curricular and co-curricular environment that prepares students for participation in a global society and is responsive to workforce needs.

Goal 2: Improve student persistence, increase graduation rates University-wide, and narrow the achievement gap for underrepresented students.

Goal 3: Recruit and retain a high-quality and diverse faculty and staff.

Goal 4: Increase revenue through fundraising, entrepreneurial activities, grants, and contracts. (http://planning.fullerton.edu/goals/goal1.aspx):

The Department of Mathematics' Mission and Goals are intertwined with those of the University. A principal University focus is in what was once referred to as "the pre-eminence of learning," which the Department also embraces as seen in our emphasis on the effective delivery of high-quality mathematics programs to effect student involvement and student learning (Goal I). These programs include not only our own undergraduate and graduate degree programs but also our service courses which are part of the University's General Education Program, as well as degree programs in other units. The Department's foremost tool for program delivery is its faculty, whose members are both scholars and teachers with dual interests in the creation and dissemination of knowledge and in the teaching and learning of our students.

The Department has taken a leadership role at the university and in the CSU to improve student persistence, increase graduation rates University-wide, and narrow the achievement gap for underrepresented students through its Course Redesign efforts and other programs such as Supplemental Instruction, “flipped” classes, and undergraduate research (Goal 2). In the last six years since our previous PPR, the department has hired thirteen (13) tenure-track faculty members; of these, (5) are women and four (4) are persons of color. With the exception of one faculty member who resigned, each of these faculty members has either been tenured or is on track towards a successful tenure outcome (Goal 3). The Department of Mathematics also has a demonstrated interest in and record of obtaining and maintaining significant levels of external funding (Goal 4).

In our last PPR report there were three specific goals identified for the next PPR cycle: (1) launching the M.S. in Statistics, an online/hybrid program; (2) exploring the development of more online/hybrid courses across all sectors of the Department; and (3) institutionalizing the SI program. We are pleased to report that each of these three goals was realized during this last cycle. The MS program in Statistics was launched in 2012 and is our fastest growing graduate program; we are now offering online sections of Math 115 College Algebra, Math 125 Precalculus, and Math 135 Business Calculus; and the SI program was institutionalized in 2013.

B. Briefly describe changes and trends in the discipline and the response of the unit to such changes. Identify if there have been external factors that impact the program. (Community/regional needs, placement, and graduate/professional school).

Overview. The field of mathematics has retained a remarkable stability as well as a vibrant dynamism over time. It is stable in that its structure, theory and tools have remained valid through the inquiry of generations of mathematicians. It is dynamic because there has been a steady advance in the theory and results in mathematics. As recent examples, in the 1990’s the long-standing problem Fermat’s Theorem was proved, and in 2002 the Poincaré Conjecture was established. Both of these problems have had a rich history and were the source of and inspiration for the development of other important mathematics.

In the recent past, the field of mathematics has become much more an applied science. This is in large part due to the introduction and use of computer technology by mathematicians, statisticians and mathematics educators. With computing available, previously unapproachable and computationally complex problems are not necessarily outside the realm of the solvable. The size and scope of many of these problems render the traditional analytic solutions impossible to obtain or, perhaps not even useful. Computer generated numerical solutions become the end product. In the context of considering these large problems, the theoretical mathematical foundations become even more important as researchers seek to find efficient shortcuts to make these problems manageable. With computing available to mathematical scientists, applications have been made in many and varied disciplines from cryptography to genetics to finance, especially with the advent of Big Data.

Technological Advances. In this context, the Department has evolved to having a more applied orientation in our programs and research, but at the same time, recognizing the absolute importance of a strong theoretical foundation, it has maintained a focus on providing students with a solid mathematical core background in undergraduate concentrations. Each of our students benefits from the Department’s increased use of technology. The Department has placed greater emphasis on having majors take Math 320, in which *MATLAB* is taught, so that students have the ability to program, use symbolic computation and take of advantage of computer generated graphics. Applied mathematics students are well versed in the modern methods of simulation, and probability/statistics students are trained in data analysis, a skill which starts on the computer for the modern statistician often using the software program *R*.

The surge of technology (advances in information technology and Internet access) has also affected the teaching of mathematics and mathematics education. The Department has experienced a rapid rise in the use of learning management systems (e.g., Titanium) and course websites as a means to communicate with students and as instructional tools. Indeed, the use of internet-based technologies (IBTs) has the power to transform how mathematics (as well as most other subjects) can be accessed and learned. The Department has incorporated technology into all or most of its courses, including the development of faculty-made videos for flipped classes in college algebra, precalculus, and calculus.

Outcome-based Learning. A major change in mathematics education is the shift in emphasis from teaching to learning, that is, evidence-based outcomes of student learning. The Department has been proactive in addressing this area, including the creation of MathEd 542, a teaching, training and support class for our graduate teaching associates, and the development and expansion of the Supplemental Instruction (SI) and flipped class programs in key gateway courses. These are also discussed in detail later in this document.

Increased Efficiency. During the AY 2017-18 we saw a marked increase in classroom size in both lower and upper division classes. With the help of Dean Johnson we have accessed a new room, MH 553, which will accommodate 40 students. In addition, our other department-owned classrooms, are also being refurbished to accommodate more students (48 in MH-390, 42 in MH 380, 42 in MH 476, and 42 in MH 480). Moreover, when funds become available we would like to re-design computer lab MH-452 to accommodate 40 students, up from its current capacity of 24. The brief report to the Dean below from September 2018 gives a Comparison of the Ratio of the Number of Sections of Math Courses to FTES, Fall 2017 and Fall 2018. Using three different measures, the department's efficiency in reducing costs was between 7-10% Based on the AY 2017-18 PTL blanket of $ 1.5M, this translates into $100-150K savings from AY 2017-18 to AY 2018-19.

Comparing FTES with the number of sections taught gives a direct measure of instructor efficiency. In fall 2017, a total of 271 sections were offered, including 20 non-credit, 191 lower division, 51 upper division, and 9 graduate. In fall 2018, a total of 227 sections were offered, including 3 non-credit, 160 lower division, 53 upper division, and 11 graduate. In fall 2017 the ratio of FTES per section was 7.34; in fall 2018 the ratio of FTES per section was 8.07. This represents an instructor efficiency increase of 9.9 % from fall 2017 to fall 2018.

Comparing the total number of WTUs taught with FTES gives a direct measure of financial efficiency. In fall 2017 there were a total of 942 WTUs taught (no. of sections of each course x no. of WTUs per course); in fall 2018 there were a total of 816 WTUs taught. Thus, the ratio of total WTUs to FTES was 974/1989, or 0.490, in fall 2017, and 816/1832, or 0.445, in fall 2018. This represents a direct cost decrease of 9.2% from fall 2017 to fall 2018.

Finally, the mean class size in fall 2017 was 30.67 and in fall 2018 was 32.76. This represents an increase in average class size of 6.81% from fall 2017 to fall 2018.

The greatest curricular and enrollment changes from fall 2017 to fall 2018 were (1) a sharp decrease in non credit-bearing courses per EO 1110; (2) a decrease in lower division courses due to "balancing" between fall and spring; and (3) significantly increasing class enrollments in each section.

Elevation of Applied Masters Degree Program to M.S. The Department has already begun the process of elevating the Applied Masters Degree Program from an M.A. to an M.S. program. We hope to have this completed by the end of the 2018-19 academic year.

Math Course	No. of Sections			Summary Information		
	Fall 2017	Fall 2018			Fall 2017	Fall 2018
M 10S-20S	0	3		**Total NC**	**20**	**3**
M 30AB-40-50	20	0		**Total LD**	**191**	**160**
CNSM/M 101	0	1		**Total UD**	**51**	**53**
M 110	21	7		**Total Grad**	**9**	**11**
M 115A	0	8				
M 115	34	26		**Total No. of Sections**	**271**	**227**
M 116	1	1		**FTES (incl. CNSM 101)**	**1989**	**1832**
M 120	12	5		**FTES/Section**	**7.34**	**8.07**
M 125	21	19				
M 130	5	8		**Total no. of WTUs**	**974**	**816**
M 135	17	16		**Total no. of WTUs /FTES**	**.490**	**.445**
M 150A	18	15				
M 150B	22	14		**Average Class Size (Stan. Deviation)**	**30.67 (7.07)**	**32.76 (8.48)**
M 180-210	3	3				
M 250A	14	10				
M 250B	11	10				
M 270A	8	11				
M 270B	4	6				
M 280-335	19	19				
M 338	16	15				
M 340-380	6	6				
M 401-489AB	10	13				
M 503AB-587	7	8				
MAED 442S-542	2	3				

C. Identify the unit's priorities for the future.

Our priorities for the future are based on the five primary goals listed earlier:

1. To maintain a commitment to excellence in the teaching and learning of mathematics.
2. To provide undergraduate and graduate programs in mathematics, which prepare students for careers in education, business, industry or government, and for graduate studies.
3. To cooperate with other departments in providing students with the concepts and skills in mathematics needed for success in their field of study.
4. To promote research and scholarship by the faculty and our students in pure and applied mathematics, mathematics education, statistics, and other areas of mathematics.
5. To provide exemplary professional service to the University and to the community.

Pursuant to these goals, we are focusing on a specific objective for each goal. These are listed and summarized below.

Goal 1: Incorporating New Instructional Modalities

The Department continues to strive to find the optimal balance between on-line and face-to-face instruction. These curricular and instructional decisions need to be informed by the specific goals and outcomes for the course, as well as the availability and accessibility of hardware and software necessary for instruction and learning. Per the recent EO 1110, we have eliminated all remedial courses and redesigned our introductory level courses, including Math 110 (Lib. Arts Math), Math 115 (College Algebra), and Math 120 (Statistics). These courses utilize a variety of learning strategies, including flipped classes, "stretch" classes (Math 115A and Math 115B), and 1-unit support courses (Math 10S and Math 20S). The flipped classes rely heavily on the use of web-based instructional videos developed by CSUF faculty members. We have also developed a MS Degree in Statistics program that can be taken as a face-to-face program or completely on-line. This is the first such program in the CSU and one of only a handful in the country.

Goal 2: Elimination of Remedial Courses

Per EO 1110, the Department has taken a leadership role at the university and in the CSU to develop, implement, and assess the elimination of remedial courses. We are one of only two campuses in the CSU to not offer remedial courses effective summer 2018; similarly, we are one of only a handful of campuses to pilot new courses designed to support M3 and M4 students who would earlier have been candidates for the remedial program. We redesigned three courses: Math 110, Liberal Arts Math; Math 120, Introduction to Statistics; and Math 115, College Algebra. In addition, we created two new courses Math 115A (Stretch College Algebra A) and Math 115B (Stretch College Algebra B). These courses and pilot results are described in greater detail later in this report.

Goal 3: Re-Alignment of Calculus Courses

One challenge that we have faced over the years is the presence of statistically significant variation in student outcomes in Math 130 (Short Course in Calculus), Math 135 (Business Calculus); Math 150A (Calculus I); and Math 150 B (Calculus II). This variability supported neither our own program nor the programs of other departments, such as business, computer science, engineering and the life sciences, whose students enrolled in these courses. Broussard and Rasmussen (2015) identified having common calculus courses as one of the "Seven Characteristics of Successful Calculus Programs" in their article of the same name in *Notices of the AMS*, 762(2), pp. 144-146. Towards this end, data was gathered in spring 2018 to examine and document this issue at CSUF Course grades from fall 2015, 2016, and 2017 showed that although adjunct faculty taught two-thirds of these courses, there was no significant difference in mean grades between full time faculty and part-time lecturers. More importantly, there were large variations in grades and DFW rates for each course, especially in Math 150B (Appendix IV). In summer 2018 two teams comprised of both FTF and PTL met to create common course syllabi, grading weights, grading scales, and assessments (exams and the final) based on department-approved course objectives for each course. These will be piloted in fall 2018 to see if there are any effects on student outcomes. Having a more consistent approach to these courses should greatly benefit both the Department as well as the other departments whose students it serves.

Goal 4: Emphasis on Undergraduate Research

Per the previous PPR, the involvement of undergraduates was still a relatively new idea in the department. Since that time it has become more common than not for a tenured or tenure-track faculty member to have one or more undergraduate students involved in a research project. In summer 2018, for example, nine faculty members directed 18 undergraduate students in research projects which were presented at the CNSM Research day on August 9. This effort was funded as a joint project between the Department and UEE. In fall 2018, more than half of the faculty, and almost all of the faculty in the RTP cycle, are working with undergraduate students on research projects, in pure and applied mathematics, mathematics education, and statistics. Three faculty members, Dr. Scott Annin, Dr. Angel Pineda, and Dr. Anael Verdugo, were awarded a significant NSF grant to create the program GRAM to encourage undergraduate research. Here is an excerpt from a post describing how these and our other undergraduate math students fared at the spring 2018 MAA regional poster competition in San Diego:

"We are so excited with the results of Saturday's Mathematical Association of America student poster session in San Diego! FOUR of SIX of the NSF GRAM grant students' six research posters (among 50+

presented at the conference) received "Outstanding Poster Awards", authored by 8 of our 12 current GRAM Scholars. In addition, CSUF math major Jasmine Camero also presented a poster of her work on curvature and received an Outstanding Poster Award! In total, CSUF accounted for MORE THAN HALF of the total awards given out in the junior/senior undergraduate category! Congratulations to Jasmine Camero, Breanna Nicole, Angie Arredondo, Robert Hernandez, Cameron Hooper, Freddy Nungaray, Laz Vertiigo, Christian Do, and James Shade, as well as the whole GRAM fam! You guys were amazing as usual. Thanks for your hard work, and thanks to all of your mentors as well: Bogdan Suceava, Roberto Soto, Laura Smith, Adam Glesser, Kevin Nichols, Matt Rathbun, Jessica Abad-Santos, and Nick Brubaker."

In summary, undergraduate research is now part of the culture of the Mathematics Department at Cal State Fullerton.

Goal 5: Developing Student Leaders and Educators

The Departments of Mathematics and Biological Sciences started the Supplemental Instruction program ten years ago on a shoestring budget with just four pilot classes. Based on its documented success, the SI program at CSUF is now institutionalized, involving some 150 courses and more than 120 student SI leaders per year (www.fullerton.edu/si). The Department has continued to be involved in recruiting and training SI leaders, both with financial support from the CSU SI Center of Excellence at Fullerton and also from the Department directly. While the SI program has been shown to significantly improve outcomes for participating students, a study by Tran et. al. documented the profound impact on the SI leaders as well [Tran C. (student), Hartmann, K. (student), CadwalladerOlsker, T., and Bonsangue, M. (Sept. 2016). The impact of supplemental instruction on the SI leader. *Journal of Supplemental Instr. 2*(1), 6-18]. The SI program, together with other student training programs, such as MAED 542 which guides and supports new TAs, are helping to produce individuals with graduate and undergraduate degrees in mathematics who are confident, articulate, and compassionate.

D. If there are programs offered in a Special Session self-support mode, describe how these programs are included in the mission, goals and priorities of the department/program (e.g. new student groups regionally, nationally, internationally, new delivery modes, etc).

The Department has continued to offer a robust summer program, including courses in remedial math, GE, LD and UD, and graduate courses. Over the last eight summers the Department has offered a decreasing number of sections ranging from 32 down to 26. As mentioned earlier in this report, effective summer 2018, remedial classes – other than a one-unit online Math 20 – were no longer offered. However, we offered two pilot sections of Math 110 with the 10S support section and one pilot section of Math 120 with the 20S support section. A summary report to the dean of these courses is given below.

The Department of Mathematics implemented its first ESM course offerings per EO 1110 in summer 2018. Two sections of ESM 110 (Liberal Arts Mathematics) and one section of ESM 120 (Introduction to Statistics) were taught, together with their one-unit support courses, ESM 10S and ESM 20S, respectively. Students enrolled in these courses were primarily CSU Category M-4 students who, prior to EO 1110, would have been enrolled in non-degree credit-bearing remedial math courses. The summer ESM courses were taught over an intensive five-week session with students meeting for approximately three hours, four days per week. A total of 95 students participated in this program, including 84 students in ESM 110 and 11 students in ESM 120.

Table 1: ESM Mathematics Course Results Summer 2018			
	ESM 110	**ESM 120**	**Total**
A	6	1	7
B	26	4	30
C	38	4	42
D	10	2	12
F	4	0	4
Total	84	11	95
Passing Rate	**83 %**	**82 %**	**83 %**
	ESM 10S	**ESM 20S**	**Total**
Credit	81	10	91
Non-Credit	3	1	4
Total	84	11	95
Passing Rate	**96 %**	**91 %**	**96 %**

In ESM 110, 70/84 students completed the course with a grade of C or better for a passing rate of 83.3 % (Table 1). In ESM 120, 9/11 students completed the course with a grade of C or better for a passing rate of 81.8 %. Overall, the mean course gpa in ESM 10 was 2.24 and the mean course gpa in ESM 120 was 2.36. Nearly all of the students in ESM 10S and ESM 20S received credit for their support class (91/95, or 95.8 %).

These course results compare well with the Math 110 and Math 120 course outcomes from fall 2017 and spring 2018 as well, with passing rates from the summer ESM courses exceeding those in Math 110 and Math 120 from both fall 2017 and spring 2018 (Table 2). The ESM 110 and 10S courses taught by Dr. Cherlyn Converse and Dr. Armando Martinez-Cruz. The ESM 120 and 20S courses were taught by Dr. Dwight Wynne.

Table 2: Math/ESM 110 and 120 Course Results Fall 2017 through Summer 2018							
	Math/ESM 110				**Math/ESM 120**		
	Fall 2017	**Spring 2018**	**Summer 2018**		**Fall 2017**	**Spring 2018**	**Summer 2018**
GPA	2.53	2.16	2.24		2.20	2.49	2.36
No. of St.	748	319	84		319	286	11
Pass Rate	**82.5%**	**72.1%**	**83.3%**		**71.2%**	**79.3%**	**81.8%**

<u>New Courses.</u> We have also developed and are offering three new courses for both native and transfer students in the major: Math 107, Introduction to Computational and Linear Algebra; Math 180, Strategies of Problem Solving; and Math 210, Introduction to Laplace and Fourier Series. These courses introduce first-year students to higher levels of mathematics thinking and applications than are traditionally found in the math curriculum, and count towards the Cognate. We recently completed a thorough self-study of the impact of these courses and found strong evidence that the courses are effectively providing students the opportunity to engage in higher-level mathematics earlier in their academic careers (Appendix 6).

II. *Department/Program Description and Analysis*

A. Identify substantial curricular changes in existing programs, new programs (degrees, majors, minors) developed since the last program review. Have any programs been discontinued?

Elevation of Applied Masters Degree Program to M.S. As stated earlier, the Department has already begun the process of elevating the Applied Masters Degree Program from an M.A. to an M.S. program. We hope to have this completed by the end of the 2018-19 academic year.

New Programs. Two programs have been created and one program has been discontinued since the last review. As discussed at length elsewhere in this report, the Developmental Math program has been discontinued per EO 1110 of the Office of the Chancellor. However, a new graduate program in Statistics and a new undergraduate concentration in Actuarial Science have been created and are fully functional.

Master of Science in Statistics. Our Master of Science (MS) degree in Statistics offers a state-of-the art curriculum with the aim of serving the growing demand for professionals with knowledge and training in data science and quantitative analysis. The program can be taken and completed via face-to-face classes, fully on-line, or using a mixed/hybrid approach, depending on student needs. It is one of only a handful of such programs in the country and the only one of its kind in the CSU. Program features include:

(1) Convenient class times for both full-time and part-time students. Classes are offered in late afternoon and evenings.

(2) Your choice to attend classes in person, or remotely via live stream. The program is unique nationally in that it is the first master's degree in statistics that broadcasts all its courses live via online two-way stream. Students can choose to attend courses remotely, via a two-way live stream, or in person at the CSUF campus.

(3) Fully online program to accommodate non-local students. All students can complete the program by attending courses online, submitting and presenting projects and homework online, and taking exams online.

(4) Prepare to join a Ph.D. program or the workforce. The courses are designed to serve students interested in continuing their graduate education by attaining their Ph.D., as well as those who plan to immediately join the workforce upon graduation.

(5) Teaching Associate opportunities for qualified students. We offer interested masters students, depending on availability, part-time instructor positions where they teach one or more of our elementary mathematics courses. Applications for the Teaching Associate (TA) position are accepted beginning in March of each year to teach the following fall semester.

(6) Non-resident fee waivers. A limited number of non-resident fee waivers are available on a competitive basis for highly qualified non-resident students.

As a coherent and modern scientific discipline, statistics provides fundamental tools for the collection, analysis, and presentation of data. This definition justifies the universal applicability of statistical methodologies in making informed decisions. Consequently, statisticians are highly in demand in almost every sector of the workforce, from academic settings and industrial companies, to governmental agencies. Hal Varian, an emeritus professor of economics at UC Berkeley and current Chief Economist at Google calls statistics "the dream job of the next decade." The 2008 National Employment Matrix, provided by the Bureau of Labor Statistics, reflects the sharp presence of statisticians in a variety of labor segments:

(1) manufacturing areas such as chemical manufacturing, pharmaceutical and medicine manufacturing, computer and electronic product manufacturing, and medical equipment and supplies manufacturing

(2) information sector in sub-areas such as publishing industries, data processing, hosting online servers, and related services

(3) finance and insurance, credit intermediation, securities, commodity contracts, insurance carriers

(4) professional, scientific, and technical services such as architectural, engineering, computer systems design, scientific research in physical, engineering, and life sciences, social sciences, and humanities

(5) management companies and enterprises

(6) administrative support and waste management and remediation services

(7) educational services, public and private

(8) health care and social assistance

(9) civic, social, professional, and similar organizations

(10) government, including federal government, postal service, state and local government

(11) self-employed statisticians

The following governmental agencies and their many branches have permanent open positions for statisticians at the level of Bachelor's, Master's, and Ph.D.: U.S. Food and Drug Administration, Bureau of Labor Statistics, U.S. Department of Agriculture, U.S. Census Bureau, National Institute of Health, Centers for Disease Control and Prevention (CDC), National Security Agency (NSA), RAND Corporation, National Highway Traffic Safety Administration, National Institute of Standards and Technology, Environmental Protection Agency, Justice Department, Weights and Measures Office, NASA, and U.S. Navy.

A glimpse at the existing job openings in the private industry would lead us to a large list of nationwide employers, constantly seeking statisticians' expertise, including Smith Hanley Consulting Group, Astra-Zeneca international pharmaceutical company, Novartis AG , Vertex Pharmaceuticals, Amgen, Biogen, Children's Hospital Boston, Brigham and Women's Hospital, Beth Israel Deaconess Medical Center, Accenture Information Group, SAS Database Company, Thomson Reuters, Cytel, Novartis Institutes For Biomedical Research, Dana-Farber Cancer Institute, Vanguard, Hyatt Hotels Corporation, and other opportunities in the tech industry.

The versatility of statistics-related jobs only adds to their popularity and attraction. The vast applicability of statistical analyses and consequently the high demand for statisticians' skills, contributes to the highly favorable statistics job environments, so that "statistician" is often ranked as one of the nation's best jobs. To give an example, one of the most reliable professional desirability surveys conducted by the private group careercast.com ranked "statistician" as the 4th best job among 200 different professions in the country in 2011. The survey was based on a variety of factors such as employment growth potentials, income growth potentials, and hiring outlooks. In addition to accommodating job environments, statistical jobs are known for their competitive salary compensations.

<u>Bachelor's Degree in Mathematics, Actuarial Science.</u> Currently, there are only three programs in California recognized as Universities and Colleges with Actuarial Programs – Advanced Curriculum (UCAP - AC) by the Society of Actuaries, and CSUF proudly represents one of them. CSUF's Center for Insurance Studies (CIS) attracts and educates talented individuals who are committed to professional careers in insurance and risk management. CIS, in partnership with the Department of Mathematics, offers an undergraduate Actuarial Science Concentration as well as graduate actuarial science courses.

The Center also provides actuarial workshops and exam study materials. In 2017, CIS was given the prestigious Global Center of Insurance Excellency (GCIE) award, presented by the International Insurance Society and selected by the Best's Review as one of the top 20 RMI programs nationwide. Appendix V gives the program brochure. We have also developed Math 437, Modern Data Analysis, for both AS and P&S students.

For the past two years the Actuarial Science Concentration has been the fasting-growing of the six concentrations in the Department.

Creation of a New Cognate. As mentioned earlier, in an effort to help allow students experience mathematics and applications of mathematics of mathematics earlier in their academic careers, the Department and the College have created a new set of Cognate courses: Math 107, Introduction to Computational Linear Algebra; Math 180, Strategies of Problem Solving; Math 210, Introduction to Laplace and Fourier Series; and CNSM 101, Think Like Einstein. Two of these math courses were first offered in fall 2017, and one in spring 2018; CNSM 101 was offered in fall 2018. We are hopeful that these early experiences will help "hook" students into the major by getting to see some of the more sophisticated ideas of mathematics early on.

B. Describe the structure of the degree program (e.g. identify required courses, how many units of electives) and identify the logic underlying the organization of the requirements.

Undergraduate Program The undergraduate major program is designed to give sufficient breadth and depth in the study of mathematics to prepare students either for a career requiring a strong mathematics background or for subsequent graduate study in mathematics or related areas. The Bachelor of Arts Degree in Mathematics is built around a set of core requirements, consisting of 25 units, including three semesters of calculus, a sophomore-level course in differential equations and linear algebra, and upper-division courses in linear algebra and advanced calculus. The set of core requirements also includes a sophomore-level course designed to help students transition from their procedurally oriented lower-division courses to the more theoretical and conceptual demands of upper-division course work. In addition to meeting the core requirements, students choose one of six concentrations, each consisting of between 21 and 23 units of coursework.

In addition to the core and concentration requirements, each mathematics major must also complete a set of courses in one of seven outside cognate areas with substantial applications of mathematics (actuarial science, computer science, economics, information systems and decision science, physics, chemistry, or civil engineering), or from a selection of upper-division mathematics courses in a concentration different from the one the student has chosen. For students interested in participating in a research project, the Department also offers a research cognate, where students satisfy the cognate requirements by participating in a research seminar and writing a thesis paper.

Finally, each undergraduate major is required to satisfy an elementary computer programming requirement, which can be met with either a course in the Computer Science Department or in the Mathematics Department, and to satisfy the University's writing requirement, which most of our majors achieve by completing our writing-oriented course, Math 380, History of Mathematics.

Graduate Program At the graduate level we offer three options: MA in Applied Mathematics, MS in Statistics and MA in the Teaching of Mathematics. There is also a Special Topics Program to meet individual student needs. We also offer a Teaching Credential Program in Mathematics.

Applied Program

The Applied Program has been in place since 1985 although the coursework itself was initiated in 1981. This program, originally designed for individuals seeking positions in industry involving mathematical or quantitative applications, has broadened to now include students wishing to enter the field of college or university teaching. The subject matter emphasizes modern practical applied mathematics, modeling, problem solving and computation. The culminating experience is a project in which students have the opportunity of working in teams on a current problem or issue, contracted and paid for by a local industrial firm. Enrollments in this program have slowly but steadily increased during the past seven years.

Statistics Program
The Statistics Program has been in place since 2012. This program is offered as face-to-face, entirely on-line, or as a hybrid depending on the student's needs. It is our fastest growing graduate program and is the first such program in the CSU. The subject matter emphasizes modern practical applied statistics, modeling, problem solving and data mining. Graduates of the program have been extremely successful getting college teaching positions and positions in industry.

Teaching Program
The Teaching Program is designed for secondary and community College teachers, as well as for students interested in a doctoral program in mathematics education. The program was originally started in the late 1960s with an NSF grant and has undergone continuous evolution in coursework and philosophy since that time. Graduates from this program occupy many positions of leadership in area middle schools and high schools. Some have gone on to further graduate work in mathematics education. Indeed, nearly every community College in southern California employs graduates from this program as full time or part time faculty. The program has continued to maintain very healthy enrollments during the period under review.

Special Topics Program
Under certain circumstances, a plan of study leading to a Master of Arts in Mathematics may be designed to provide advanced work in mathematics. A personalized study plan to meet the objectives of each student may be developed within the general framework of the degree requirements. The program is used very rarely.

Teaching Credential Program
This robust program has been ongoing since the beginning of the formation of the department. The program credentials approximately 15-20 students per year in teaching secondary level mathematics. Our math teachers can be found actively involved as teachers and leaders in virtually every school district in the greater Orange County area.

C. Using data provided by the Office of Assessment and Institutional Effectiveness to discuss student demand for the unit's offerings; discuss topics such as over enrollment, under enrollment, (applications, admissions and enrollments) retention, (native and transfer) graduation rates for majors, and time to degree.

The Office of Analytical Studies and Institution Research has provided historical data on student demand, enrollment, graduation rates, faculty allocation and student-faculty ratios. This information has been summarized in tables, which can be found in Appendices I and II. This section gives a discussion and summary of this information.

<u>Undergraduate Programs</u>. Focusing first on student admissions into the mathematics major, the admission rate for the first-time freshmen applicants in the Mathematics Department has been around 75% for the academic years spanning 2013-2018 (Appendix I Table 1-A). This percentage is up slightly from the 70% rate reported in our previous PPR. The Department has maintained an 18% enrollment rate among the admitted first-time freshmen group, down from the 25% rate from our previous PPR. The enrollment rates are higher for the upper division transfers (Appendix I Table 1-B). These rates fluctuate around 40%

for the latter group, perhaps reflecting the determination of a more seasoned group of students interested in majoring in mathematics. However, this is significantly down from the 60% rate in our last PPR.

The lower division enrollment in FTES in the Mathematics Department had been on a gradual decline for the period of 2013-2018 (Appendix I Table 2-A). However, enrollments in the upper division have increased from 218 to 287, for a growth rate of 32%. It should be noted that the FTES per headcount has remained at 0.80 for the entire 6 years of this study (Appendix I Table 2-B), a sign that mathematics majors at CSUF tend to maintain their full-time status. This has undoubtedly contributed to a more positive academic experience for our majors, resulting in graduating more skilled mathematicians in the various concentrations within the program. Moreover, the FTES for majors increased from 92.2 to 121.8, for a gain of 32%. In summary, while the lower division FTES has slightly declined, the upper-division course FTES and math major FTES have grown significantly.

During the period of 2010-2014, the campus annually admitted from 40 to 68 first-time freshmen mathematics majors during the six years of study, while the associated counts vary from 36 to 39 for transfer students (Appendix I Tables 3-A and 3-B). Both of these are sharp gains of the 21-16 and 21-33 ranges, respectively, reported in our last PPR. In the freshmen category, there was a surge in the four-year graduation rate among those freshmen admitted in 2010 (29.2%). In this cohort, 11.9% finished their undergraduate work in the major, whereas 17.3% graduated outside the major. The proportion of four and five year graduation rates in the major was somewhat the same over the six years, whereas a significantly lower percentage of students who graduated in the major took more than five years to graduate. Expectedly, a higher proportion of students graduating outside the major demonstrated longer graduation times (five years or more). All of these graduation rates are about the same as those reported in our previous PPR.

This may be taken as a sign that to many students the challenges of completing a major in mathematics only settles in after a preliminary phase of being exposed to foundational math ideas such as calculus. Prior to 2017, the degree was structured so that it is only after taking a series of calculus courses that students in the various mathematics concentrations are able to experience more specialized and complex upper division mathematical courses. However, with the introduction of the new Cognate comprised of Math 107 (Introduction to Computational Linear Algebra, Math 180 (Strategies of Problem Solving), 210 (Introduction to Laplace and Fourier Series), and CNSM 101 (Think Like Einstein), first-year students can get exposure to more sophisticated mathematical ideas. In addition, a larger percentage of transfer students graduated in three or four years. Typically, this group consists of Community College transfers who have already satisfied calculus and linear algebra requirements, and at times, a large number of General Education units. This background clearly facilitates their eligibility to decide on a concentration in the major and hence taking the required upper division courses.

During the six-year period detailed in Appendix I Tables 3-A and 3-B, the overall graduation rate of freshmen mathematics majors within the math major was 20.8%. For transfer students, the three-year graduation rate within the major was higher at 43.7%. In the time period from 2013 to 2017, the Department has graduated 209 students in the major. Appendix I Table 4 shows that overall the graduation counts in all for the mathematics major increased from 46 to 63, a bump of 36.9%.

Graduate Programs. The graduate programs in the Department have benefited from consistently high numbers of applicants and have consequently secured 27 to 43 new enrollments per year in 2013-2018 (Appendix II Table 5). Nearly 90% of these applicants were accepted, with more than half (56.3%) of these enrolling in a graduate program in mathematics.

The graduate program annual enrollment in terms of FTES ranges between 30 and 53 for 2013-2018 (Appendix II Tables 6-A and 6-B). Our FTES peaked in 2016-17 at 54.2, a possible reflection of the difficult job market leaving education as an alternative for students who were unemployed or under employed. This was much higher than the figure of 30.8 reported in our last PPR and was probably a result of the creation of the M.S. in Statistics program in 2015. A solid majority of the graduate students finish their program within three years after their enrollment (Appendix II Tables 7 and 8), nearly two-third (67.8%) completing their degree.

In summary, the Department has awarded an average of 33 masters degrees per year in the 2013 to 2017 period, with higher counts of graduation in 2016-2017 with 47 degrees awarded. The stabilized pattern of awarded masters degrees perhaps mirrors not only the success, but also the popularity of our three graduate programs.

The Department's Single Subject Credential Program has also had steady enrollment. Departmental records show that between 16 and 25 students have been in this program each year from 2013 to 2018. Each of these students is full-time and takes 15 units each semester. The student success rate in this program is high with over 90% of these students completing their requirements for the credential. In addition, essentially 100% of these students are successful in securing teaching positions in the public schools.

<u>Enrollments in Redesigned Courses.</u> Per EO 1110, the Department redesigned three courses for the AY 2018-19. Math 110 (Liberal Arts Math) and Math 120 (Intro to Statistics) were both redesigned to include more student-centered activities and active learning. We also developed a one-unit support course (10S and 20S, respectively), for students who may need extra support. The Department also created a new course, Math 115A, which is the first of a two-course sequence (115A and B) that, together, are equivalent to Math 115, College Algebra. Each of these is a three-unit course and Math 115A, which is a "flipped" course, meets the GE B4 requirement. Each of these redesigned and new courses was created to accommodate CSU category M3 and M4 students who, prior to EO 1110, would have been placed into remedial math courses.

We piloted Math 110/10S and Math 120/20S in summer 2018, and will pilot Math 115A, together with these two courses, in fall 2018. As described earlier, students were very successful in each of these summer courses; we will report the fall 2018 outcomes when they are available.

Enrollments for Math 110 and Math 120 for fall 2018 were much lower than in past fall semesters. In fall 2017 we ran 15 sections of Math 110; in fall 2018 we are running 7 sections. Similarly, in fall 2017 we ran 12 sections of Math 120; in fall 2018 we ran 5 sections. The Math 115A enrollments are strong with five sections offered, each with enrollments in the mid-thirties.

There are at least three factors that could be impacting fall enrollments. First, non-STEM students are not required (in fact, are discouraged) from taking their math course in the fall semester. While this recommendation has been in place for several years, it seems that only recently it is being effectively communicated to incoming students. Second, the ALEKS PPL system is being used, essentially for the first time, for placement into calculus/precalculus/college algebra. And third, with the emphasis on STEM, Health, and Business as viable career options, more students may be gravitating towards the precalculus/college algebra track.

D. Discuss the unit's enrollment trends since the last program review, based on enrollment targets (FTES), faculty allocation, and student faculty ratios. For graduate programs, comment on whether there is sufficient enrollment to constitute a community of scholars to conduct the program.

Data provided from IRAS give Undergraduate and Graduate Program Enrollments in FTES from 2013-14 to 2017-18 (Appendices I and II, Tables 2A and Table 6, respectively). Using institutional records, we confirmed these numbers and also retrieved data from 2011-12 and 2012-13 so that the record would give a full reflection of enrollment trends since our last PPR. Table 9 below gives total undergraduate and graduate FTES by semester and year for this time period.

Year	Fall FTES	Spring FTES	AY FTES
2011-12	1877.25	1256.95	1567
2012-13	2104.03	1308.02	1706
2013-14	2223.35	1424.58	1824
2014-15	2173.08	1424.88	1799
2015-16	1958.62	1583.45	1771
2016-17	2014.55	1607.25	1831
2017-18	2009.32	1613.14	1811

Table 9: Total Undergraduate and Graduate FTES by Semester and Year from 2011-12 to 2017-18

The Dean's Office of the CNSM provided FTEF during this same time period; these data are given in Table 10 below.

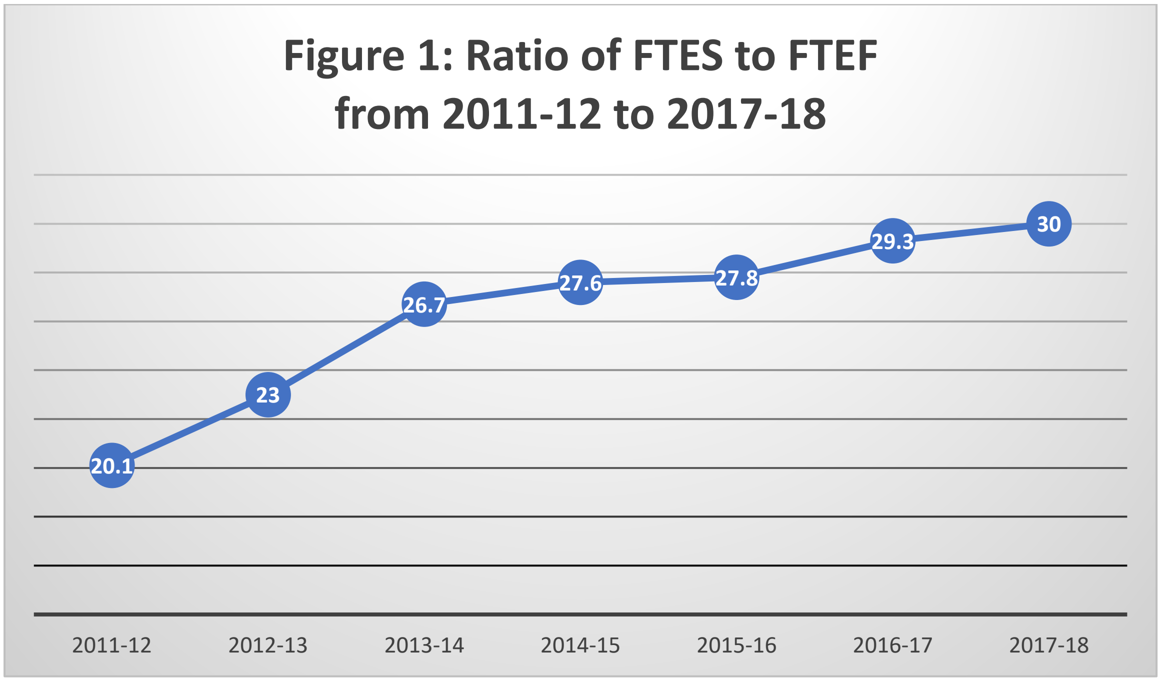
Year	Tenured	Tenure Track	Sabbaticals at 0.5	FERP at 0.5	Lecturers	Actual FTEF
2011-12	15	10	0	4	60	78.03
2012-13	15	9	3	5	69	74.03
2013-14	19	7	2	4	73	68.42
2014-15	19	8	2	3	78	65.23
2015-16	17	14	2	4	72	63.69
2016-17	19	15	0	1	68	61.89
2017-18	19	15	0	1	65	60.45

Table 10: Total FTEF from 2011-12 to 2017-18

Table 11 gives ratio of FTES to FTEF over this time period. Examining this ratio shows a clear trend. In 2010-11, this ratio was 20.1; in 2017-18 the ratio had grown steadily to 30.0 (Figure 1). Thus, in the seven years since our last PPR, the Department's FTES to FTEF ratio has grown by 9.9 students per faculty member, for a growth rate of 49.3%.

AY	FTES/FTEF
2011-12	20.1
2012-13	23
2013-14	26.7
2014-15	27.6
2015-16	27.8
2016-17	29.3
2017-18	30.0

Table 11: Ratio of FTES to FTEF from 2011-12 to 2017-18



E. Describe any plans for curricular changes in the short (three-year) and long (seven-year) term, such as expansions, contractions or discontinuances. Relate these plans to the priorities described above in section I. C.

As discussed earlier, CSUF discontinued offering remedial courses effective summer 2018. We have created and implemented university and GE (B4) credit courses, namely College Algebra A, Math for Liberal Arts with a Support Course, and Introduction to Statistics with a Support Course, which was offered on a multi-section scale in fall 2018. We are also aligning our calculus courses to help ensure validity and reliability in student outcomes in these multi-section courses. Many of these courses are taught using a non-traditional flipped model, and all of them have Supplemental Instruction support available. The SI leaders are undergraduate math majors. Thus, these changes link directly to goals 1, 2, 3, and 5 in section I.C. We will continue to assess and refine these courses in the future.

F. Include information on any Special Sessions self-support programs offered by the department/program.

As discussed in section ID, the Department has continued to offer a robust summer program, including courses in remedial math, GE, LD and UD, and graduate courses. Over the last eight summers the Department has offered a decreasing number of sections ranging from 32 down to 26. As mentioned earlier in this report, effective summer 2018, remedial classes – other than a one unit online Math 20 – were no longer offered. However, we did offer a pilot section of Math 110 with the 10S support section and Math 120 with the 20S support section. We will continue to assess and refine these summer courses as we go along.

III. ***<u>Documentation of Student Academic Achievement and Assessment of Student Learning Outcomes</u>***

Because student learning is central to our mission and activities, it is vital that each department or program includes in its self-study a report on how it uses assessment to monitor the quality of student learning in its degree program(s) and/or what plans it has to build systematic assessment into its program(s). Please provide information on the following aspects, and if applicable, please feel free to include relevant documents in the Appendices.

A. **Describe the department/program assessment plan (e.g. general approach, time table, etc.) and structure (e.g. committee, coordinator, etc.), and if applicable, how the plan and/or structure have changed since the last PPR.**

Departmental self-assessment. The math department currently assesses student learning outcomes in both its service courses as well as the major as a whole. The primary assessment tool that we utilize in our service courses is embedded questions on final exams. We currently collect this data for Math 110 (Math for Liberal Arts Students), Math 115 (College Algebra), Math 125 (Precalculus), Math 150AB (Calculus), and Math 303AB (Fundamental Concepts of Elementary Mathematics).

Our undergraduate major program is built around a set of core requirements, consisting of 25 units, including three semesters of calculus (Math 150A–250A), and a sophomore-level course in differential equations and linear algebra (Math 250B). For the mathematics major, Calculus is a common thread that impacts the curriculum at both the lower and upper division levels, so Math 150A/B are particularly good courses to assess intellectual literacy at an early stage in the program. Moreover, Calculus requires math majors to think critically, use analytical and quantitative reasoning, and apply concepts to new situations, challenges, and everyday problems. We therefore feel that this is an important course to obtain an early idea whether the appropriate learning goals are being met and so include embedded questions on the final exam.

Student self-assessment. In an effort to help direct and encourage students to think towards a four-year graduation plan, the Department developed Eight Term Academic Plans, or 8-TAPS, for each of the six Undergraduate Concentrations in Mathematics (Appendix III). Each of these outlines the complete set of math, GE, and other courses that the student needs to take each semester in order to graduate in four years. In advising students in the AY 2017-18, advisors found these to be extremely useful for students, including non-native students, to provide a clear visual overview of where they are in their academic trajectory and where they are going. Feedback from students was likewise highly positive.

B. **For each degree program, provide the student learning outcomes (SLOs); describe the methods, direct or indirect, used to measure student learning; and summarize the assessment results of the SLOs.**

Five student learning outcomes (SLOs) have been identified as being essential for all majors in mathematics. These are listed below in Table 12 along with the University-wide Student Learning Outcomes (USLO) to which they correspond.

Table 12: Student Learning Outcomes for Mathematics Undergraduates
1. Understand and construct mathematical proofs. (USLO I, II) 2. Communicate mathematics in written and oral forms. (USLO III) 3. Use mathematics to solve problems. (USLO II) 4. Be competitive in the job market and/or in pursuing graduate education. (USLO I, II) 5. Utilize technology when doing mathematics. (USLO II)

The Department of Mathematics also has three Masters level programs (MA Mathematics (Applied Option), MA Mathematics (Teaching Math Option), MS Statistics). The graduate committees for each of these programs developed Student Learning Outcomes specific to their disciplines. These outcomes are listed below.

Student Learning Outcomes for MA Mathematics (Applied Option)
1. Use mathematical and computational methods to solve real-world problems. 2. Communicate mathematical and computational findings in written and oral forms. 3. Be competitive in the job market and/or be ready to pursue a Ph.D. degree.

Student Learning Outcomes for MA Mathematics (Teaching Math Option)
1. Make sense of problems, persevere in solving them and pose other problems. 2. Be competitive in the job market, and/or be prepared to continue graduate studies at the Ph.D. level. 3. Communicate mathematics in written and oral forms.

Student Learning Outcomes for MS Statistics
1. Will be able to decipher and solve real world problems. 2. Will be able to utilize technology and statistical software to construct statistical models and perform statistical computations. 3. Will be able to communicate statistical findings in written and oral forms. 4. Will be competitive in the job market and/or be prepared to continue their graduate studies at the Ph.D. level.

Beginning during the 2014–2015 academic year (2015–2016 for the graduate programs), as part of the University's annual assessment exercise, the department's Assessment Committee collects data for these outcomes on an ongoing basis, but assesses one outcome per year program. Generally, the Assessment Committee consists of four or five members and is selected by the department chair to include at least one member from each of the department's concentrations (Applied, Pure, Teaching, Statistics). Members of the Assessment Committee coordinate with instructors of various upper-division and/or graduate courses to collect data relevant to assessing the Student Learning Outcomes. Typically, the Assessment Committee does not mandate the form or content of the question, but rather confers with the instructor as to what type of existing assignments will meaningfully assess whether students are meeting the department's learning outcomes. For each Student Learning Outcome, a benchmark for success is chosen before completing the assessment exercise. If the benchmark is met, then no further action must be taken. However, even when the benchmark is met, if the committee finds that improvement actions are warranted, they will bring these suggestions to the department for discussion and action. If the benchmark is not met, then the Assessment Committee will consult first the department chair and, if necessary, the department's Curriculum Committee to determine what improvement actions are necessary.

Thus far, the department has assessed three of the Student Learning Outcomes for each program, meeting the benchmarks in all but one case. During the 2016–2017 assessment of the BA Mathematics SLO on Communication, the Assessment Committee found that the department had met the benchmark, but that improvement action was still necessary. The department designed three new lower-division courses meant to address, among other things, the findings of the Assessment Committee. Additionally, several faculty members obtained a university grant to assess the impact of these courses. The one instance in which a program failed to meet its benchmark was during the 2017–2018 assessment of the BA Mathematics Student Learning Outcome on Problem Solving. The issues noted by the Assessment Committee are likely to be addressed by the three new courses noted above. Consequently, no improvement were immediately taken. When the Problem Solving outcome is assessed again, if no significant changes are seen relative to the benchmark, then the department will decide on more substantial changes that will enhance student learning. Direct assessments were determined by course grades and grading of common assessment questions across the department in multi-section courses. Indirect assessments were determined by faculty conversation about curriculum design and the role of technology (Appendix VII).

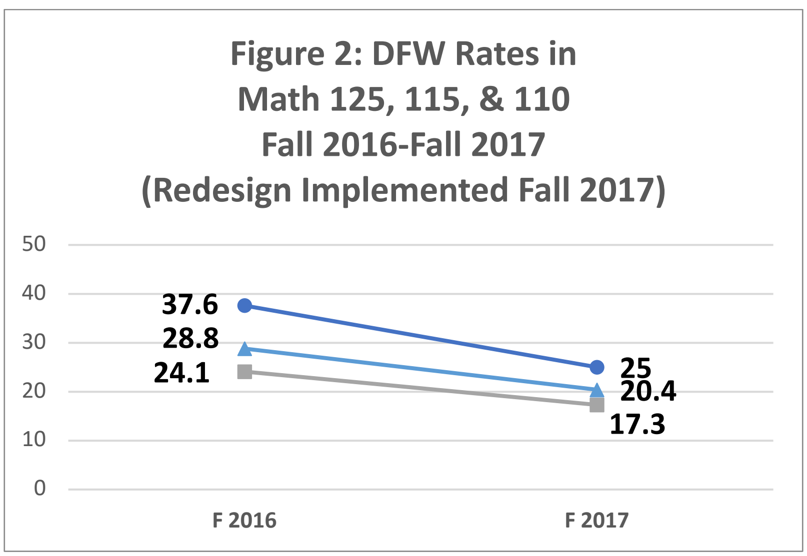
C. Describe whether and how assessment results have been used to improve teaching and learning practices, and/or overall departmental effectiveness. Please cite specific examples.

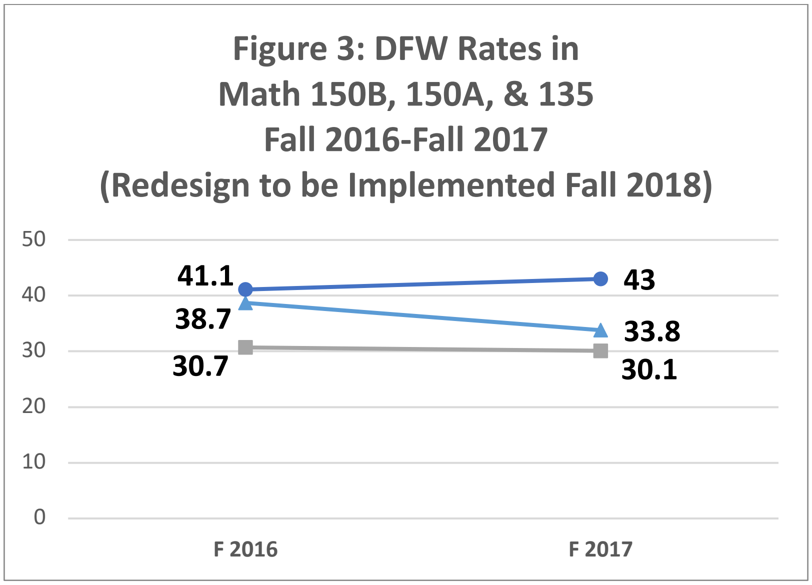
During this past cycle the CO began a system-wide study to identify and address so-called “bottleneck” courses that impede students’ success, retention, and progress to graduation. As discussed earlier in this report, the Department has gotten out in front of EO 1110 called for the end of remedial programs and the development of credit-bearing mathematics courses that offer additional support for students as needed.

At CSUF the following courses were identified as bottleneck courses based on high DFW rates: Math 110 (Liberal Arts Math), Math 115 (College Algebra), Math 120 (Introduction to Statistics), Math 125 (Precalculus), Math 135 (Business Calculus), Math 150A (Calculus I) and Math 150B (Calculus II). Based on data from the fall semesters 2015-17, the department did a comprehensive analysis of the student outcomes of courses (Appendix IV). Main findings included the following:

- About two-thirds of all of our calculus courses are taught by part-time lecturers; and
- There are no significant course grade differences in these courses between part-time lecturers and full-time faculty

By fall 2017 we had already implemented course redesign in Math 110, 115, and 125. Per the CO’s directive of comparing course outcomes from fall 2016 as the baseline semester and fall 2017 as the first trial semester, we found that the three courses that the DFW in all three of these courses had fallen significantly (Figure 2). Not surprisingly, the outcomes for the re-aligned calculus courses, which will be piloted in fall 2018, remained the same during this time (Figure 3).





The Department is taking seriously the challenge to reduce the DFW rate in the calculus classes. In summer 2018 two teams of faculty, including both full-time faculty and part-time lecturers, worked over a two-month period to re-align the Math 130, 135, 150A, and 150B calculus courses. The goal here was to create a common syllabus, grade components, grade weights, grading rubrics, as well as assessments that were directly linked to the course learning goals (Table 13).

Table 13: Department of Mathematics
Calculus Course Alignment Team
Summer 2018

Goal
To create course structures in entry-level calculus courses that help ensure consistency and efficiency in the course for both students and instructors.

Meeting Dates and Times

Friday June 8, 9:00 am – 1:00 pm	Intro/work begins
Friday June 22, 9:00 am – 1:00 pm	Course Syllabi completed
Friday July 6, 9:00 am – 1:00 pm	Assessments and Final Exam completed
Friday July 20, 9:00 am – 1:00 pm	Summary/future directions

Products
1. Create a sample Course Syllabus that includes a common Grading Components/Weights, Grading Scale, and Course Timeline.

2. Create sample exams/assessments with questions that are aligned with the Course Learning Goals. It may be helpful to create two versions of each exam/assessment.

3. Create a sample comprehensive final exam/assessment that is aligned with the Course Learning Goals. It may be helpful to create two versions of the comprehensive final exam/assessment.

D. Describe other quality indicators identified by the department/program as evidence of effectiveness/success other than student learning outcomes (e.g. graduation rate, number of students attending graduate or professional school, job placement rates, etc.).

Giving. One indicator of program impact is the giving record over time. During the five-year period from 2013 to 2017, to the Department has received more than 1.3 million dollars in giving (Table 14). This includes a $920,000 scholarship gift from the estate of former math faculty member Dr. Russell Benson. During this time, the Bonsangue Family Scholarship was established as an endowed scholarship, and the Gannon scholarship is in the process of being endowed for 2018-19. Dr. Bonsangue (active) and Dr. Gannon (retired) are both math faculty members. Each of these has received funding from alumni as well as from colleagues. The Cher and Carl Carrera Scholarship and Kathryn Godshalk Memorial Scholarship, were established to honor math alums Cher Carrera and Kathy Godshalk. Project MISS is in its 25th year with support from a variety of corporations as well as private giving.

Table 14: Mathematics Department Giving by Fiscal Year, 2013-2017

Project		2013		2014		2015		2016		2017	
Code	**Name**	**Giving**	**Corp.**	**Giving**	**Corp.**	**Giving**	**Corp.**	**Giving**	**Corp.**	**Giving**	**Corp.**
070300	Proj. MISS	810	40000	979	57500	600	39040	1150	49500	1142	57500
070302	Math Dept.	440	2625	560	0	955	0	3330	0	1700	904
070316	Benson Grad.	n/a	n/a	460000	0	25000	0	6000	0	0	0
070317	Benson Under.	n/a	n/a	460000	0	25000	0	6000	0	0	0
070315	Carrera Schol.	667	0	25	0	50501	0	5000	5000	0	500
070340	Math Schol.	220	250	195	0	147	250	250	0	0	250
070346	Bons. Family	4028	0	3760	0	5811	0	2870	0	8530	0
070347	Math Circle	0	6000	0	6260	0	0	0	0	0	1000
070348	Gannon Schol.	n/a	n/a	750	500	11300	0	5800	0	1750	0
070349	Gdshlk. Schol.	n/a	n/a	2400	0	2400	0	0	0	0	0
TOTAL		6165	48875	928669	64260	71714	39290	28650	50250	13122	60154
ANNUAL TOTAL		**55,040**		**992,929**		**111,004**		**78,900**		**73,276**	

External Grants. During the fiscal years 2013 through 2018, the Department was awarded a total of 2.8 million dollars on 29 grant projects for which a Math Department faculty member was the Principal Investigator (PI). In addition, math faculty were co-PIs on two other major NSF grants totaling 5.3 million dollars. Awardees included both senior and junior faculty members.

Other. In spring 2018 Dean Johnson asked each department to put together a one page Summary of Accomplishments per CSUF President Virjee's request, reprinted below.

The Department of Mathematics at California State University, Fullerton, is the largest department on campus and one of the largest in the CSU system. In 2017-2018 we served more than 15,000 students in both entry-level and STEM service courses in mathematics. The Department has been actively involved in strengthening student outcomes, as evidenced by its robust Supplemental Instruction program and the development of "flipped" classes. The Department has been a leader in the state on presenting these models across the CSU, with four faculty members having been invited to present hour-long webinars for the Chancellor's Office on developing and implementing flipped classes, statistics support courses, and non-traditional assessment practices. The Department has also been a leader in the GI-2025 and EO-1110 efforts, working closely with the CNSM Dean's office to develop new instructional models for students who may need additional support. Based largely on her work on these projects, mathematics associate professor Dr. Cherie Ichinose was recognized as the 2018 Carol Barnes Excellence in Teaching Award winner at Cal State Fullerton. This is the highest teaching recognition given at the university.

The Department has also been active in Scholarly and Creative activities. During 2017-18, faculty and students in the Department of Mathematics produced:

- Five books and two chapters in books. Six of these were written by Dr. Bogdan Suceava, and two included CSUF mathematics students as co-authors.
- More than 30 articles published in peer-reviewed journals. Nine of these included CSUF mathematics students as co-authors.
- More than 25 conference presentations given by mathematics faculty, including ten invited addresses.
- More than 40 posters presented by students at local and national conferences. Twenty-five of these were based on work done with faculty mentor Dr. Laura Smith.
- Five internal grants awarded to junior faculty members.
- Eight new or continuing major external grants totaling more than ten million dollars; five of these were led by Dr. David Pagni.

In spring 2018 CSUF mathematics students took home thirteen (13) different poster awards at the Joint American Mathematical Society/Mathematical Association of America Meeting in San Diego, and the Southern California-Nevada Section Meeting of the Mathematical Association of America. This was more than any other CSU campus and eclipsed a number of elite schools from across the country.

In addition, six (6) students have been admitted into Ph.D. programs in mathematics, statistics, or biostatistics for fall 2018 at various institutions, including the University of California campuses at Berkeley, Irvine, Riverside, and Santa Cruz.

E. Many department/programs are offering courses and programs via technology (e.g. on-line, etc.) or at off campus sites and in compressed schedules. How is student learning assessed in these formats/modalities?

<u>Online Course Offerings</u>
Since the previous PPR report the Department has approved and is offering fully on-line courses in College Algebra (Math 115 OL), Pre-Calculus (Math 125 OL), and Business Calculus (Math 135 OL). Math 115 OL and Math 125 OL are both synchronous courses; that is, the lessons are delivered in real time to students enrolled in the course via computer interface. The instructor can communicate verbally and in writing with the entire group as well as with students individually and can monitor their work and participation. Math 135 is asynchronous, whereby students work at their own pace to complete required assignments. In all three courses assessments/exams and the finial assessment/exam are proctored through Proctor U.

Success rates have been strong for students who complete the course. Typically, about one-third of the students withdraw from the course prior to the census date, perhaps because it becomes clear that the course will be the same amount of – and perhaps more – work than a traditional face-to-face course. Of those who complete the course the success rate is 75-80%.

<u>Two-day v. Four- or Five-day Classes</u>
One of the questions that we have wrestled with is this: *Is teaching in a 4 or 5 day per week format more effective than teaching in a 2-day per week format for 4 unit or 5 unit courses?* In the fall 2018 semester the question became especially relevant since the two-day classes filled up almost instantly, while the

four-day classes fill much more slowly, if at all. With the changes in remedial/GE requirements, together with tighter budgets and higher accountability, it is important to ensure that, all things being equal, our math classes are filled to room capacity.

Based on weaker enrollments in four-day per week classes as compared to 2-day per week in college algebra, precalculus, and calculus, we compared student outcomes (course grades) between 2-day and 4-day sections from the fall 2015, fall 2016, and fall 2017 semesters.

Math 115 (4 units) and 125 (5 units) are coordinated courses using the same assessments, grading rubrics, and grading scales. Since daytime and evening student populations may not be the same, we compared course grades in Math 115 College Algebra between day (starting before 4 pm) and evening (starting at 4 pm or later) for two-day and four-day classes. We did the same with Math 125 precalculus, which is offered in 2-day, 3-day, and 5-day per week formats. The results are given in Table 16 and Table 17.

Table 16: Math 115 Class Grades, Fall Semesters 2015, 2016, and 2017

	Two-Day Before 4 pm	**Two-Day After 4 PM**	**All Two- Day Classes**	**All Four-Day Classes**
Mean	**2.15**	**2.40**	**2.26**	**2.35**
Standard Deviation	0.34	0.49	0.41	0.34
Number of Sections	17	14	31	57

Table 17: Math 125 Class Grades, Fall Semesters 2015, 2016, and 2017

	Two/Three-Day Before 4 pm	**Two-Day After 4 PM**	**All Two/Three-Day Classes**	**All Five-Day Classes**
Mean	**1.92**	**2.07**	**2.00**	**2.06**
Standard Deviation	0.59	0.56	0.57	0.50
Number of Sections	11	13	24	32

In Math 115 grades were slightly (but not significantly) stronger in four-day classes v. all two day classes. In 125 there were no significant difference between grades in four-day classes v. all two day classes. There were borderline differences in 2-day morning/day classes v. 2-day evening classes ($p = .08$), perhaps reflective of a somewhat more sophisticated evening audience.

We also made the same comparison for Math 150A (Calculus I) and Math 150B (Calculus II). Table 18 gives the summary data for all 2-day and 4-day Math 150A and 150B course grades from the fall 2015, 2016, and 2017 semesters.

Table 18: Course Grade Data for Two-Day and Four-Day Sections of Math 150A and Math 150B from Fall 2015, Fall 2016, and Fall 2017 Combined

	Math 150A		**Math 150B**	
	Two-Day Secs.	**Four-Day Secs.**	**Two-Day Secs.**	**Four-Day Secs.**
Average	**2.05**	**2.03**	**1.78**	**1.68**
Standard Dev.	0.23	0.41	0.41	0.36
Number of Secs.	26	30	33	34

In Math 150A the mean grades were 2.05 and 2.03, a very close match. In Math 150B, the mean grades were 1.78 and 1.68, with the (non-significantly) higher grade linked to the two-day classes. In short, the number of times the class met per week was not associated with a higher or lower mean course grade (Figure 4).

This data was shared with each faculty member, many of whom seemed surprised that the four-day or five-day class grades were not “better” than those from the two-day classes. This information was helpful both for challenging assumptions about our courses and for shaping the fall 2019 schedule. We will be offering mostly 2-day formats for the 4-unit courses and 2-day and 3-day formats for Pre-calculus. We will continue to offer 4-day formats for instructors who indicated that they preferred these as well.

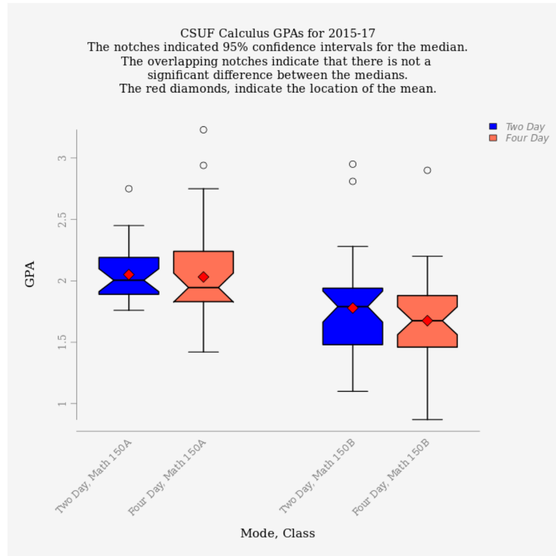


Figure 4: Confidence Intervals for Math 150A and Math 150B Course Grades

APPENDIX I. UNDERGRADUATE DEGREE PROGRAMS

PPR Tables Mathematics (BA, MA)

Office of Assessment and Institutional Effectiveness

TABLE 1. Undergraduate Program Applications, Admissions, and Enrollments

TABLE 1-A. First-time Freshmen: Program Applications, Admissions, and Enrollments

AY	applied	admitted	enrolled
2013-2014	404	302	57
2014-2015	367	278	44
2015-2016	402	295	54
2016-2017	546	402	73
2017-2018	529	415	56

TABLE 1-B. Upper Division Transfers: Program Applications, Admissions, and Enrollments

AY	applied	admitted	enrolled
2013-2014	234	124	47
2014-2015	226	140	71
2015-2016	207	128	63
2016-2017	270	161	54
2017-2018	237	116	38

TABLE 2. Undergraduate Program Enrollment in FTES

TABLE 2-A. Undergraduate Program Enrollment in FTES

AY	LDFTES	LDFTESbyMajorsOnly	UDFTES	UDFTESbyMajorsOnly
2013-2014	1575.9	53.2	218.4	92.2
2014-2015	1528.4	64.0	231.1	100.3
2015-2016	1478.8	61.6	248.8	109.2
2016-2017	1492.0	67.5	285.9	121.8
2017-2018	1476.2	NA	287.3	NA

TABLE 2-B. Undergraduate Program Enrollment (Headcount)

AY	LowerDivision	UpperDivision	Total	FTESperHC
2013-2014	98.5	228.0	326.5	0.8

2014-2015	95.0	265.5	360.5	0.8
2015-2016	107.5	276.0	383.5	0.8
2016-2017	140.0	295.5	435.5	0.8
2017-2018	131.5	288.5	420.0	0.8

TABLE 3. Graduation Rates for Majors

TABLE 3-A. FIRST-TIME FRESHMAN GRADUATION RATES FOR MAJORS

EnteredIn	Headcount	InMaj4yr	AllMaj4yr	InMaj5yr	AllMaj5yr	InMaj6yr	AllMaj6yr
2010	68	5.9	10.3	14.7	42.6	20.6	63.2
2011	40	5.0	10.0	22.5	47.5	22.5	52.5
2012	42	4.8	19.0	11.9	42.9		
2013	57	8.8	21.1				
2014	44						

TABLE 3-B. TRANSFER STUDENT GRADUATION RATES FOR MAJORS

EnteredIn	Headcount	InMaj2yr	AllMaj2yr	InMaj3yr	AllMaj3yr	InMaj4yr	AllMaj4yr
2012	44	4.5	6.8	36.4	47.7	52.3	70.5
2013	41	4.9	4.9	24.4	36.6	29.3	43.9
2014	49	2.0	2.0	30.6	36.7		
2015	39	0.0	5.1				
2016	36						

TABLE 4. DEGREES AWARDED

CY	Degrees Awarded
2013-2014	46
2014-2015	49
2015-2016	48
2016-2017	63

APPENDIX II. GRADUATE DEGREE PROGRAMS

TABLE 5. GRADUATE PROGRAM APPLICATIONS, ADMISSIONS, AND ENROLLMENTS

AY	applied	admitted	enrolled

2013-2014	72	68	29
2014-2015	69	56	32
2015-2016	70	60	27
2016-2017	57	52	32
2017-2018	59	55	43

TABLE 6-A. GRADUATE PROGRAM ENROLLMENT IN FTES

AY	FTES
2013-2014	29.7
2014-2015	39.5
2015-2016	43.4
2016-2017	53.2
2017-2018	47.4

TABLE 6-B. GRADUATE PROGRAM ENROLLMENT IN HEADCOUNT

AY	headcount	FTESperHC
2013-2014	59	0.5
2014-2015	64	0.5
2015-2016	66	0.5
2016-2017	71	0.5
2017-2018	80	0.4

TABLE 7. GRADUATION RATES FOR MASTER'S-SEEKING STUDENTS

EnteredIn	headcount	pctGrad2yr	pctGrad3yr	pctGrad4yr
2012	38	50.0	60.5	63.2
2013	27	44.4	66.7	66.7
2014	31	51.6	67.7	67.7
2015	23	82.6	82.6	82.6

TABLE 8. MASTER'S DEGREES AWARDED

CY	Degrees Awarded
2013-2014	37
2014-2015	23
2015-2016	27
2016-2017	47

ASSESSMENT INQUIRY GRANT FINAL REPORT FOR "ASSESSING THE EFFECTIVENESS OF MATH 107/180/210 ON THE MATHEMATICS MAJOR"

LAURA SMITH CHOWDHURY, ADAM GLESSER, THOMAS MURPHY, AND MATT RATHBUN

1. Introduction

Three new courses have been introduced into the mathematics curriculum on a temporary basis with the hopes of improving student learning and performance in upper-division mathematics courses. Students have been advised into these classes, and incentivized through specific requirement replacement, but the courses are not mandatory.

MATH 180 (Strategies of Problem Solving). MATH 180 exposes students to the types of mathematical questions and methods of reasoning that are ubiquitous in upper-division mathematics courses and is specifically hypothesized to:

(1) Improve student success in two of the identified bottle-neck courses in the mathematics curriculum: MATH 280 (Strategies of Proof) and MATH 350 (Advanced Calculus);
(2) Achieve either specific learning objectives of the program, or objectives that support and reinforce student success generally;
(3) Increase feelings of community amongst mathematics majors;
(4) Help students determine whether the work required in the mathematics major aligns with their academic interests.

MATH 180 was first offered during the Fall 2017 semester and is being offered a second time during the Fall 2018 semester. A post-course survey has been administered to the first cohort of students, and a pre-course survey has been administered to the second cohort of students. Questions on the post-survey assess four specific topics:

(1) Whether the early exposure to mathematical ideas beyond Calculus has had any influence on decisions to stay with or to leave the mathematics major;
(2) Whether students perceived any changes in their problem-solving abilities and confidence with mathematics;
(3) Whether students who went on to take other math classes felt that they had benefited from MATH 180; and
(4) Whether the course had encouraged students to form study groups or community with other math majors.

Questions on the pre-survey get baseline data about the students including:

(1) The mathematics courses the students have taken;
(2) Which concentration of the major the students are currently in;
(3) The students' current attitude about their problem-solving abilities and about mathematics in general;

(4) The students' expectation about the role problem solving will play in their future; and
(5) The reasons the students chose to take MATH 180.

MATH 107 (Introduction to Computational Linear Algebra). MATH 107 gives a freshman level introduction to both mathematical programming and linear algebra and is specifically hypothesized to improve student success in two of the identified bottle-neck courses in the mathematics curriculum: MATH 250B (Introduction to Linear Algebra and Differential Equations) and MATH 320 (Introduction to Mathematical Computation). MATH 107 was offered for the first time during the Spring 2018 semester and will be offered a second time in Spring 2019. For this course, students were given a pre-course survey and a post-course survey to identify:

(1) Students' attitudes about programming and its relationship to their future careers;
(2) Students' confidence levels about preparation for MATH 250B and MATH 320; and
(3) Whether the course would be beneficial to add to the mathematics major.

MATH 210 (Introduction to Laplace Transforms and Fourier Series). MATH 210 teaches students how to solve differential equations using Laplace Transforms and series and is specifically hypothesized to:

(1) Generally improve student success in upper-division courses by reinforcing the key ideas in MATH 150B (Calculus II), which is an identified bottle-neck course; and
(2) Better prepare students for the more difficult conceptual courses in differential equations, namely MATH 250B, MATH 310 (Ordinary Differential Equations), and MATH 406 (Partial Differential Equations).

MATH 210 was first offered during the Fall 2017 semester and is being offered a second time during the Fall 2018 semester. A post-course survey has been administered to the first cohort of students. The main topics of the survey were:

(1) Whether MATH 210 reinforced and improved students' understanding of the topics from MATH 150B;
(2) Whether MATH 210 improved their confidence and abilities as a Math major;
(3) Whether MATH 210 helped build a spirit of community amongst the lower-division mathematics majors; and
(4) Whether the techniques learned helped in subsequent courses, particularly MATH 310 and MATH 250B.

2. Overall Student Outcomes

We have obtained data about students' current majors and enrollments in math courses from the Office of Assessment and Institutional Effectiveness. This data indicates that several students have decided to leave the mathematics major. The largest number of students changing majors correlates with taking MATH 180. The summary of the data below do not have any overlap in students that dropped courses or are not enrolled in math courses during the Fall 2018 semester. One student is not enrolled in any courses during the Fall 2018 semester (the student was in all three of these courses and not included in any of the counts below).

Course	Enrollment	Changed Major	No Fall 2018 course
MATH 180	48	11	9
MATH 210	18	2	2
MATH 107	25	1	1

The Office of Assessment and Institutional Effectiveness also provided us data on the grades that the students have received in other mathematics courses since completing one of these three courses. Of the MATH 180 students, five have taken MATH 280, and all of them have passed the course with a C or better. Of the MATH 210 students, six have taken either MATH 310 or MATH 250B. Of these, only one did not pass MATH 310 with a C or better.

3. MATH 180 Survey Results

The post-course survey for MATH 180 indicates promising answers to all four areas of inquiry. With 28 of the original 48 students responding, a response rate of 58.33% is relatively high for a follow-up survey of students. The Fall 2018 cohort consists of 59 students, all of whom completed the pre-course survey.

(1) The survey results show that only two students were either non-majors/minors in mathematics, or were unsure about their status when taking MATH 180. However, four are non-majors/minors now, and six indicate that they either do not intend or may not intend to finish their degree with a mathematics major or minor. The supporting written comments indicate that those still in the math major are highly enthusiastic and that they are more committed because of MATH 180, while those who have decided not to major in mathematics found it helpful to discover that the mathematics major did not align with their academic interests.

(2) The survey indicates that students feel the course positively affected their attitude and mathematical abilities. Of the respondents, 78.5% indicated that their attitude about mathematics improved either "a lot" or "a little" as a result of the class, with 32.2% indicating "a lot." More markedly, students' rating of their own problem-solving ability increased "a lot" or "a little" for 92.9% of respondents, with a full 50% indicating "a lot."

(3) According to the survey, 85.7% of respondents indicated that MATH 180 had helped them with their other math courses, with open-ended responses including,
   - "It made me not afraid to try things and that it's okay to be frustrated. It helps me continue to [persevere] in the courses I've taken,"
   - "It's helped me approach problems that would normally be intimidating and it's helped me make more connections to prior learning experiences in order to come up with a solution,"
   - "Because I'm currently taking [MATH 280], [MATH 180] had prepared me on how to approach proofs and how to clarify my thoughts on paper,"
   - "The in depth discussion about infinity has helped me to understand discussions about infinity when discussing sums and series for example in other classes. The time spent on problem solving and learning problem solving strategies has helped me tremendously when working on assignments in nearly every other class," and
   - "[MATH 180] greatly prepared me especially for [MATH 280]. Learning set theory was one of the most important things because other classes just assume you know it. I think it should be a [prerequisite] for [MATH 280]."

(4) Of the respondents, 67.9% said that they have taken other mathematics courses with students from their MATH 180 course, and these classes ranged from MATH 150A and MATH 107, to upper-division courses. Notably, 31.6% took MATH 280 with other students from their MATH 180 class, and 26.3% took upper-division courses with other students from their MATH 180 class. Of the students who have taken courses with fellow MATH 180 students, 64.3% report that they have continued to work with students from their class, and all of them rated the value of working with other students as 6 or above (out of 10), with 80% rating the value as 8 or above (out of 10).

Implications. The survey results suggest strongly that MATH 180 is accomplishing the intended objectives. Importantly, MATH 280 is one of the identified bottle-neck courses in the mathematics curriculum, so indications that MATH 180 helps students to be successful in this course are quite promising.

Furthermore, a major issue observed in major advising is that students start the mathematics major incorrectly expecting upper-division coursework to be similar to their lower-division calculus courses, and may only realize well into their third year that they do not want to complete the mathematics major. After having spent two years taking prerequisites, this leaves them in the difficult position of either struggling to graduate in a major that does not align with their academic interests, or changing majors and starting over with that field's prerequisites, likely increasing their time to graduation. Helping students recognize what a mathematics major entails early results in students directing their attentions on subjects better suited to their interests much earlier in their academic career. That 23% of students changed their major after at most one semester following taking MATH 180 suggests that the course is serving its role in helping students make more informed academic decisions. Further study is needed to determine how this rate compares with students who did not take MATH 180.

We are also pleased to see that nearly two-thirds of students are continuing to work with students from their previous classes, and that they report high satisfaction with working with their peers. We will continue to track these students with further surveys in the future.

The survey and student data provide justification for adding the course MATH 180 to the course catalog as a permanent class. The question of whether to make the course mandatory will depend on further survey data from future cohorts, and data about student grades in targeted future classes (MATH 280 and MATH 350).

4. MATH 107 Survey Results

All 25 enrolled students completed the pre-class survey (100% completion rate), and 20 students completed the post-class survey (80% completion rate). The students' attitudes about programming improved from 5.9/10 to 6.73/10, with 10 being the most positive attitude. However, the attitude about how programming would be involved in their future careers remained almost constant (6.16/10 versus 6.15/10). This is likely due to 18/25 students intending to go into teaching instead of applying their degrees in industry. However, one student commented "At the beginning of the course I thought I wouldn't be needing computer programming in my future career but now I see myself using it a lot more. It really is a great introduction to computer programming for linear algebra."

In questions regarding confidence for MATH 250B, only one student felt "not very confident" about preparation for the next course. For MATH 320, two students were "not very confident" and one student "not confident at all."

The post-course survey indicated that most students felt the course should be added to the mathematics degree. Only one student thought the course would not be beneficial to add to the major. Of the twenty respondents, twelve (60%) said the course should absolutely be added.

Implications. The survey results suggest that students have a better perception of programming. It also shows that most students felt MATH 107 should be added to the curriculum. However, the impact on later courses will still need to be evaluated in future semesters, once the data become available.

5. MATH 210 Survey Results

Currently 63% of the first cohort have responded to the post-course survey. The main results are:

(1) 89% of students felt the material helped them achieve a greater understanding of the material in MATH 250B. 44.5% agreed with the statment and 44.5% agreed strongly with the statement.
(2) 100% of students agreed that the course reinforced the concepts introduced in MATH 150B.
(3) 87.5% of the students who have since taken MATH 250B found the alternative techniques for solving differential equations easier than the material presented in MATH 250B, with the remainder being indifferent.
(4) 100% of students who have since taken MATH 310 said they felt better prepared after taking MATH 210.
(5) On a scale of 1 to 5, with 5 indicating complete agreement, there was strong evidence students found the course stimulating. 80% of respondents gave a mark of 5, 10% gave a mark of 4 and 10% gave a mark of 3.
(6) On the same scale, 50% gave a 4 mark and 50% gave a 5 mark when asked if the course improved their sense of community as a Math major.

Written evaluations of the course also provide evidence the course is meeting its key objectives. For example, one student commented,

> "I really enjoyed the topics in this class. I think it will be very helpful for math students to take after MATH 150B so that they can have a second look at many topics discussed in that class so that they can get a better understanding of them, rather than forgetting them."

Implications. The data suggests that MATH 210 is having a positive impact on students' educational experience and the large majority of students are very happy with the course and suggest it should be added to the curriculum. The impact on later courses will need to be statistically reinforced to strengthen these initial findings.

6. Summary

For the special courses MATH 180, MATH 107, and MATH 210, we have constructed pre- and/or post-course surveys, and, when possible, have adminstered them to the first and second cohorts of students in these courses. Coupling this self-reported data from the students with data supplied by the Office of Assessment and Institutional Effectiveness on the students' academic progress, we are able to assess the effectiveness of these three courses *vis-à-vis* their intended objectives. While more research is needed about the long-term impact of these courses, the current data suggests that they have been effective in their initial offerings. Should these trends continue, the department will consider adding these courses permanently to the department course catalog, as well as possibly making them requirements for the mathematics major.

7. Acknowledgments

The investigators wish to thank the Office of Assessment and Institutional Effectiveness as well as the Office of the Provost for their support on this project. We would also like to thank the mathematics department Administrative Support Coordinator Renee Bennett who helped us access data through the Office of Assessment and Institutional Effectiveness.

Department of Mathematics 2019–2023 Assessment Plan

Data is collected, analyzed, and aggregated on a continual basis, but each Student Learning Outcome is only assessed every three to five years (unless there is a need for higher frequency) based on the number of Student Learning Outcomes for the program. Each period, a subset of the assessment committee will assess the sample materials and assign scores based on a rubric for each Outcome. If the result of the assessment is below a chosen threshold, then the assessment committee will, in consultation with the department chair and, if necessary, the deparment Curriculum Committee, make recommendations to improve those outcomes.

Student Learning Outcome	Year	Material Assessed
BA Mathematics		
1. Proofs	2021	Written solutions samples from MATH 350
2. Communication	2022	Written and oral presentation samples from MATH 380
3. Problem Solving	2023	Written solution samples from MATH 335
4. Marketability	2020	Survey to graduated students
5. Technological Proficiency	2019	Code samples from MATH 320
MA Mathematics (Applied Option)		
1. Problem Solving	2021	Student grades in MATH 597
2. Communication	2020, 2023	Written and Oral Reports in MATH 497
3. Marketability	2019, 2022	Survey to graduated students
MA Mathematics (Teaching Option)		
1. Problem Solving	2021	Student grades in MATH 587
2. Marketability	2019, 2022	Survey to graduated students
3. Communication	2020, 2023	All coursework, comprehensive exams, and 25–40 page research paper

Student Learning Outcome	Year	Material Assessed
MS Statistics		
1. Problem Solving	2022	Student grades in MATH 539
2. Technological Proficiency	2020	Embedded problem in MATH 531-T
3. Communication	2021	Oral and written reports in MATH 539
4. Marketability	2019, 2023	Survey to graduating students

College of Natural Sciences and Mathematics

DEPARTMENT OF MATHEMATICS

MATHEMATICS BACHELOR OF ARTS

CLASS OF 2022

CONCENTRATION IN ACTUARIAL SCIENCE

TERM 1	TERM 2	TERM 3	TERM 4	TERM 5	TERM 6	TERM 7	TERM 8
MATH 150A (GE B.4) 4 units	MATH 150B 4 units	MATH 250A 4 units	MATH 250B 4 units	MATH 338 4 units	MATH 335 3 units	MATH 438 3 units	MATH 460 3 units
CNSM 101 (Cognate I ^a) 3 units	FIN 320 (Cognate II ^b) 3 units	FIN 340 or FIN 360 or ISDS 473 (Cognate III ^b) 3 units	MATH 280 3 units	MATH 307 3 units	MATH 350 3 units	MATH 439 3 units	FIN 444 3 units
		MATH 380 (Upper Division Writing) 3 units	Math 320 (Computer Programming) 3 units		FIN 415 3 units		
MATH 151A 1 unit	MATH 151B 1 unit	MATH 251A 1 unit					
GE A.1 3 units	GE A.2 3 units	GE B.1 3 units	GE C.2 3 units	GE C.1 3 units	GE D.1 3 units	GE B.3 1 units	
GE A.3 3 units	GE B.2 3 units	HISTORY 110A GE C.4 3 units	HISTORY 110B GE D.2 3 units	GE B.5 3 units		GE D.4 3 units	Electives to complete 120 units
				GE D.3 3 units	Upper Division GE D.5 3 units	Upper Division GE E 3 units	Upper Division GE C.3 3 units
14 units	14 units	17 units	16 units	16 units	15 units	13 units	15 units

a. CNSM 101 may be used as a "wild card" replacement course for any cognate
b. Other cognates are also available – see reverse side

40	GE lower division
9	GE upper division
62	Mathematics Required Courses
3	Mathematics Supporting Courses
6	Electives
120	**TOTAL UNITS**

INSTRUCTIONS FOR COMPLETING THE MATHEMATICS BACHELOR OF ARTS

1. Meet with your assigned faculty advisor each semester to plan and review your academic progress.
2. Visit your College of Natural Sciences and Mathematics Student Success Team in MH 488 to review GE and graduation requirements.
3. Complete GE courses in areas A1, A2, and A3 with a C- or higher. Complete a total of 12 units in GE Area B. One course from GE Area Z can also fulfill a requirement in categories D1, C4, or D4. Check your Titan Degree Audit for courses that appear in both categories.
4. **All** Mathematics courses must be completed with a grade of C or higher.
5. Apply for Graduation through your Student Center at the start of Term 7.

Revised June 14, 2018

MATHEMATICS BACHELOR OF ARTS
ACTUARIAL SCIENCE Concentration

The Math Major is for students who are preparing to (1) enter a graduate study in mathematics, (2) seek math-related careers in business, industry or government, or (3) pursue a career in teaching.

MATHEMATICS CORE AND SUPPORTING COURSES

- **Complete the courses listed below:**

Course	Course Title
MATH 150A	Calculus I
MATH 151A	Calculus I Workshop
MATH 150B	Calculus II
MATH 151B	Calculus II Workshop
MATH 250A	Calculus III
MATH 251A	Calculus III Workshop
MATH 250B	Intro to Linear Algebra and Differential Equations
MATH 280	Strategies of Proof
MATH 307	Linear Algebra
MATH 350	Advanced Calculus I

- **Actuarial Science Concentration Requirements (22 units total)**

FIN 415	Quantitative Theory of Interest (3)
FIN 444	Options and Futures (3)
MATH 335	Mathematical Probability (3)
MATH 338	Statistics Applied to Natural Sciences (4)
MATH 438	Introduction to Stochastic Processes (3)
MATH 439	Intermediate Data Analysis (3)
MATH 460	Actuarial Models (3)

COGNATE OPTIONS

Each student is required to select one of the following cognates:

Chemistry	10 Units
CHEM 120A	General Chemistry (5)
CHEM 120B	General Chemistry (5)

Civil Engineering	9 Units
EGCE 201	Statics (3)
EGCE 301	Mechanics of Materials (3)
EGCE 302 **OR** EGCE 325	Dynamics (3) Structural Analysis (3)

Computer Science	10 Units
CPSC 131	Data Structures Concepts (3)
CPSC 223H **OR** CPSC 223J **OR** CPSC 223N	Visual BASIC Programming (3) Java Programming (3) Visual C# Programming (3)
CPSC 240 **OR** CPSC 332	Computer System Architecture I (3) File Structures and Database Systems (3)
CPSC 253U	Operating System Workshop in Unix (1)

Economics	9 Units
ECON 201	Principles of Microeconomics (3)
ECON 202	Principles of Macroeconomics (3)
ECON 310 **OR** ECON 320 **OR** ECON 440 **OR** ECON 441	Intermediate Microeconomics Analysis (3) Intermediate Macroeconomics Analysis (3) Econometrics (3) Mathematical Economics (3)

Finance	9 Units
FIN 320	Financial Management (3)
Two of the following course options:	
FIN 340	Introduction to Investments (3)
FIN 360	Principles of Insurance (3)
ISDS 473	Applied Business Forecasting (3)

Intro to Math	10 Units
CNSM 101	Think Like Einstein (3)
MATH 107	Intro to Computational Linear Algebra (4)
MATH 180 **OR** MATH 210	Strategies of Problem Solving (3) Intro to Laplace Transforms and Fourier Series (3)

ISDS	9 Units
Three of the following course options:	
ISDS 422	Surveys and Sampling Design and Applications (3)
ISDS 465	Linear Programming in Management Science (3)
ISDS 467	Statistical Quality Control (3)
ISDS 472	Design of Experiments (3)
ISDS 474	Data Mining (3)
ISDS 475	Multivariate Analysis (3)

Physics	11 Units
PHYS 225	Mechanics (3)
PHYS 225L	Fundamental Physics: Laboratory (1)
PHYS 226	Fundamental Physics: Electricity Magnetism (3)
PHYS 226L	Fundamental Physics: Laboratory (1)
PHYS 227	Fundamental Physics: Waves, Optics and Modern Physics (3)

Mathematics	9 Units
Three upper-division courses in Mathematics from one of the four concentrations of the Mathematics major other than the student's own concentration.	

Research	9 Units
MATH 491	Research Seminar (1)
MATH 497	Undergraduate Research (3,3)
MATH 498	Senior Thesis (2)

*The research cognate is intended for students that would benefit more from research and a thesis than a standard cognate. Student should begin this cognate no later than their junior year.

UNIVERSITY & GE REQUIREMENTS

- **Upper Division Writing Requirement**

To meet the upper-division baccalaureate writing requirement, students must pass with a "C" (2.0) or better MATH 380.

- **Computer Programming Requirement**

To meet the elementary computer programming requirement, students must pass with a "C" (2.0) or better MATH 320, CPSC 120 or CPSC 121.

GENERAL EDUCATION REQUIREMENTS

- **Area A Core Competencies – 9 units**

Subarea	Title
A1	Oral Communication
A2	Written Communication
A3	Critical Thinking

- **Area B Scientific and Quantitative Reasoning – 12 units**

Subarea	Title
B1	Physical Science
B2	Life Science
B3	Laboratory Experience
B4	Mathematics/Quantitative Reasoning
B5	Implications & Explorations NSM (upper div)

- **Area C Arts and Humanities – 12 units**

Subarea	Title
C1	Introduction to the Arts
C2	Introduction to the Humanities
C3	Origins of World Civilizations
C4	Explorations in the Arts and Humanities (upper div)

- **Area D Social Sciences – 15 units**

Area	Title
D1	Introduction to the Social Sciences
D2	American History, Institutions, and Values
D3	American Government
D4	Explorations in the Social Sciences (upper div)

- **Area E Lifelong Learning and Self Development – 3 units of your choosing**
- **Area Z Cultural Diversity**. Area Z should be completed with a course that will fulfill Area C4 and Area Z OR Area D1 and Area Z OR Area D4 and Area Z.

College of Natural Sciences and Mathematics

DEPARTMENT OF MATHEMATICS

MATHEMATICS BACHELOR OF ARTS

CLASS OF 2022

CONCENTRATION IN APPLIED MATHEMATICS CLASSICAL

TERM 1	TERM 2	TERM 3	TERM 4	TERM 5	TERM 6	TERM 7	TERM 8
MATH 150A (GE B.4) 4 units	MATH 150B 4 units	MATH 250A 4 units	MATH 250B 4 units	MATH 306 3 units	MATH 310 3 units	MATH 302 3 units	MATH 412 or Math 414 or MATH 450 3 units
CNSM 101 (Cognate I ^a) 3 units	MATH 107 (Cognate II ^b) 4 units	MATH 180 or MATH 210 (Cognate III ^b) 3 units	MATH 280 3 units	MATH 307 3 units	MATH 350 3 units	MATH 425 3 units	MATH 412 or MATH 414 or MATH 450 3 units
		MATH 380 (Upper Division Writing) 3 units	Math 320 (Computer Programming) 3 units		MATH 406 3 units		
MATH 151A 1 unit	MATH 151B 1 unit	MATH 251A 1 unit					
GE A.1 3 units	GE A.2 3 units	GE B.1 3 units	GE C.2 3 units	GE C.1 3 units	GE D.1 3 units	GE B.3 1 units	
GE A.3 3 units	GE B.2 3 units	HISTORY 110A GE C.4 3 units	HISTORY 110B GE D.2 3 units	GE B.5 3 units		GE D.4 3 units	Electives to complete 120 units
				GE D.3 3 units	Upper Division GE D.5 3 units	Upper Division GE E 3 units	Upper Division GE C.3 3 units
14 units	15 units	17 units	16 units	15 units	15 units	13 units	15 units

a. CNSM 101 may be used as a "wild card" replacement course for any cognate
b. Other cognates are also available – see reverse side

40	GE lower division
9	GE upper division
62	Mathematics Required Courses
3	Mathematics Supporting Courses
6	Electives
120	**TOTAL UNITS**

INSTRUCTIONS FOR COMPLETING THE MATHEMATICS BACHELOR OF ARTS

1. Meet with your assigned faculty advisor each semester to plan and review your academic progress.
2. Visit your College of Natural Sciences and Mathematics Student Success Team in MH 488 to review GE and graduation requirements.
3. Complete GE courses in areas A1, A2, and A3 with a C- or higher. Complete a total of 12 units in GE Area B. One course from GE Area Z can also fulfill a requirement in categories D1, C4, or D4. Check your Titan Degree Audit for courses that appear in both categories.
4. **All** Mathematics courses must be completed with a grade of C or higher.
5. Apply for Graduation through your Student Center at the start of Term 7.

Revised June 14, 2018

MATHEMATICS BACHELOR OF ARTS
APPLIED CLASSICAL Concentration

The Math Major is for students who are preparing to (1) enter a graduate study in mathematics, (2) seek math-related careers in business, industry or government, or (3) pursue a career in teaching.

MATHEMATICS CORE AND SUPPORTING COURSES

- **Complete the courses listed below:**

Course	Course Title
MATH 150A	Calculus I
MATH 151A	Calculus I Workshop
MATH 150B	Calculus II
MATH 151B	Calculus II Workshop
MATH 250A	Calculus III
MATH 251A	Calculus III Workshop
MATH 250B	Intro to Linear Algebra and Differential Equations
MATH 280	Strategies of Proof
MATH 307	Linear Algebra
MATH 350	Advanced Calculus I

- **Applied Classical Concentration Requirements (21 units total)**

Applied Classical Mathematics Required Courses (15 units)

MATH 302	Modern Algebra (3)
MATH 306	Vector and Tensor Analysis (3)
MATH 310	Ordinary Differential Equations (3)
MATH 406	Intro to Partial Differential Equations (3)
MATH 425	Differential Geometry (3)

Applied Classical Mathematics Elective Courses (6 units)

Course	Course Title
MATH 412	Complex Analysis (3)
MATH 414	Topology (3)
MATH 450	Advanced Calculus II (3)

COGNATE OPTIONS

Each student is required to select one of the following cognates:

Chemistry	10 Units
CHEM 120A	General Chemistry (5)
CHEM 120B	General Chemistry (5)

Civil Engineering	9 Units
EGCE 201	Statics (3)
EGCE 301	Mechanics of Materials (3)
EGCE 302 **OR** EGCE 325	Dynamics (3) Structural Analysis (3)

Computer Science	10 Units
CPSC 131	Data Structures Concepts (3)
CPSC 223H **OR** CPSC 223J **OR** CPSC 223N	Visual BASIC Programming (3) Java Programming (3) Visual C# Programming (3)
CPSC 240 **OR** CPSC 332	Computer System Architecture I (3) File Structures and Database Systems (3)
CPSC 253U	Operating System Workshop in Unix (1)

Economics	9 Units
ECON 201	Principles of Microeconomics (3)
ECON 202	Principles of Macroeconomics (3)
ECON 310 **OR** ECON 320 **OR** ECON 440 **OR** ECON 441	Intermediate Microeconomics Analysis (3) Intermediate Macroeconomics Analysis (3) Econometrics (3) Mathematical Economics (3)

Finance	9 Units
FIN 320	Financial Management (3)
Two of the following course options:	
FIN 340	Introduction to Investments (3)
FIN 360	Principles of Insurance (3)
ISDS 473	Applied Business Forecasting (3)

Intro to Math	10 Units
CNSM 101	Think Like Einstein (3)
MATH 107	Intro to Computational Linear Algebra (4)
MATH 180 **OR** MATH 210	Strategies of Problem Solving (3) Intro to Laplace Transforms and Fourier Series (3)

ISDS	9 Units
Three of the following course options:	
ISDS 422	Surveys and Sampling Design and Applications (3)
ISDS 465	Linear Programming in Management Science (3)
ISDS 467	Statistical Quality Control (3)
ISDS 472	Design of Experiments (3)
ISDS 474	Data Mining (3)
ISDS 475	Multivariate Analysis (3)

Physics	11 Units
PHYS 225	Mechanics (3)
PHYS 225L	Fundamental Physics: Laboratory (1)
PHYS 226	Fundamental Physics: Electricity Magnetism (3)
PHYS 226L	Fundamental Physics: Laboratory (1)
PHYS 227	Fundamental Physics: Waves, Optics and Modern Physics (3)

Mathematics	9 Units
Three upper-division courses in Mathematics from one of the four concentrations of the Mathematics major other than the student's own concentration.	

Research	9 Units
MATH 491	Research Seminar (1)
MATH 497	Undergraduate Research (3,3)
MATH 498	Senior Thesis (2)

*The research cognate is intended for students that would benefit more from research and a thesis than a standard cognate. Student should begin this cognate no later than their junior year.

UNIVERSITY & GE REQUIREMENTS

- **Upper Division Writing Requirement**

To meet the upper-division baccalaureate writing requirement, students must pass with a "C" (2.0) or better MATH 380.

- **Computer Programming Requirement**

To meet the elementary computer programming requirement, students must pass with a "C" (2.0) or better MATH 320, CPSC 120 or CPSC 121.

GENERAL EDUCATION REQUIREMENTS

- **Area A Core Competencies – 9 units**

Subarea	Title
A1	Oral Communication
A2	Written Communication
A3	Critical Thinking

- **Area B Scientific and Quantitative Reasoning – 12 units**

Subarea	Title
B1	Physical Science
B2	Life Science
B3	Laboratory Experience
B4	Mathematics/Quantitative Reasoning
B5	Implications & Explorations NSM (upper div)

- **Area C Arts and Humanities – 12 units**

Subarea	Title
C1	Introduction to the Arts
C2	Introduction to the Humanities
C3	Origins of World Civilizations
C4	Explorations in the Arts and Humanities (upper div)

- **Area D Social Sciences – 15 units**

Area	Title
D1	Introduction to the Social Sciences
D2	American History, Institutions, and Values
D3	American Government
D4	Explorations in the Social Sciences (upper div)

- **Area E Lifelong Learning and Self Development – 3 units of your choosing**

- **Area Z Cultural Diversity**. Area Z should be completed with a course that will fulfill Area C4 and Area Z OR Area D1 and Area Z OR Area D4 and Area Z.

DEPARTMENT OF MATHEMATICS

MATHEMATICS BACHELOR OF ARTS

CLASS OF 2022

CONCENTRATION IN APPLIED MATHEMATICS COMPUTATIONAL

TERM 1	TERM 2	TERM 3	TERM 4	TERM 5	TERM 6	TERM 7	TERM 8
MATH 150A (GE B.4) 4 units	MATH 150B 4 units	MATH 250A 4 units	MATH 250B 4 units	MATH 306 3 units	MATH 340 3 units	MATH 370 3 units	MATH 406 or MATH 440 or MATH 470 3 units
CNSM 101 (Cognate I ^a) 3 units	MATH 107 (Cognate II ^b) 4 units	MATH 180 or MATH 210 (Cognate III ^b) 3 units	MATH 280 3 units	MATH 307 3 units	MATH 350 3 units	MATH 406 or MATH 440 or MATH 470 3 units	
		MATH 380 (Upper Division Writing) 3 units	Math 320 (Computer Programming) 3 units	MATH 310 3 units	MATH 335 3 units		
MATH 151A 1 unit	MATH 151B 1 unit	MATH 251A 1 unit					
GE A.1 3 units	GE A.2 3 units	GE B.1 3 units	GE C.2 3 units		GE D.1 3 units	GE B.3 1 units	GE C.1 3 units
GE A.3 3 units	GE B.2 3 units	HISTORY 110A GE C.4 3 units	HISTORY 110B GE D.2 3 units	GE B.5 3 units		GE D.4 3 units	Electives to complete 120 units
				GE D.3 3 units	Upper Division GE D.5 3 units	Upper Division GE E 3 units	Upper Division GE C.3 3 units
14 units	15 units	17 units	16 units	15 units	15 units	13 units	15 units

a. CNSM 101 may be used as a “wild card” replacement course for any cognate
b. Other cognates are also available – see reverse side

40	GE lower division
9	GE upper division
62	Mathematics Required Courses
3	Mathematics Supporting Courses
6	Electives
120	**TOTAL UNITS**

INSTRUCTIONS FOR COMPLETING THE MATHEMATICS BACHELOR OF ARTS

1. Meet with your assigned faculty advisor each semester to plan and review your academic progress.
2. Visit your College of Natural Sciences and Mathematics Student Success Team in MH 488 to review GE and graduation requirements.
3. Complete GE courses in areas A1, A2, and A3 with a C- or higher. Complete a total of 12 units in GE Area B. One course from GE Area Z can also fulfill a requirement in categories D1, C4, or D4. Check your Titan Degree Audit for courses that appear in both categories.
4. **All** Mathematics courses must be completed with a grade of C or higher.
5. Apply for Graduation through your Student Center at the start of Term 7.

Revised June 14, 2018

MATHEMATICS BACHELOR OF ARTS
APPLIED COMPUTATIONAL Concentration

The Math Major is for students who are preparing to (1) enter a graduate study in mathematics, (2) seek math-related careers in business, industry or government, or (3) pursue a career in teaching.

MATHEMATICS CORE AND SUPPORTING COURSES

- **Complete the courses listed below:**

Course	Course Title
MATH 150A	Calculus I
MATH 151A	Calculus I Workshop
MATH 150B	Calculus II
MATH 151B	Calculus II Workshop
MATH 250A	Calculus III
MATH 251A	Calculus III Workshop
MATH 250B	Intro to Linear Algebra and Differential Equations
MATH 280	Strategies of Proof
MATH 307	Linear Algebra
MATH 350	Advanced Calculus I

- **Applied Computational Concentration Requirements (21 units total)**

Applied Computational Mathematics Required Courses (15 units)

MATH 306	Vector and Tensor Analysis (3)
MATH 310	Ordinary Differential Equations (3)
MATH 335	Mathematical Probability (3)
MATH 340	Numerical Analysis (3)
MATH 370	Mathematical Model Building (3)

Applied Computational Mathematics Elective Courses (6 units)

Course	Course Title
MATH 406	Intro to Partial Differential Equations (3)
MATH 440	Advanced Numerical Analysis (3)
MATH 470	Advanced Mathematical Model Building (3)

COGNATE OPTIONS

Each student is required to select one of the following cognates:

Chemistry	10 Units
CHEM 120A	General Chemistry (5)
CHEM 120B	General Chemistry (5)

Civil Engineering	9 Units
EGCE 201	Statics (3)
EGCE 301	Mechanics of Materials (3)
EGCE 302 **OR** EGCE 325	Dynamics (3) Structural Analysis (3)

Computer Science	10 Units
CPSC 131	Data Structures Concepts (3)
CPSC 223H **OR** CPSC 223J **OR** CPSC 223N	Visual BASIC Programming (3) Java Programming (3) Visual C# Programming (3)
CPSC 240 **OR** CPSC 332	Computer System Architecture I (3) File Structures and Database Systems (3)
CPSC 253U	Operating System Workshop in Unix (1)

Economics	9 Units
ECON 201	Principles of Microeconomics (3)
ECON 202	Principles of Macroeconomics (3)
ECON 310 **OR** ECON 320 **OR** ECON 440 **OR** ECON 441	Intermediate Microeconomics Analysis (3) Intermediate Macroeconomics Analysis (3) Econometrics (3) Mathematical Economics (3)

Finance	9 Units
FIN 320	Financial Management (3)
Two of the following course options:	
FIN 340	Introduction to Investments (3)
FIN 360	Principles of Insurance (3)
ISDS 473	Applied Business Forecasting (3)

Intro to Math	10 Units
CNSM 101	Think Like Einstein (3)
MATH 107	Intro to Computational Linear Algebra (4)
MATH 180 **OR** MATH 210	Strategies of Problem Solving (3) Intro to Laplace Transforms and Fourier Series (3)

ISDS	9 Units
Three of the following course options:	
ISDS 422	Surveys and Sampling Design and Applications (3)
ISDS 465	Linear Programming in Management Science (3)
ISDS 467	Statistical Quality Control (3)
ISDS 472	Design of Experiments (3)
ISDS 474	Data Mining (3)
ISDS 475	Multivariate Analysis (3)

Physics	11 Units
PHYS 225	Mechanics (3)
PHYS 225L	Fundamental Physics: Laboratory (1)
PHYS 226	Fundamental Physics: Electricity Magnetism (3)
PHYS 226L	Fundamental Physics: Laboratory (1)
PHYS 227	Fundamental Physics: Waves, Optics and Modern Physics (3)

Mathematics	9 Units
Three upper-division courses in Mathematics from one of the four concentrations of the Mathematics major other than the student's own concentration.	

Research	9 Units
MATH 491	Research Seminar (1)
MATH 497	Undergraduate Research (3,3)
MATH 498	Senior Thesis (2)

*The research cognate is intended for students that would benefit more from research and a thesis than a standard cognate. Student should begin this cognate no later than their junior year.

UNIVERSITY & GE REQUIREMENTS

- **Upper Division Writing Requirement**

To meet the upper-division baccalaureate writing requirement, students must pass with a "C" (2.0) or better MATH 380.

- **Computer Programming Requirement**

To meet the elementary computer programming requirement, students must pass with a "C" (2.0) or better MATH 320, CPSC 120 or CPSC 121.

GENERAL EDUCATION REQUIREMENTS

- **Area A Core Competencies – 9 units**

Subarea	Title
A1	Oral Communication
A2	Written Communication
A3	Critical Thinking

- **Area B Scientific and Quantitative Reasoning – 12 units**

Subarea	Title
B1	Physical Science
B2	Life Science
B3	Laboratory Experience
B4	Mathematics/Quantitative Reasoning
B5	Implications & Explorations NSM (upper div)

- **Area C Arts and Humanities – 12 units**

Subarea	Title
C1	Introduction to the Arts
C2	Introduction to the Humanities
C3	Origins of World Civilizations
C4	Explorations in the Arts and Humanities (upper div)

- **Area D Social Sciences – 15 units**

Area	Title
D1	Introduction to the Social Sciences
D2	American History, Institutions, and Values
D3	American Government
D4	Explorations in the Social Sciences (upper div)

- **Area E Lifelong Learning and Self Development – 3 units of your choosing**

- **Area Z Cultural Diversity**. Area Z should be completed with a course that will fulfill Area C4 and Area Z OR Area D1 and Area Z OR Area D4 and Area Z.

College of Natural Sciences and Mathematics

DEPARTMENT OF MATHEMATICS

MATHEMATICS BACHELOR OF ARTS

CLASS OF 2022

CONCENTRATION IN PROBABILITY AND STATISTICS

TERM 1	TERM 2	TERM 3	TERM 4	TERM 5	TERM 6	TERM 7	TERM 8
MATH 150A (GE B.4) 4 units	MATH 150B 4 units	MATH 250A 4 units	MATH 250B 4 units	MATH 338 4 units	MATH 335 3 units	MATH 438 3 units	MATH 435 3 units
CNSM 101 (Cognate I ^a) 3 units	MATH 107 (Cognate II ^b) 4 units	MATH 180 or MATH 210 (Cognate III ^b) 3 units	MATH 280 3 units	MATH 307 3 units	MATH 340 or MATH 370 3 units	MATH 439 3 units	MATH 437 4 units
		MATH 380 (Upper Division Writing) 3 units	Math 320 (Computer Programming) 3 units			MATH 350 3 units	
MATH 151A 1 unit	MATH 151B 1 unit	MATH 251A 1 unit					
GE A.1 3 units	GE A.2 3 units	GE B.1 3 units	GE C.2 3 units	GE C.1 3 units	GE D.1 3 units		
GE A.3 3 units	GE B.2 3 units	HISTORY 110A GE C.4 3 units	HISTORY 110B GE D.2 3 units	GE B.5 3 units	GE B.3 1 units	GE D.4 3 units	Electives to complete 120 units
				GE D.3 3 units	Upper Division GE D.5 3 units	Upper Division GE E 3 units	Upper Division GE C.3 3 units
14 units	15 units	17 units	16 units	16 units	13 units	15 units	14 units

a. CNSM 101 may be used as a “wild card” replacement course for any cognate
b. Other cognates are also available – see reverse side

40	GE lower division
9	GE upper division
64	Mathematics Required Courses
3	Mathematics Supporting Courses
4	Electives
120	**TOTAL UNITS**

INSTRUCTIONS FOR COMPLETING THE MATHEMATICS BACHELOR OF ARTS

1. Meet with your assigned faculty advisor each semester to plan and review your academic progress.
2. Visit your College of Natural Sciences and Mathematics Student Success Team in MH 488 to review GE and graduation requirements.
3. Complete GE courses in areas A1, A2, and A3 with a C- or higher. Complete a total of 12 units in GE Area B. One course from GE Area Z can also fulfill a requirement in categories D1, C4, or D4. Check your Titan Degree Audit for courses that appear in both categories.
4. **All** Mathematics courses must be completed with a grade of C or higher.
5. Apply for Graduation through your Student Center at the start of Term 7.

Revised June 14, 2018

MATHEMATICS BACHELOR OF ARTS
PROBABILITY & STATISTICS Concentration

The Math Major is for students who are preparing to (1) enter a graduate study in mathematics, (2) seek math-related careers in business, industry or government, or (3) pursue a career in teaching.

MATHEMATICS CORE AND SUPPORTING COURSES

- **Complete the courses listed below:**

Course	Course Title
MATH 150A	Calculus I
MATH 151A	Calculus I Workshop
MATH 150B	Calculus II
MATH 151B	Calculus II Workshop
MATH 250A	Calculus III
MATH 251A	Calculus III Workshop
MATH 250B	Intro to Linear Algebra and Differential Equations
MATH 280	Strategies of Proof
MATH 307	Linear Algebra
MATH 350	Advanced Calculus I

- **Probability & Statistics Concentration Requirements (23 units total)**

Probability & Statistics Required Courses (20 units)

MATH 335	Mathematical Probability (3)
MATH 338	Statistics Applied to Natural Sciences (4)
MATH 435	Mathematical Statistics (3)
MATH 437	Modern Approaches to Data Analysis (4)
MATH 438	Introduction to Stochastic Processes (3)
MATH 439	Data Analysis (3)

Probability & Statistics Elective Courses (3 units)

Course	Course Title
MATH 340	Numerical Analysis (3)
MATH 370	Mathematical Model Building (3)

COGNATE OPTIONS

Each student is required to select one of the following cognates:

Chemistry	10 Units
CHEM 120A	General Chemistry (5)
CHEM 120B	General Chemistry (5)

Civil Engineering	9 Units
EGCE 201	Statics (3)
EGCE 301	Mechanics of Materials (3)
EGCE 302 **OR** EGCE 325	Dynamics (3) Structural Analysis (3)

Computer Science	10 Units
CPSC 131	Data Structures Concepts (3)
CPSC 223H **OR** CPSC 223J **OR** CPSC 223N	Visual BASIC Programming (3) Java Programming (3) Visual C# Programming (3)
CPSC 240 **OR** CPSC 332	Computer System Architecture I (3) File Structures and Database Systems (3)
CPSC 253U	Operating System Workshop in Unix (1)

Economics	9 Units
ECON 201	Principles of Microeconomics (3)
ECON 202	Principles of Macroeconomics (3)
ECON 310 **OR** ECON 320 **OR** ECON 440 **OR** ECON 441	Intermediate Microeconomics Analysis (3) Intermediate Macroeconomics Analysis (3) Econometrics (3) Mathematical Economics (3)

Finance	9 Units
FIN 320	Financial Management (3)
Two of the following course options:	
FIN 340	Introduction to Investments (3)
FIN 360	Principles of Insurance (3)
ISDS 473	Applied Business Forecasting (3)

Intro to Math	10 Units
CNSM 101	Think Like Einstein (3)
MATH 107	Intro to Computational Linear Algebra (4)
MATH 180 **OR** MATH 210	Strategies of Problem Solving (3) Intro to Laplace Transforms and Fourier Series (3)

ISDS	9 Units
Three of the following course options:	
ISDS 422	Surveys and Sampling Design and Applications (3)
ISDS 465	Linear Programming in Management Science (3)
ISDS 467	Statistical Quality Control (3)
ISDS 472	Design of Experiments (3)
ISDS 474	Data Mining (3)
ISDS 475	Multivariate Analysis (3)

Physics	11 Units
PHYS 225	Mechanics (3)
PHYS 225L	Fundamental Physics: Laboratory (1)
PHYS 226	Fundamental Physics: Electricity Magnetism (3)
PHYS 226L	Fundamental Physics: Laboratory (1)
PHYS 227	Fundamental Physics: Waves, Optics and Modern Physics (3)

Mathematics	9 Units
Three upper-division courses in Mathematics from one of the four concentrations of the Mathematics major other than the student's own concentration.	

Research	9 Units
MATH 491	Research Seminar (1)
MATH 497	Undergraduate Research (3,3)
MATH 498	Senior Thesis (2)

*The research cognate is intended for students that would benefit more from research and a thesis than a standard cognate. Student should begin this cognate no later than their junior year.

UNIVERSITY & GE REQUIREMENTS

- **Upper Division Writing Requirement**

To meet the upper-division baccalaureate writing requirement, students must pass with a "C" (2.0) or better MATH 380.

- **Computer Programming Requirement**

To meet the elementary computer programming requirement, students must pass with a "C" (2.0) or better MATH 320, CPSC 120 or CPSC 121.

GENERAL EDUCATION REQUIREMENTS

- **Area A Core Competencies – 9 units**

Subarea	Title
A1	Oral Communication
A2	Written Communication
A3	Critical Thinking

- **Area B Scientific and Quantitative Reasoning – 12 units**

Subarea	Title
B1	Physical Science
B2	Life Science
B3	Laboratory Experience
B4	Mathematics/Quantitative Reasoning
B5	Implications & Explorations NSM (upper div)

- **Area C Arts and Humanities – 12 units**

Subarea	Title
C1	Introduction to the Arts
C2	Introduction to the Humanities
C3	Origins of World Civilizations
C4	Explorations in the Arts and Humanities (upper div)

- **Area D Social Sciences – 15 units**

Area	Title
D1	Introduction to the Social Sciences
D2	American History, Institutions, and Values
D3	American Government
D4	Explorations in the Social Sciences (upper div)

- **Area E Lifelong Learning and Self Development – 3 units of your choosing**

- **Area Z Cultural Diversity**. Area Z should be completed with a course that will fulfill Area C4 and Area Z OR Area D1 and Area Z OR Area D4 and Area Z.

College of Natural Sciences and Mathematics

DEPARTMENT OF MATHEMATICS

MATHEMATICS BACHELOR OF ARTS

CLASS OF 2022

CONCENTRATION IN PURE MATHEMATICS

TERM 1	TERM 2	TERM 3	TERM 4	TERM 5	TERM 6	TERM 7	TERM 8
MATH 150A (GE B.4) 4 units	MATH 150B 4 units	MATH 250A 4 units	MATH 250B 4 units	MATH 302 3 units	MATH 350 3 units	MATH 414 3 units	MATH 450 3 units
CNSM 101 (Cognate I ^a) 3 units	MATH 107 (Cognate II ^b) 4 units	MATH 180 or MATH 210 (Cognate III ^b) 3 units	MATH 280 3 units	MATH 307 3 units	MATH 407 3 units	MATH 430 or MATH 425 or MATH 471 3 units	MATH 412 3 units
		MATH 380 (Upper Division Writing) 3 units	MATH 320 (Computer Programming) 3 units		MATH 430 or MATH 425 or MATH 471 3 units		
MATH 151A 1 unit	MATH 151B 1 unit	MATH 251A 1 unit					
GE A.1 3 units	GE A.2 3 units	GE B.1 3 units	GE C.2 3 units	GE C.1 3 units	GE D.1 3 units	GE B.3 1 unit	
GE A.3 3 units	GE B.2 3 units	HISTORY 110A GE C.4 3 units	HISTORY 110B GE D.2 3 units	GE B.5 3 units		GE D.4 3 Units	Electives to complete 120 units
				GE D.3 3 units	GE D.5 (Upper Division) 3 units	GE E (Upper Division) 3 units	GE C.3 (Upper Division) 3 units
14 units	15 units	17 units	16 units	15 units	15 units	13 units	15 units

a. CNSM 101 may be used as a “wild card” replacement course for any cognate
b. Other cognates are also available – see reverse side

40	GE lower division
9	GE upper division
62	Mathematics Required Courses
3	Mathematics Supporting Courses
6	Electives
120	**TOTAL UNITS**

INSTRUCTIONS FOR COMPLETING THE MATHEMATICS BACHELOR OF ARTS

1. Meet with your assigned faculty advisor each semester to plan and review your academic progress.
2. Visit your College of Natural Sciences and Mathematics Student Success Team in MH 488 to review GE and graduation requirements.
3. Complete GE courses in areas A1, A2, and A3 with a C- or higher. Complete a total of 12 units in GE Area B. One course from GE Area Z can also fulfill a requirement in categories D1, C4, or D4. Check your Titan Degree Audit for courses that appear in both categories.
4. **All** Mathematics courses must be completed with a grade of C or higher.
5. Apply for Graduation through your Student Center at the start of Term 7.

Revised June 14, 2018

MATHEMATICS BACHELOR OF ARTS
PURE Concentration

The Math Major is for students who are preparing to (1) enter a graduate study in mathematics, (2) seek math-related careers in business, industry or government, or (3) pursue a career in teaching.

MATHEMATICS CORE AND SUPPORTING COURSES

- **Complete the courses listed below:**

Course	Course Title
MATH 150A	Calculus I
MATH 151A	Calculus I Workshop
MATH 150B	Calculus II
MATH 151B	Calculus II Workshop
MATH 250A	Calculus III
MATH 251A	Calculus III Workshop
MATH 250B	Intro to Linear Algebra and Differential Equations
MATH 280	Strategies of Proof
MATH 307	Linear Algebra
MATH 350	Advanced Calculus I

- **Pure Mathematics Concentration Requirements (21 units total)**

Pure Mathematics Required Courses (9 units)

MATH 302	Modern Algebra (3)
MATH 414	Topology (3)
MATH 450	Advanced Calculus II (3)

Pure Mathematics Elective Courses (12 units)

Course	Course Title
MATH 407	Abstract Algebra (3)
MATH 412	Complex Analysis (3)
MATH 425	Differential Geometry (3)
MATH 430	Number Theory (3)
MATH 471	Combinatorics (3)

COGNATE OPTIONS

Each student is required to select one of the following cognates:

Chemistry	10 Units
CHEM 120A	General Chemistry (5)
CHEM 120B	General Chemistry (5)

Civil Engineering	9 Units
EGCE 201	Statics (3)
EGCE 301	Mechanics of Materials (3)
EGCE 302 **OR** EGCE 325	Dynamics (3) Structural Analysis (3)

Computer Science	10 Units
CPSC 131	Data Structures Concepts (3)
CPSC 223H **OR** CPSC 223J **OR** CPSC 223N	Visual BASIC Programming (3) Java Programming (3) Visual C# Programming (3)
CPSC 240 **OR** CPSC 332	Computer System Architecture I (3) File Structures and Database Systems (3)
CPSC 253U	Operating System Workshop in Unix (1)

Economics	9 Units
ECON 201	Principles of Microeconomics (3)
ECON 202	Principles of Macroeconomics (3)
ECON 310 **OR** ECON 320 **OR** ECON 440 **OR** ECON 441	Intermediate Microeconomics Analysis (3) Intermediate Macroeconomics Analysis (3) Econometrics (3) Mathematical Economics (3)

Finance	9 Units
FIN 320	Financial Management (3)
Two of the following course options:	
FIN 340	Introduction to Investments (3)
FIN 360	Principles of Insurance (3)
ISDS 473	Applied Business Forecasting (3)

Intro to Math	10 Units
CNSM 101	Think Like Einstein (3)
MATH 107	Intro to Computational Linear Algebra (4)
MATH 180 **OR** MATH 210	Strategies of Problem Solving (3) Intro to Laplace Transforms and Fourier Series (3)

ISDS	9 Units
Three of the following course options:	
ISDS 422	Surveys and Sampling Design and Applications (3)
ISDS 465	Linear Programming in Management Science (3)
ISDS 467	Statistical Quality Control (3)
ISDS 472	Design of Experiments (3)
ISDS 474	Data Mining (3)
ISDS 475	Multivariate Analysis (3)

Physics	11 Units
PHYS 225	Mechanics (3)
PHYS 225L	Fundamental Physics: Laboratory (1)
PHYS 226	Fundamental Physics: Electricity Magnetism (3)
PHYS 226L	Fundamental Physics: Laboratory (1)
PHYS 227	Fundamental Physics: Waves, Optics and Modern Physics (3)

Mathematics	9 Units
Three upper-division courses in Mathematics from one of the four concentrations of the Mathematics major other than the student's own concentration.	

Research	9 Units
MATH 491	Research Seminar (1)
MATH 497	Undergraduate Research (3,3)
MATH 498	Senior Thesis (2)

*The research cognate is intended for students that would benefit more from research and a thesis than a standard cognate. Student should begin this cognate no later than their junior year.

UNIVERSITY & GE REQUIREMENTS

- **Upper Division Writing Requirement**

To meet the upper-division baccalaureate writing requirement, students must pass with a "C" (2.0) or better MATH 380.

- **Computer Programming Requirement**

To meet the elementary computer programming requirement, students must pass with a "C" (2.0) or better MATH 320, CPSC 120 or CPSC 121.

GENERAL EDUCATION REQUIREMENTS

- **Area A Core Competencies – 9 units**

Subarea	Title
A1	Oral Communication
A2	Written Communication
A3	Critical Thinking

- **Area B Scientific and Quantitative Reasoning – 12 units**

Subarea	Title
B1	Physical Science
B2	Life Science
B3	Laboratory Experience
B4	Mathematics/Quantitative Reasoning
B5	Implications & Explorations NSM (upper div)

- **Area C Arts and Humanities – 12 units**

Subarea	Title
C1	Introduction to the Arts
C2	Introduction to the Humanities
C3	Origins of World Civilizations
C4	Explorations in the Arts and Humanities (upper div)

- **Area D Social Sciences – 15 units**

Area	Title
D1	Introduction to the Social Sciences
D2	American History, Institutions, and Values
D3	American Government
D4	Explorations in the Social Sciences (upper div)

- **Area E Lifelong Learning and Self Development – 3 units of your choosing**

- **Area Z Cultural Diversity**. Area Z should be completed with a course that will fulfill Area C4 and Area Z OR Area D1 and Area Z OR Area D4 and Area Z.

College of Natural Sciences and Mathematics

DEPARTMENT OF MATHEMATICS

MATHEMATICS BACHELOR OF ARTS

CLASS OF 2022

CONCENTRATION IN TEACHING MATHEMATICS

TERM 1	TERM 2	TERM 3	TERM 4	TERM 5	TERM 6	TERM 7	TERM 8
MATH 150A (GE B.4) 4 units	MATH 150B 4 units	MATH 250A 4 units	MATH 250B 4 units	MATH 302 3 units	MATH 335 3 units	MATH 401 3 units	MATH 402 3 units
CNSM 101 (Cognate I ^a) 3 units	MATH 107 (Cognate II ^b) 4 units	MATH 180 or MATH 210 (Cognate III ^b) 3 units	MATH 280 3 units	MATH 307 3 units	MATH 350 3 units	MATH 414 or MATH 471 3 units	MATH 407 or MATH 417 or MATH 430 3 units
		MATH 380 (Upper Division Writing) 3 units	Math 320 (Computer Programming) 3 units	MATH 338 4 units			
MATH 151A 1 unit	MATH 151B 1 unit	MATH 251A 1 unit					
GE A.1 3 units	GE A.2 3 units	GE B.1 3 units	GE C.2 3 units	GE C.1 3 units	GE D.1 3 units	GE B.3 1 units	
GE A.3 3 units	GE B.2 3 units	HISTORY 110A GE C.4 3 units	HISTORY 110B GE D.2 3 units	GE B.5 3 units	GE D.3 3 units	GE D.4 3 units	Electives to complete 120 units
					Upper Division GE D.5 3 units	Upper Division GE E 3 units	Upper Division GE C.3 3 units
14 units	15 units	17 units	16 units	16 units	15 units	13 units	14 units

a. CNSM 101 may be used as a “wild card” replacement course for any cognate
b. Other cognates are also available – see reverse side

40	GE lower division
9	GE upper division
63	Mathematics Required Courses
3	Mathematics Supporting Courses
5	Electives
120	**TOTAL UNITS**

INSTRUCTIONS FOR COMPLETING THE MATHEMATICS BACHELOR OF ARTS

1. Meet with your assigned faculty advisor each semester to plan and review your academic progress.
2. Visit your College of Natural Sciences and Mathematics Student Success Team in MH 488 to review GE and graduation requirements.
3. Complete GE courses in areas A1, A2, and A3 with a C- or higher. Complete a total of 12 units in GE Area B. One course from GE Area Z can also fulfill a requirement in categories D1, C4, or D4. Check your Titan Degree Audit for courses that appear in both categories.
4. **All** Mathematics courses must be completed with a grade of C or higher.
5. Apply for Graduation through your Student Center at the start of Term 7.

Revised June 14, 2018

MATHEMATICS BACHELOR OF ARTS
TEACHING Concentration

The Math Major is for students who are preparing to (1) enter a graduate study in mathematics, (2) seek math-related careers in business, industry or government, or (3) pursue a career in teaching.

MATHEMATICS CORE AND SUPPORTING COURSES

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MATH 280	Strategies of Proof
MATH 307	Linear Algebra
MATH 350	Advanced Calculus I

- **Teaching Concentration Requirements (21-22 units total)**

Teaching Mathematics Required Courses (15-16 units)

MATH 302	Modern Algebra (3)
MATH 335	Mathematical Probability (3)
MATH 370	Mathematical Model Building (3) ▪ Or MATH 338 Statistics Applied to Natural Sciences (4) ▪ Or MATH 375 Discrete Dynamical Systems and Chaos (3)
MATH 401	Algebra & Probability for the Secondary Teacher (3)
MATH 402	Logic & Geometry for the Secondary Teacher (3)

Teaching Mathematics Elective Courses (6 units)

Course	Course Title
MATH 407	Abstract Algebra (3)
MATH 414	Topology (3)
MATH 417	Foundations of Geometry (3)
MATH 430	Number Theory (3)
MATH 471	Combinatorics (3)

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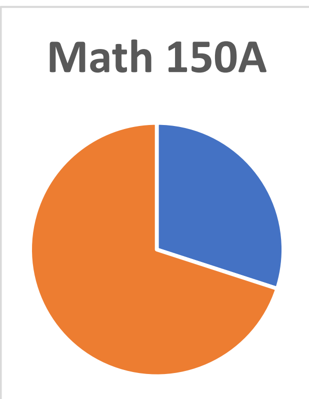
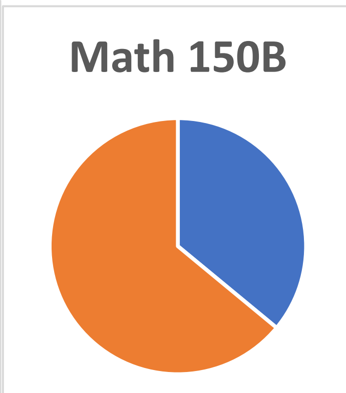
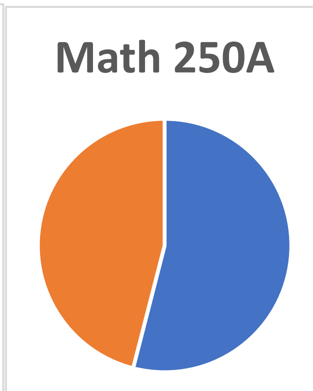
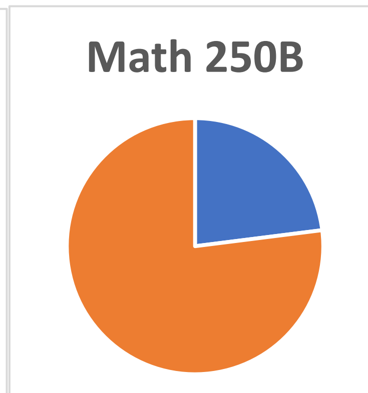
Number of Math 150A-250B Classes Taught by Part Time Lecturers and Full Time Faculty Fall Semesters 2015-2017								
	Math 150A		**Math 150B**		**Math 250A**		**Math 250B**	
	PTL	**FTF**	**PTL**	**FTF**	**PTL**	**FTF**	**PTL**	**FTF**
F 2015	15	6	15	8	6	6	8	1
F 2016	14	7	14	10	4	9	7	4
F 2017	13	5	15	7	8	6	9	2
Total	42	18	44	25	18	21	24	7
Pct.	**70 %**	**30 %**	**64 %**	**36 %**	**46 %**	**54 %**	**77 %**	**23 %**

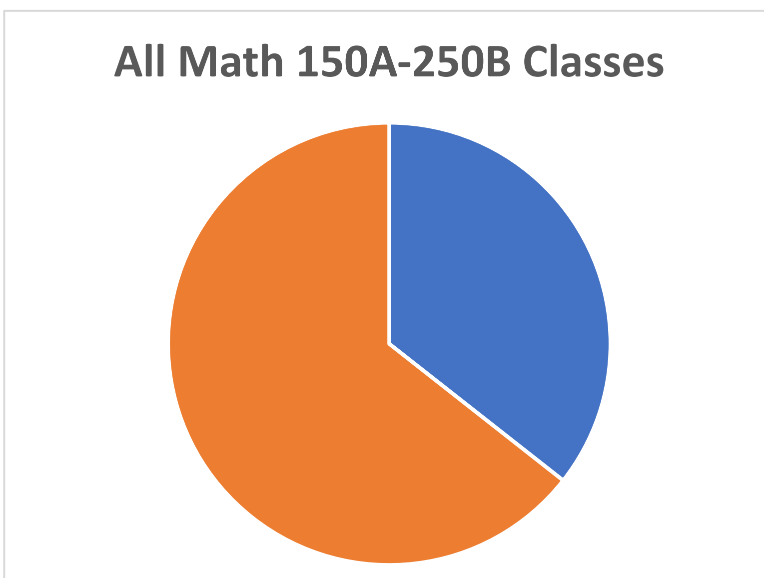
Of the 199 sections of 150A-250B classes taught in the fall semesters in 2015-17, 128 (64.4%) were taught by PTL (in orange) and 71 (35.6%) were taught by FTF (in blue).



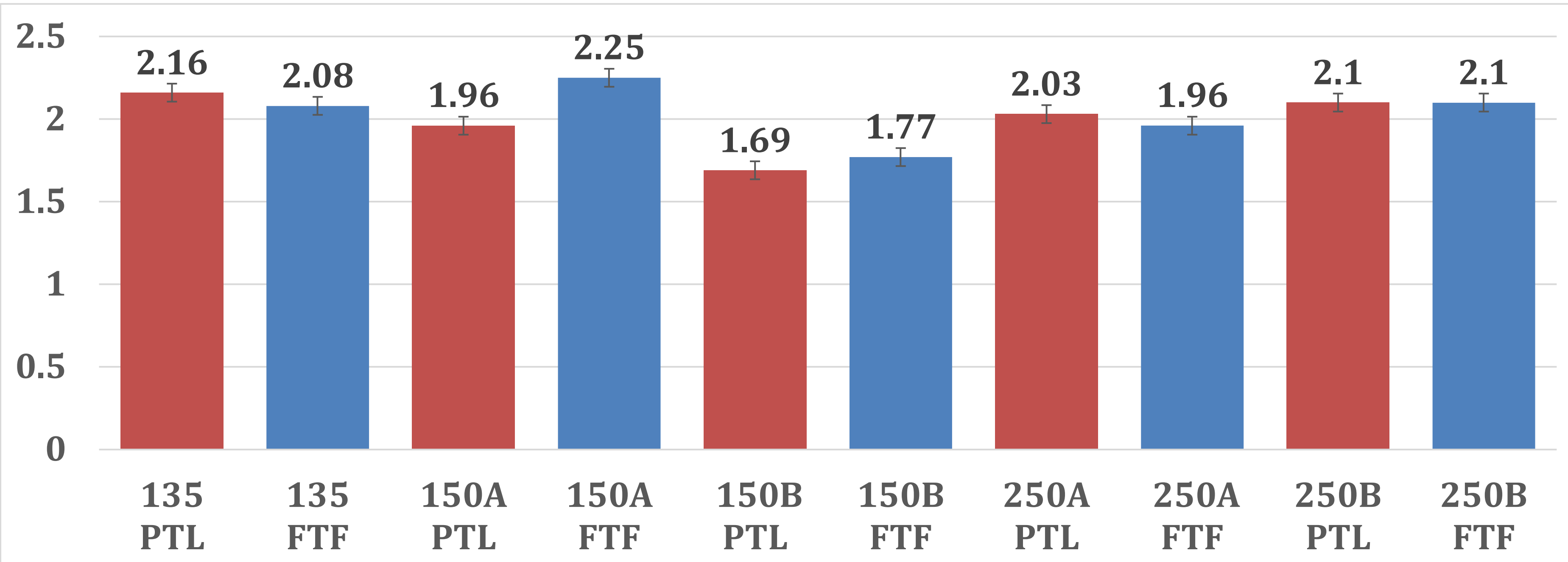








Math 135 and 150A-250B Grades for Fall 2015, Fall 2016, and Fall 2017										
	Math 135		Math 150A		Math 150B		Math 250A		Math 250B	
	PTL	FTF	PTL	FTF	PTL	FTF	PTL	FTF	PTL	FTF
mean	**2.16**	**2.08**	**1.96**	**2.25**	**1.69**	**1.77**	**2.03**	**1.96**	**2.10**	**2.10**
stdev	0.36	0.38	0.29	0.41	0.36	0.44	0.47	0.26	0.44	0.21
n	47	8	42	18	44	25	18	21	24	7
mean	**2.14**		**2.04**		**1.73**		**1.99**		**2.10**	
stdev	0.36		0.35		0.38		0.36		0.39	
n	55		60		69		39		31	

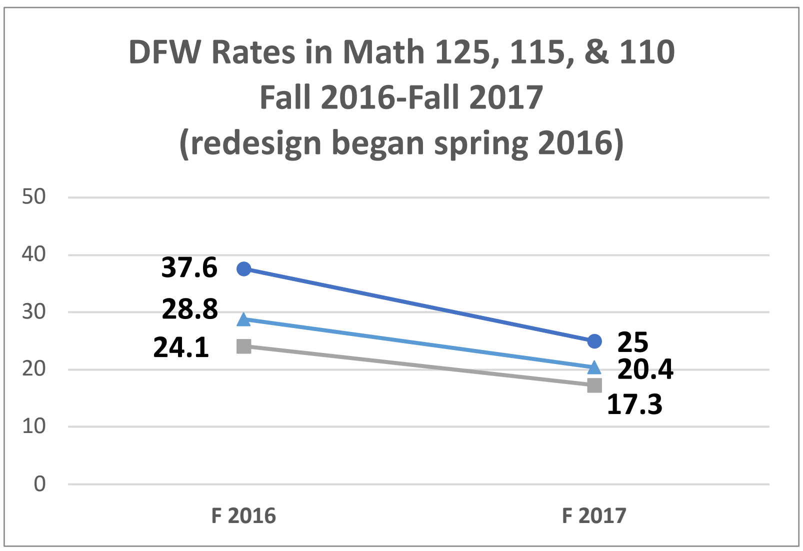


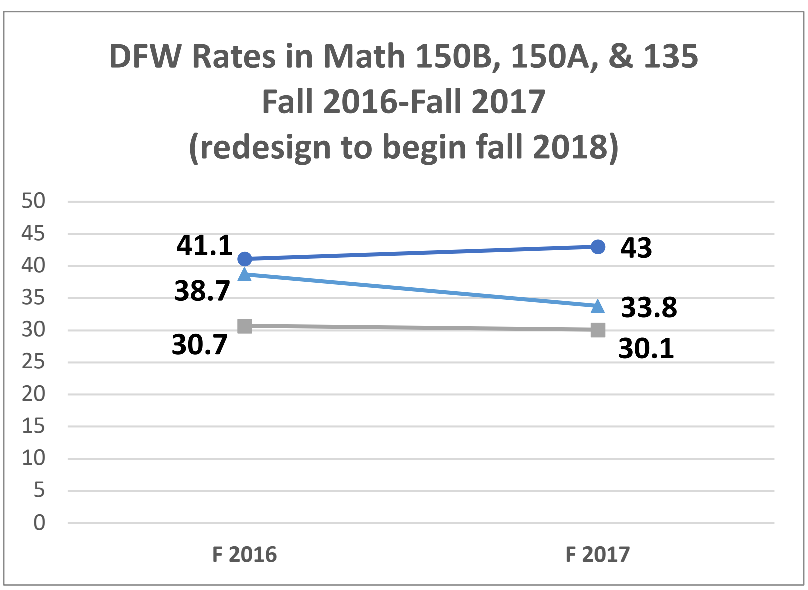
Math 135 and Math 150A-250B Course Grade Means Fall Semesters 2015-2017*									
Math 135 55 sections		**Math 150A 60 sections**		**Math 150B 69 sections**		**Math 250A 39 sections**		**Math 250B 31 sections**	
1.49	2.13	1.42	1.98	0.87	1.71	0.94	2.05	0.85	2.05
1.50	2.13	1.44	2.00	1.10	1.71	1.35	2.06	1.66	2.06
1.61	2.14	1.46	2.01	1.15	1.73	1.51	2.08	1.72	2.11
1.62	2.15	1.53	2.06	1.19	1.75	1.57	2.12	1.82	2.19
1.64	2.19	1.61	2.06	1.24	1.77	1.60	2.12	1.82	2.21
1.64	2.19	1.62	2.09	1.26	1.78	1.70	2.15	1.85	2.23
1.67	2.19	1.69	2.10	1.29	1.78	1.71	2.17	1.89	2.24
1.67	2.20	1.74	2.11	1.31	1.79	1.72	2.17	**1.90**	**2.38**
1.71	2.23	1.76	2.11	1.32	1.80	1.75	2.18	1.90	2.42
1.73	2.27	1.76	2.12	1.34	1.82	**1.76**	**2.18**	1.95	2.42
1.82	2.31	1.78	2.13	1.35	1.86	1.81	2.24	1.95	2.48
1.89	2.38	1.82	2.13	1.39	1.86	1.81	2.26	1.95	2.53
1.89	2.38	1.83	2.14	1.39	1.86	1.85	2.26	1.97	2.74
1.90	**2.43**	1.84	2.19	1.40	1.88	1.88	2.27	1.97	2.78
1.92	2.47	**1.84**	**2.20**	1.41	1.89	1.88	2.29	2.03	2.96
1.93	2.47	1.85	2.20	1.41	1.90	1.89	2.33	**2.05**	
1.94	2.49	1.85	2.24	**1.46**	**1.90**	1.93	2.7		
1.96	2.50	1.86	2.25	1.48	1.91	1.96	2.78		
1.99	2.53	1.88	2.25	1.48	1.94	1.96	2.81		
2.03	2.60	1.89	2.26	1.48	1.94	**2.00**			
2.04	2.62	1.89	2.27	1.50	1.95				
2.06	2.63	1.90	2.32	1.55	1.95				
2.06	2.65	1.90	2.43	1.56	1.97				
2.08	2.67	1.90	2.44	1.56	1.97				
2.08	2.74	1.91	2.45	1.57	2.02				
2.09	2.97	1.91	2.75	1.57	2.06				
2.09	3.03	1.92	2.75	1.58	2.12				
2.12		1.92	2.80	1.62	2.14				
		1.93	2.94	1.64	2.20				
		1.96	3.23	1.66	2.23				
				1.67	2.28				
				1.68	2.81				
				1.69	2.90				
				1.69	2.95				
				1.71					

***Quartiles indicated in bold font**

CSUF Dept. of Mathematics Course Grade Data for Fall 2016 and Fall 2017								
	Fall 2016 (baseline)				Fall 2017			
Math Course	Mean Grade	Stan. Dev.	DFW Rate	No. of Students	Mean Grade	Stan. Dev.	DFW Rate	No. of Students
110*	2.23	0.45	24.1%	631	2.53	0.28	17.3%	748
115*	2.09	0.33	28.8%	1070	2.48	0.31	20.4%	1193
120	2.29	0.29	28.2%	267	2.20	0.35	29.5%	319
125*	1.87	0.35	37.6%	623	2.34	0.50	25.0%	694
130	2.13	0.32	33.4%	212	2.26	0.21	32.7%	140
135*	2.13	0.34	30.7%	598	2.22	0.41	30.1%	577
150A*	2.02	0.43	38.7%	559	2.07	0.23	33.8%	526
150B*	1.78	0.46	41.1%	706	1.71	0.41	43.0%	628
250A	2.00	0.36	36.9%	400	1.91	0.32	34.5%	407
250B	2.14	0.30	28.2%	339	1.93	0.45	36.8%	379
270A	2.16	0.30	30.9%	314	2.18	0.26	32.6%	291
270B	2.54	0.04	16.4%	147	2.78	0.22	12.2%	147

* Identified as a Course Redesign mathematics course for 2017-18





ACTUARIAL SCIENCE CONCENTRATION

CSUF DEPARTMENT OF MATHEMATICS

Who Are Actuaries?

Actuaries are highly sought-after professionals who develop and communicate solutions for complex financial issues.

Most actuaries work for insurance companies. Although most work full time in an office setting, some actuaries who work as consultants may travel to meet with clients.

What Actuaries Do

Actuaries analyze the financial costs of risk and uncertainty. They use mathematics, statistics, and financial theory to assess the risk of potential events, and they help businesses and clients develop policies that minimize the cost of that risk. Actuaries' work is essential to the insurance industry.

Why Become An Actuary?

According to Bureau of Labor Statistics, the median salary for an actuary was $100,610 per year (2016) or $48.37 per hour.

Employment of actuaries is projected to grow 22 percent from 2016 to 2026, much faster than the average for all occupations.

PREPARE FOR SOA EXAMS

…and become an actuary!

- Exam P (Math 335)
- Exam FM (Finance 415)
- Exam MFE/IFM (Finance 444 & 542)
- Exam C (Math 460)

Why Cal State Fullerton?

Currently, there are only three programs in California recognized as Universities and Colleges with Actuarial Programs - Advanced Curriculum (UCAP - AC) by the Society of Actuaries, and CSUF proudly represents one of them.

CSUF's Center for Insurance Studies (CIS) attracts and educates talented individuals who are committed to professional careers in insurance and risk management. CIS, in partnership with the Department of Mathematics, offers an undergraduate Actuarial Science Concentration as well as graduate actuarial science courses. The Center also provides actuarial workshops and exam study materials. In 2017, CIS was given the prestigious Global Center of Insurance Excellency (GCIE) award, presented by the International Insurance Society and selected by the Best's Review as one of the top 20 RMI programs nationwide.

In the past two years, there have been more than 20 CSUF students who have passed at least one SOA exam. Many of these students have obtained internships and entry-level positions shortly thereafter.

EDUCATION

REQUIRED COURSES:

- **Math 335** Mathematical Probability
- **Math 338** Applied Statistics
- **Math 435** Mathematical Statistics
- **Math 460** Actuarial Models
- **Fin 415** Quantitative Theory of Interest
- **Fin 444** Options and Futures
- One of the following classes:
  - **Math 437** Modern Approaches to Data Analysis
  - **Math 438** Introduction to Stochastic Processes
  - **Math 439** Intermediate Data Analysis

FINANCE COGNATE:

- **Fin 320** Financial Management I
- **Fin 340** Introduction to Investments
- **Fin 360** Principles of Insurance

VALIDATION FOR EDUCATIONAL EXPERIENCE (VEE):

- **Fin 320** for Corporate Finance & Accounting
- **Math 435** for Mathematical Statistics
- **Econ 201 & Econ 202** for Economics

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CALIFORNIA STATE UNIVERSITY FULLERTON
MIHAYLO COLLEGE OF BUSINESS AND ECONOMICS

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CENTER FOR INSURANCE STUDIES