PROGRAM REVIEW – CM1
COLLEGE LEVEL MATH COURSES
(MATH 170, 180, 190, 191, 210, 220, 270)

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1. Overview of the Program

a) Description of the Program

The College Level Mathematics Program (CM1) is a vital part of the Mathematics Division at El Camino College. We provide an outstanding learning environment in which students can develop the skills and knowledge needed for success in any STEM (Science, Technology, Engineering, and Mathematics) field. The CM1 program served 3485 students in 91 course sections during the 2015-16 school year. Our program has grown in the past four years, but further expansion and improvement of instruction could be hampered by two major factors: 1) a lack of growth in the number of full-time faculty needed to maintain a quality program, and 2) a limited amount of space in the current building housing the math department, MBA, that was not built, nor had space allocated, with such growth in mind.

The program consists of the following courses:

Math 170 – Trigonometry
Math 180 – Precalculus
Math 190 – Single Variable Calculus and Analytical Geometry I
Math 191 – Single Variable Calculus and Analytical Geometry II
Math 210 – Introduction to Discrete Structures
Math 220 – Multivariable Calculus
Math 270 – Differential Equations with Linear Algebra

The core of the program is the STEM Calculus sequence (and often the prerequisites). Many students must take this progression of courses: Math 170, 180, 190, 191, 220 and 270. The outlier is Math 210, a course in math relating to computer science, but also relevant to future mathematicians and others interested in math.

CM1 students form the core of the Math Team that consistently places in the top 10% of schools nationally in the AMATYC (American Math Association of Two Year Colleges) Student Math League. Typically around one hundred students participate each year, attending weekly practices and taking the test once in the Fall and once in the Spring.

The CM1 math courses form the core of a well-rounded STEM education.

As stated on the www.ed.gov website:

The United States has developed as a global leader, in large part, through the genius and hard work of its scientists, engineers, and innovators. In a world that's becoming increasingly complex, where success is driven not only by what you know, but by what you can do with what you know, it's more important than ever for our youth to be equipped with the knowledge and skills to solve tough problems, gather and evaluate evidence, and make sense of information. These are the types of skills that students learn by studying science, technology, engineering, and math—subjects collectively known as STEM.

Yet today, few American students pursue expertise in STEM fields—and we have an inadequate pipeline of teachers skilled in those subjects. That's why President Obama has set a priority of increasing the number of students and teachers who are proficient in these vital fields.

This sentiment is echoed in a CNN interview with noted astrophysicist Neil Degrasse Tyson:

Innovations in science, engineering, technology and math will be the drivers of tomorrow's economy. … And if you are not a participant on that frontier, you will trail behind it and possibly get left behind entirely.

In 2011, the U.S. Department of Commerce's Economics and Statistics Administration released an article entitled *STEM: Good Jobs Now and For the Future*, detailing the state of STEM jobs over the first decade of the 21st century. In it, they found that the "growth in STEM jobs was three times as fast as growth in non-STEM jobs." In terms of earnings, "STEM workers command higher wages, earning 26 percent more than their non-STEM counterparts." Interestingly, they found that having a degree in a STEM field led to increased wages "regardless of whether they work in STEM or non-STEM occupations".

The common thread is that a STEM education, which comes in part from classes such as those present in CM1, leads to increased job opportunities and higher wages *even for those who choose not to pursue a career in a STEM field*. In turn, the demand for a quality STEM education is likely to be on the rise. The skills gained in taking and succeeding, for example, in higher level math courses permeates other areas that are vital to future success, such as critical thinking and problem solving.

The primary vision of the CM1 Program is to provide the community with a comprehensive and dynamic mathematics curriculum that will not only strengthen the math skills of our students, but will also bolster their efforts in all STEM courses. This will lead to higher success rates, graduation rates, and transfer rates. We must strive to be a department that will attract students from near or far. The local area population is aging and there are expected to be fewer school-aged children in future. CM1 will respond to this vision by maintaining our high standards, by continuously reviewing our curriculum, and by keeping up with educational trends both at local colleges and nationally.

Our vision is a teaching environment that encourages faculty and students to share ideas and explore. Some teachers do this by offering student projects that go beyond course content and allow interested students to learn more than what is in the course outline. The use of *Mathematica* for projects, for example, allows students the opportunity to investigate mathematical concepts on their own. This also has the added benefit of introducing students to basic computer programming, which may aid them in future courses or introduce them to related fields such as computer science that they may have not considered studying before. Encouraging faculty to share their ideas, student projects, or teaching ideas at Brown Bags, which are talks given by faculty to their peers during the college hour, would foster a more stimulating educational atmosphere.

b) **Degrees and Certificates**

Students may earn an A.S. degree in Mathematics.

From the El Camino College 2016-17 catalog:

The degree provides the student with sufficient depth to support a lifelong interest in mathematics, and is suitable for the student who plans to transfer in mathematics. The core of the major is the calculus sequence, in which the student will acquire a conceptual understanding of the principles of differential and integral calculus for calculus of one and several variables, as well as the ability to apply calculus techniques in a variety of applications.

The required courses are Math 190, 191, 220, and 270. Also, 4-5 additional units from Math 150, Math 210, CSCI 1, CSCI 2, CSCI 3, PHYS 1A or PHYS 3A.

Additionally, the AS-T degree in Mathematics is available. This is intended for students who plan to complete a bachelor's degree in a similar subject at a CSU campus. Students completing the AS-T degree are given priority consideration for admission to the CSU system. This has the same required courses as the A.S. Degree.

c) **College Mission and Strategic Initiatives**
Explain how the program fulfills the college's mission and aligns with the strategic initiatives.

CM1 Mission Statement:
The College Level Mathematics Program at El Camino College offers quality, comprehensive mathematics courses to ensure the educational success of students from our diverse community, with an emphasis on preparing students to transfer to STEM-related majors at four-year colleges and universities. Students will learn to think analytically and critically, to work collaboratively, and to model real world problems both with and without technology and to become better communicators.

The following is an overview of how the CM1 Program aligns with the college's strategic initiatives.

A. STUDENT LEARNING
Support student learning using a variety of effective instructional methods, educational technologies, and college resources.

CM1 courses rely heavily on the use of educational technology such as Mathematica, both for student assignments and to illustrate difficult graphical and computational concepts. CM1 instructors engage students with a variety of teaching approaches, and many attend conferences and workshops each year to improve and learn new strategies.

B. STUDENT SUCCESS & SUPPORT
Strengthen quality educational and support services to promote and empower student learning, success, and self-advocacy.

CM1 instructors advocate for more funding so that the tutoring center can be improved, so that MESA can be expanded, so that Supplemental Instruction can be introduced, and so that more workshops can be scheduled. We desire to increase the participation and success of all demographic groups through such funding and through other projects such as having a variety of outside speakers come to discuss math and STEM careers.

C. COLLABORATION
Advance an effective process of collaboration and collegial consultation conducted with integrity and respect.

The CM1 Committee is one of the largest in the Math Division. The processes of course review, program review and SLOs are all done with efficiency and effectiveness. Many instructors work together to discuss ways to improve curriculum and to increase student engagement both in and out of class. We plan to collaborate with the Computer Science Department and other STEM departments in an effort to obtain new grants.

D. COMMUNITY RESPONSIVENESS
Develop and enhance partnerships with schools, colleges, universities, businesses, and community-based organizations to respond to the educational, workforce training, and economic development needs of the community.
The CM1 Committee makes sure that all courses articulate with all major four-year colleges in the state. We offer courses that form the core of a good STEM education, preparing students for many fields that will be important for the economic growth of our country.

E. INSTITUTIONAL EFFECTIVENESS
Strengthen processes, programs, and services through the effective and efficient use of assessment, program review, planning, and resource allocation.

The CM1 Committee always gets 100% of the SLOs done on time. We work hard on course reviews and program reviews. We have strong representation on various committees, such as the Division Council, the Division Curriculum Committee, the Division Learning Outcomes Committee and the Academic Senate.

F. MODERNIZATION
Modernize infrastructure and technological resources to facilitate a positive learning and working environment.

The CM1 Committee strongly supports an increase in funding to increase the number of computer labs, to improve the WiFi in the MBA building, to keep computer software up to date, and an allocation of more instructional space for STEM and other math and computer science courses.

d**) Status of Previous Recommendations from 2011 Program Review:**

Recommendation 2011-1a: (Increase Course Offerings – Math 210) It is recommended that Math 210 be offered in both the Fall and the Spring Semesters on a permanent basis.

Status: Completed. This policy was put into action in 2013. There have been sections of Math 210 offered in both the Fall and the Spring Semesters since Spring 2013. In fact, to keep up with the growth of our Computer Science program, we increased the Math 210 offerings to two sections per semester starting in Spring 2016.

Recommendation 2011-1b: (Increase Course Offerings-Other Courses) Also, it is recommended that at least two additional sections of Math 170, 180, and 190 and at least one additional section of Math 191, 220 and 270 be added to the schedule each semester.

Status: Mostly Completed

CM 1 Course Offerings

	M170	**M180**	**M190**	**M191**	**M220**	**M270**
Fall 11	8	9	8	6	3	2
Spring 12	7	9	9	7	2	2
Fall 15	10	11	10	7	4	3
Spring 16	11	9	11	8	4	4

The recommendation has been implemented for all courses except for Math 180, where the same number of sections were offered in Spring 2012 and Spring 2016. There is still room for growth, as will be discussed in the Section 2 under Scheduling of Classes. In Spring 2016, additional sections were scheduled, but had to be cancelled due to low enrollment, possibly because of times during which these sections were offered.

Recommendation 2011-1c: (Increase Course Offerings-Intermediate Algebra) Also, a significant increase in the number of Math 80 sections offered is recommended. (Curriculum)

Status: In Progress. There has been a significant increase in the number of sections of Math 80 since 2011. However, we are nowhere near the level we were at in 2008. For background on this recommendation, see the Curriculum section.

Recommendation 2011-2: (Faculty Hiring) It is recommended that four more full-time tenure track professors be hired beyond our present count of forty. It is further recommended that CM1 courses be taught by full-time instructors only, when possible. (Staffing)

Status: No Change. Currently there are 40 full-time math faculty. We have fluctuated between 38 and 41 over the past six years due to the cycle of retiring and hiring. We will recommend hiring several more full-time faculty that are capable of teaching at all levels in the math department.

Recommendation 2011-3: (Technology) It is recommended that a long-range, sustainable plan to purchase and use the most up-to-date version of the software and hardware used in the courses in this program be implemented and that newer technologies be investigated for possible introduction to the CM1 Program. Additionally, classroom sets of graphing calculators and scientific calculators should be purchased.

Status: In Progress. Graphing calculators have been purchased. This will be further discussed in the Technology section.

Recommendation 2011-4: (Facilities) It is recommended that funding be provided for an expanded tutoring center. Perhaps some instructor office hours could take place there. Computers and a reserve desk, stocked with textbooks and calculators, should be added.

Status: No Change. The math department moved into the new MBA building in Spring 2013 and got a new tutoring center in MBA 119. We will address new recommendations in the Facilities section.

Recommendation 2011-5: It is recommended that SI sections be funded for CM1 courses and that funding be increased for MESA workshops.

Status: No change. Scheduling SI sections for STEM courses will be investigated further, since MESA has limited membership and resources.

Recommendation 2011-6: It is recommended that funding be increased for conferences and professional development.

Status: No Change. There is still $200 available from the school and $700 available from the district – these should still be raised. There was funding available from the HSI-STEM grant, but that has ended.

Recommendation 2011-7: (SLOs) It is recommended that we work to increase participation of faculty, both full-time and part-time, in the administration, reporting and analysis of SLOs. Additionally, we should continue to develop and review the SLO statements and assessments and update relevant course outlines on a regular basis.

Status: In progress

2. Analysis of Research Data

a) Head count of students in the program

Figure 1 shows that the number of students in the CM-1 Program has been steadily increasing, although there was a slight dip (less than a 2% decrease) from 2011-12 to 2012-13. The increase in the following years was more than 12% and 6%, respectively, which is significant. This trend is also reflected in Figure 2, demonstrating that student participation at the college has also behaved in a similar manner over this time period and is not something endemic only to math.

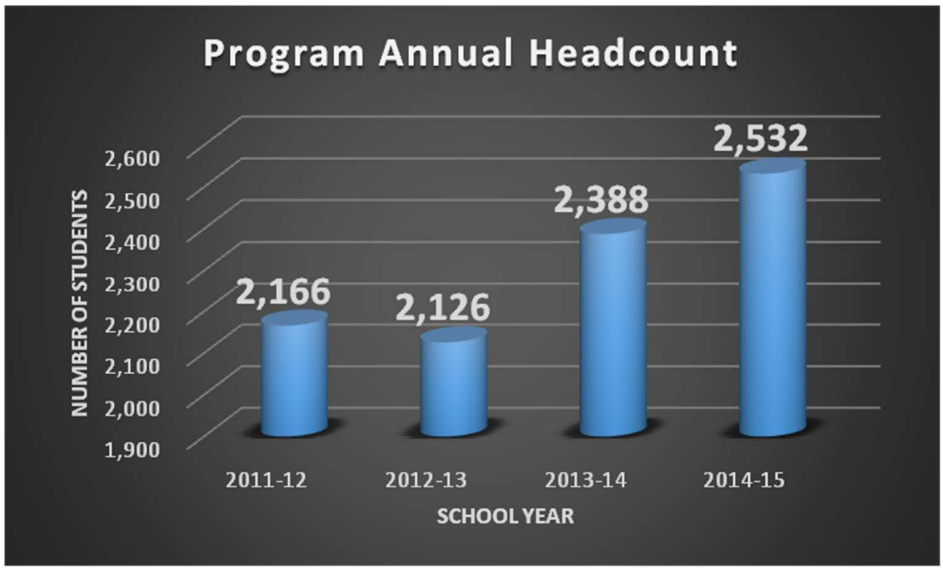


Figure 1: CM1 Program – Annual Headcount

Figure 2: CM1 Program – Annual Seat Count and Sections

b) Course grade distribution (Are there some courses that stand out in one way or another in terms of grades?)

From Figures 3-6, we can see that:

- For all four consecutive academic years, 2011-2012 through 2014-2015, Math 220 and 270 reported the top three percentages of A's. At the same time, these two courses saw the lowest percentages of withdrawals. We may conclude that those students who survived successfully from Math 190 through Math 220 were well prepared to end the calculus sequence in Math 270 strongly.
- The top three percentages of withdrawals for the four academic years occurred in Math 190 and 191. This may be a sign that some of our students that entered the calculus sequence were not sufficiently prepared at the previous levels or may have had a semester or more gap between taking the prerequisite courses and enrolling in Math 190 or 191. Even though Math 180 is a prerequisite for Math 190, much of the content in the course has been covered in various courses, from Math 40 up through Math 170. Despite all Math 190 instructors reviewing the prerequisite material at the beginning of the course, this may not be enough to mend the students' lack of mastery of these materials.
- The percentage of A's for Math 170 and Math 180 rank near the bottom throughout all four academic years. This may be the reason why the percentage of withdrawals for Math 190 and 191 consistently rank highest, or almost so, over the same period of time, as these students may have understood the material well enough to advance beyond the current class but not enough to progress further.

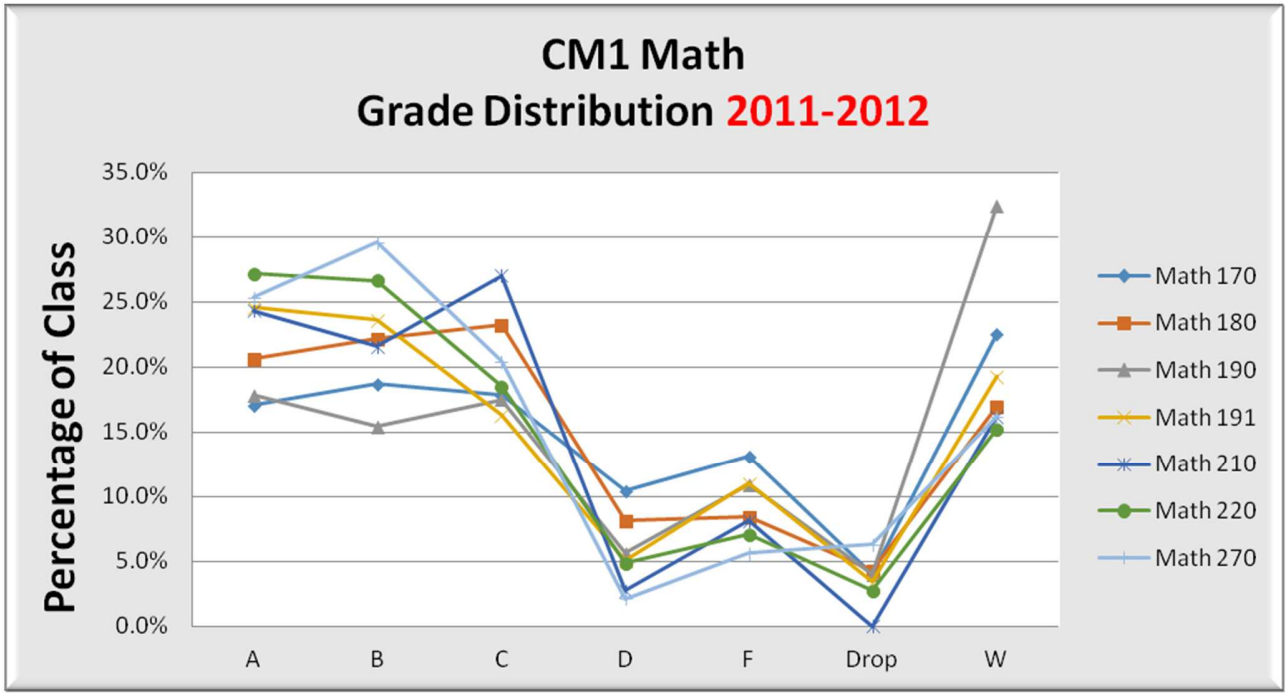


Figure 3: CM1 Program – Grade Distribution 2011-12

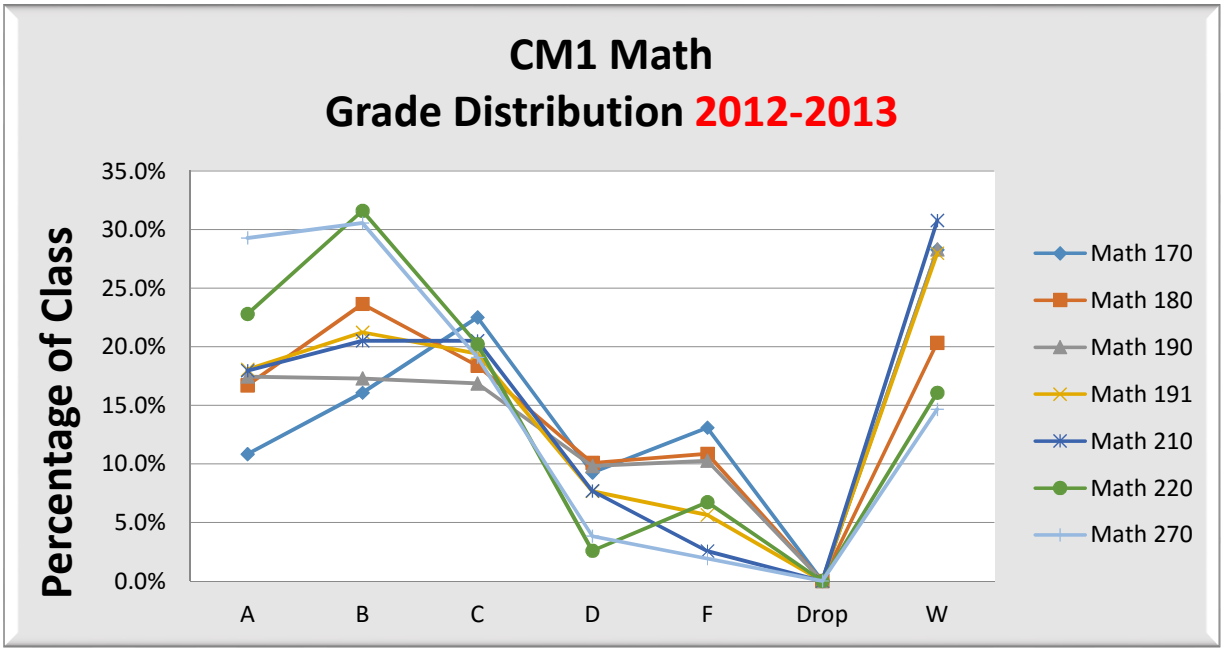


Figure 4: CM1 Program – Grade Distribution 2012-13

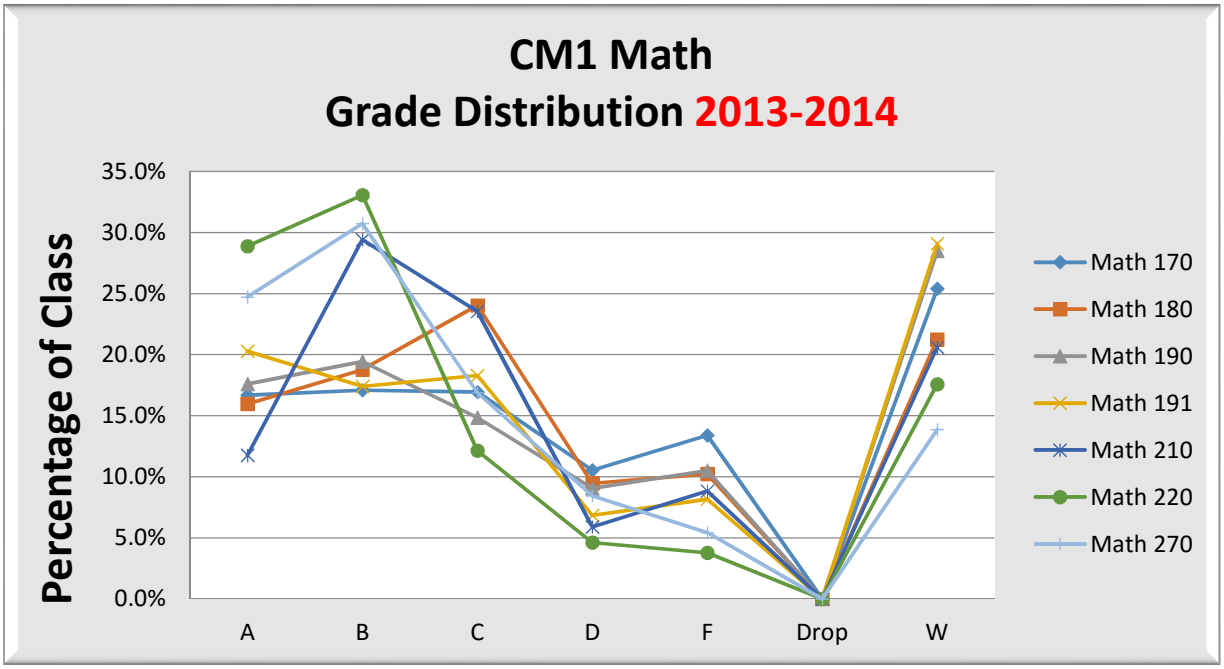


Figure 5: CM1 Program – Grade Distribution 2013-14

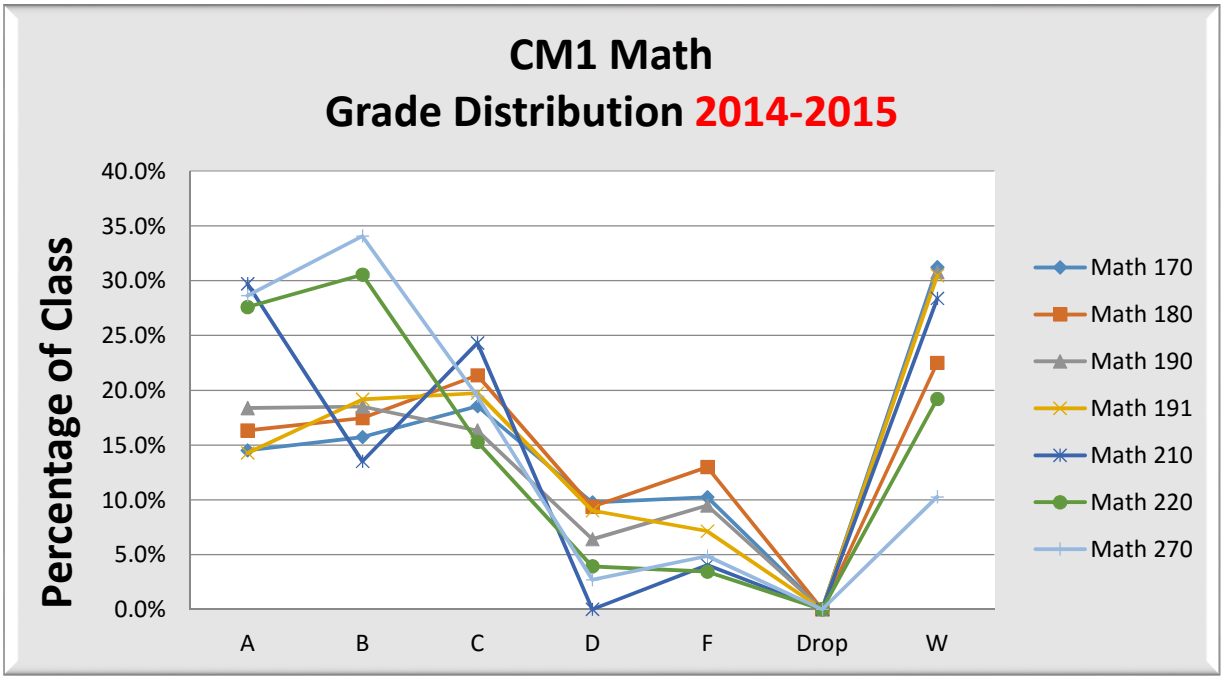


Figure 6: CM1 Program – Grade Distribution 2014-15

c) Success rates (Discuss your program's rates in light of the college's success rate standard. Set a standard for your program.)

The college's preliminary success standard is set as 57.6%, a standard provided by the college. In Figure 7, if we compare Math 170 (Trigonometry) and Math 180 (Pre-Calculus), the two courses which lead into the calculus sequence, the annual success rate for Math 170 is 7.2% below standard, but Math 180 is slightly above by 2%. This may be due to Math 170 being one of the first courses for students beyond algebra that presents predominantly new material, whereas Math 180 is largely a review of content from previous courses, including Math 170.

For the calculus sequence itself, Math 190 through 270, the annual success rate for Math 190 sits around 6.7% below standard but, for each successive course, the success rate is above the standard and climbs slowly to over a 77% success rate by the end of the sequence.

CM1 Program Success Rates *(Yearly)*					
	2011-12	**2012-13**	**2013-14**	**2014-15**	**Course Success Rate**
MATH 170	53.6%	49.4%	50.7%	48.8%	50.4%
MATH 180	66.0%	58.7%	58.8%	55.2%	59.6%
MATH 190	50.7%	51.6%	51.8%	53.2%	51.9%
MATH 191	64.4%	58.7%	55.9%	53.2%	57.8%
MATH 210	73.0%	59.0%	64.7%	67.6%	66.1%
MATH 220	72.3%	74.6%	74.1%	73.4%	73.6%
MATH 270	75.4%	79.0%	72.3%	82.2%	77.4%
Program Success Rate	60.5%	57.3%	56.8%	55.8%	

Figure 7: CM1 – Yearly Success Rates

Figures 8 and 9 compare the success rates, by course, for each of the fall and spring semesters. For Math 210, 220, and 270, the success rates are consistently above the standard for both fall and spring. From the success rates for Math 170, 180, 190 and 191, it is apparent that a sizable percentage of students who are entering the calculus sequence are in need of better preparation to pass these courses. The addition of SI sections, workshops and pre-math 190 boot camps would be helpful to deal with this situation.

CM1-College Level Math Program Success Rates – Fall Terms						
Course	**2011**	**2012**	**2013**	**2014**	**2015**	**Course Success Rate**
MATH 170	52.5%	53.0%	51.8%	48.8%	42.9%	**49.8%**
MATH 180	63.2%	59.1%	63.5%	62.1%	56.9%	**61.0%**
MATH 190	49.7%	52.8%	53.1%	54.4%	53.4%	**52.7%**
MATH 191	57.5%	54.0%	57.1%	46.4%	56.3%	**54.3%**
MATH 210	-	-	56.7%	63.9%	59.5%	**60.0%**
MATH 220	67.0%	77.7%	72.2%	77.9%	71.9%	**73.3%**
MATH 270	72.6%	75.9%	68.9%	81.5%	74.4%	**74.7%**
PROGRAM SUCCESS RATE	57.6%	58.1%	58.1%	56.9%	55.2%	**57.2%**
MATH DEPT SUCCESS RATE	54.1%	54.6%	52.8%	54%	53%	
COLLEGE SUCCESS RATE	67.3%	69.8%	68.2%	68%	68%	

Figure 8: CM1 – Fall Success Rates

CM1-College Level Math Program Success Rates – Spring Terms						
Course	**2012**	**2013**	**2014**	**2015**	**2016**	**Course Success Rate**
MATH 170	50.4%	45.4%	49.6%	48.8%	56.0%	**50.0%**
MATH 180	63.3%	58.4%	53.1%	46.6%	53.7%	**55.0%**
MATH 190	48.0%	50.7%	50.7%	51.9%	54.9%	**51.2%**
MATH 191	67.1%	62.7%	54.8%	59.3%	59.6%	**60.7%**
MATH 210	73.0%	59.0%	71.1%	71.1%	60.7%	**67.0%**
MATH 220	75.3%	69.5%	75.6%	68.7%	72.5%	**72.3%**
MATH 270	68.4%	82.1%	74.2%	82.7%	82.8%	**78.0%**
PROGRAM SUCCESS RATE	58.3%	56.5%	55.5%	54.7%	59.2%	**56.8%**
MATH DEPT SUCCESS RATE	53.3%	56.3%	52.7%	54%	54%	
COLLEGE SUCCESS RATE	68.1%	69.2%	67.9%	68%	70%	

Figure 9: CM1 – Spring Success Rates

Success Rates by Gender

Figures 10 and 11 demonstrate no appreciable difference in the success rate of CM1 math classes between the genders. Females had a higher rate of success in 5 of the 8 semesters studied, but the differences either way were very small with none exceeding 5%. However, the number of female students in STEM math class courses lags behind the number of males. The creation of workshops geared towards women would be useful, especially if they involved outside female speakers who have had success in the STEM field. We will work with the Computer Science Committee to search for other ideas to get more female students to show interest in STEM fields. We will also encourage more female students to participate in the AMATYC math contest.

Demographic Success Characteristics by Gender – Fall Semesters								
	Fall 2011		Fall 2012		Fall 2013		Fall 2014	
Gender	**N**	**Success**	**N**	**Success**	**N**	**Success**	**N**	**Success**
Male	934	59.6%	926	58.4%	1049	58.5%	1113	55.3%
Female	401	60.6%	394	57.4%	455	57.1%	482	60.6%

Figure 10

Demographic Success Characteristics by Gender – Spring Semesters								
	Spring 2012		Spring 2013		Spring 2014		Spring 2015	
Gender	**N**	**Success**	**N**	**Success**	**N**	**Success**	**N**	**Success**
Male	903	61.4%	1002	55.9%	1106	54.6%	1154	53.6%
Female	413	61.3%	429	58.0%	457	57.5%	467	57.6%

Figure 11

Success Rates by Ethnicity

Figures 12 and 13 depict the demographic success characteristics by ethnicity. The highlighted sectors indicate areas of concern, namely groups that achieve a rate at less than 80% of the reference group. African-Americans and Latinos each fall into this category in 4 of the 8 semesters studied. Additionally, the success rates for these groups were significantly lower than the other two major groups, Asian and White, in the other four semesters. The school is attempting to address this equity issue with several special programs. In our program, we should do a better job of making all groups aware of the resources available to them, such as MESA and the tutoring center. We suggest increasing the funding for these programs, so that the capacity of MESA can be increased and more advanced tutors can be hired, in addition to a full-time tutoring coordinator. Additionally, SI sessions could be added to STEM courses and pre-STEM boot camps could be scheduled. We could also look for grant money to hold special workshops, some featuring speakers of various ethnicities that have had success in the STEM math field, for these courses (The HSI-STEM grant did some of this in the 2015-16 year, but that funding ran out).

Demographic Success Characteristics by Ethnicity – Fall Semesters								
	Fall 2011		Fall 2012		Fall 2013		Fall 2014	
ETHNICITY	**N**	**Success**	**N**	**Success**	**N**	**Success**	**N**	**Success**
African-American	74	47.3%	80	50.5%	91	50.5%	98	52.0%
Amer. Ind /Alask. Native	X	0%	X	0%	X	100.0%	X	0%
Asian	486	70.8%	440	68.0%	492	66.5%	490	64.9%
Latino	455	49.2%	468	48.7%	594	51.0%	682	48.2%
Pacific Islander	X	25.0%	X	60.0%	X	80.0%	X	60.0%
Two or More	45	68.9%	68	63.2%	80	47.5%	69	69.6%
Unknown or Decline	49	63.3%	24	37.5%	15	60.0%	X	62.5%
White	217	61.3%	236	63.1%	226	64.6%	237	63.3%

X: Counts are suppressed for groups with less than 10 students.
Shaded regions indicate groups achieving at a rate less than the 80% of the reference group

Figure 12

Demographic Success Characteristics by Ethnicity – Spring Semesters								
	Spring 2012		Spring 2013		Spring 2014		Spring 2015	
ETHNICITY	**N**	**Success**	**N**	**Success**	**N**	**Success**	**N**	**Success**
African-American	76	44.7%	87	39.1%	95	49.5%	103	45.6%
Amer. Ind /Alask. Native	X	0%	X	0%	X	100%	X	0%
Asian	507	70.4%	479	64.7%	487	67.1%	470	63.8%
Latino	426	52.6%	544	47.8%	635	47.4%	722	46.1%
Pacific Islander	X	50.0%	X	66.7%	X	66.7%	X	75.0%
Two or More	45	66.7%	61	63.9%	81	54.3%	77	63.6%
Unknown or Decline	34	67.6%	29	41.4%	14	64.3%	X	40.0%
White	222	61.3%	225	66.7%	244	54.9%	236	63.6%

Figure 13

d) Retention rates

In Figures 14 and 15, the retention rates for CM1 courses are consistent with the overall rates for the math department. It is not surprising that the highest rates occur in courses such as Math 220 and 270, since the students who get to these courses are sufficiently prepared and ready, having run the gamut of previous courses in the calculus sequence. That the lowest retention rates occur in Math 190 and 191 is not surprising either – these courses introduce students to many new ideas and at a higher level of rigor than they may be used to. The introduction of more resources, such as SI sessions, could potentially raise these retention rates.

CM1-College Level Math Program Retention Rates – Fall **Terms**						
Course	**2011**	**2012**	**2013**	**2014**	**2015**	**Course Retention Rate**
MATH 170	73.9%	73.2%	73.8%	68.5%	73.2%	**72.5%**
MATH 180	81.8%	78.8%	81.3%	83.1%	80.9%	**81.2%**
MATH 190	64.4%	74.8%	71.5%	69.3%	70.4%	**70.1%**
MATH 191	73.5%	65.3%	72.8%	62.3%	72.0%	**69.2%**
MATH 210	-	-	73.3%	66.7%	73.0%	**71.0%**
MATH 220	79.5%	88.4%	79.6%	81.7%	84.9%	**82.8%**
MATH 270	75.3%	82.3%	82.4%	87.7%	91.5%	**83.8%**
PROGRAM RETENTION RATE	74.2%	75.5%	75.7%	73.1%	76.2%	**74.9%**
MATH DEPT RETENTION RATE	75.5%	77.6%	76.1%	75%	76%	
COLLEGE RETENTION RATE	81.8%	84.3%	83.1%	82%	83%	

Figure 14: CM1 – Fall Retention Rates

CM1-College Level Math Program Retention Rates – Spring Terms						
Course	**2012**	**2013**	**2014**	**2015**	**2016**	**Course Retention Rate**
MATH 170	75.2%	70.1%	75.3%	69.1%	74.8%	72.9%
MATH 180	77.4%	80.5%	75.5%	70.6%	75.5%	75.9%
MATH 190	65.5%	69.3%	71.6%	69.1%	74.2%	69.9%
MATH 191	82.7%	77.6%	69.1%	76.1%	73.5%	75.8%
MATH 210	83.8%	69.2%	84.2%	76.3%	65.6%	75.8%
MATH 220	87.0%	78.0%	84.7%	79.8%	82.4%	82.4%
MATH 270	82.3%	88.5%	89.2%	91.3%	90.5%	88.4%
PROGRAM RETENTION RATE	75.3%	75.1%	75.3%	72.9%	76.0%	74.9%
MATH DEPT RETENTION RATE	74.7%	76.7%	76.1%	74%	74%	
COLLEGE RETENTION RATE	82.0%	82.8%	83.0%	81%	83%	

Figure 15: CM1 – Spring Retention Rates

e) A comparison of success and retention rates in face-to-face classes with distance education classes.

There are no CM1 distance education classes.

f) Enrollment statistics with section and seat counts and fill rates.

Figure 16 shows the section counts for each CM1 course, by semester, since the last program review. There is a gradual increase in section offerings for each course, which was one of the recommendations from the last program review.

CM1 Program – Section Counts: Fall 2011-Spring 2016								
	M170	**M180**	**M190**	**M191**	**M210**	**M220**	**M270**	**Total**
F11	8	9	8	6	0	3	2	36
W12	2	0	0	0	0	0	0	2
S12	8	9	9	7	1	2	2	38
Sum12	3	2	3	2	0	1	0	11
F12	8	9	8	6	0	3	2	36
W13	2	0	0	0	0	0	0	2
S13	7	9	10	7	1	2	2	38
Sum13	5	4	4	3	0	2	0	18
F13	9	10	9	7	1	3	2	41
S14	10	9	11	7	1	5	3	46
Sum14	6	4	4	3	0	2	0	19
F14	10	11	10	7	1	3	2	44
S15	12	9	10	8	1	4	3	47
Sum15	7	5	5	3	0	2	0	22
F15	10	11	10	7	1	4	3	46
S16	12	10	11	8	2	4	4	51
Totals	**119**	**111**	**112**	**81**	**9**	**40**	**25**	**497**

Figure 16 – CM1 Section Counts

Figure 17 shows students enrolled in each course by semester since the last program review. Just as there was a gradual increase in the number of sections offered, there is a commensurate increase in enrollees.

CM1 Program – Seat Counts: Fall 2011-Spring 2016								
	M170	**M180**	**M190**	**M191**	**M210**	**M220**	**M270**	**Total**
F11	318	351	306	226	0	112	73	1386
W12	77	0	0	0	0	0	0	77
S12	278	332	342	225	37	77	79	1370
Sum12	108	75	107	65	0	37	0	392
F12	302	325	301	202	0	112	79	1321
W13	66	0	0	0	0	0	0	66
S13	271	339	381	241	39	82	78	1431
Sum13	171	116	152	110	0	62	0	611
F13	355	359	354	224	30	108	74	1504
S14	377	286	408	230	38	131	93	1563
Sum14	207	112	141	94	0	64	0	618
F14	377	396	349	252	36	104	81	1595
S15	443	320	337	280	38	99	104	1621
Sum15	223	157	150	113	0	62	0	705
F15	366	408	365	268	37	146	82	1672
S16	425	339	388	260	61	153	116	1742

Totals	**4364**	**3915**	**4081**	**2790**	**316**	**1349**	**859**	**17674**

Figure 17 – CM1 Seat Counts

Figure 18 shows the overall CM1 fill rates for the fall semesters from 2011-2014. While there was a slight decline, this is not a problem since the rates are all well over 100%. This decline could be attributed to the increase in the number of sections. When there were too few sections, the classes were often filled to the maximum capacity of each room in an effort to meet the needs of the students. However, the higher student-teacher ratio that a 110% fill rate generates is not as conducive to student learning as a properly-sized class.

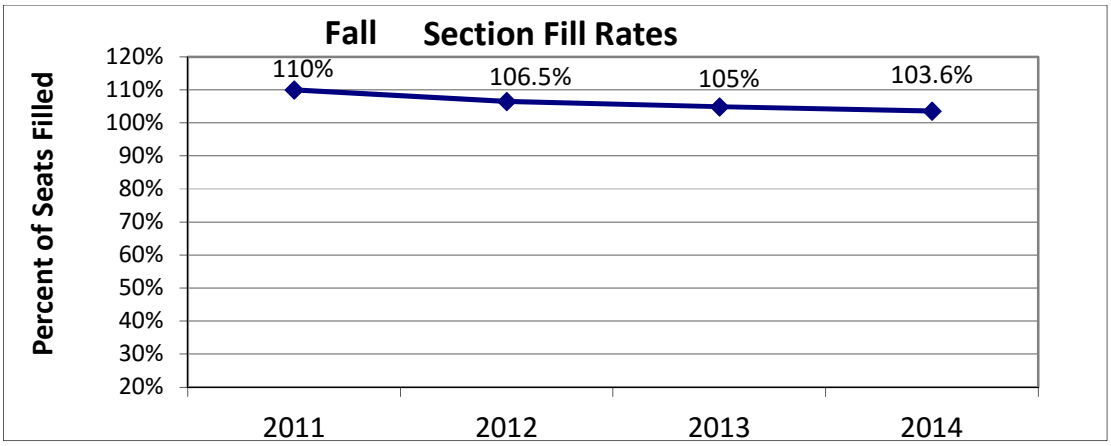


Figure 18 – CM1 Fill Rates – Fall Semesters

Figure 19 shows the overall CM1 fill rates for the spring semesters from 2012-2015. A similar downward trend is evident, but the fill rates still hover near 100%.

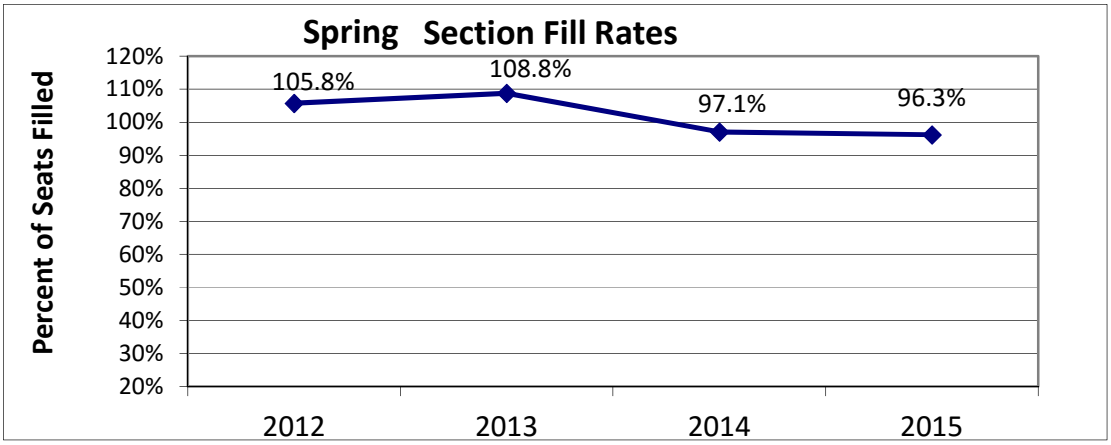


Figure 19 – CM1 Fill Rates – Spring Semesters

Figure 20 shows the fill rates for all CM1 courses during all semesters since the last program review. The overall fill rate for the 497 course sections offered from Fall 2011 to Spring 2016 is 101.6%. A majority of CM1 courses had fill rates over 100%. There were only two times that the fill rates dipped below 80%: both were for Math 220 in Spring 2014 and Spring 2015 when there was possibly one too many sections offered that semester. However, that was not a problem in Spring 2016 when the Math 220 fill rate rebounded to 109.3%.

CM1 Program – Fill Rates: Fall 2011-Spring 2016								
	M170	**M180**	**M190**	**M191**	**M210**	**M220**	**M270**	**Total**
F11	113.6%	111.4%	109.3%	107.6%	-	106.7%	104.3%	110.0%
W12	110.0%	-	-	-	-	-	-	110.0%
S12	99.3%	105.4%	108.6%	91.8%	105.7%	110.0%	112.9%	103.0%
Sum12	102.9%	107.1%	101.9%	92.9%	-	105.7%	-	101.8%
F12	107.9%	103.2%	107.5%	96.2%	-	106.7%	112.9%	104.8%
W13	94.3%	-	-	-	-	-	-	94.3%
S13	110.6%	107.6%	108.9%	98.4%	111.4%	117.1%	111.4%	107.6%
Sum13	97.7%	82.9%	108.6%	104.8%	-	88.6%	-	97.0%
F13	112.7%	102.6%	112.4%	91.4%	85.7%	102.9%	105.7%	104.8%
S14	107.7%	90.8%	106.0%	93.9%	108.6%	74.9%	88.6%	97.1%
Sum14	98.6%	80.0%	100.7%	89.5%	-	91.4%	-	93.0%
F14	107.7%	102.9%	99.7%	102.9%	102.9%	99.0%	115.7%	103.6%
S15	105.5%	101.6%	96.3%	100.0%	108.6%	70.7%	99.0%	98.5%
Sum15	91.0%	89.7%	85.7%	107.6%	-	88.6%	-	91.6%
F15	104.6%	106.0%	104.3%	109.4%	105.7%	104.3%	78.1%	103.9%
S16	101.2%	96.9%	100.8%	92.9%	87.1%	109.3%	82.9%	97.6%
Totals	**104.8%**	**100.8%**	**104.1%**	**98.4%**	**100.3%**	**96.4%**	**98.2%**	**101.6%**

Figure 20 – CM1 Fill Rates for all courses and semesters

g) Scheduling of courses (day vs. night, days offered, and sequence offered, and sequence)
Figures 21 and 22 show the enrollment by time of day. Approximately 80% of the enrollment is during the day and 20% is during the evening.

Enrollment by Time of Day –Fall				
Fall Term	2011	2012	2013	2014
Day	78.1%	78.5%	80.7%	82.8%
Night	21.9%	21.5%	19.3%	17.2%
Weekend/Unknown	0.0%	0.0%	0.0%	0.0%

Figure 21

Enrollment by Time of Day-Spring				
Spring Term	2012	2013	2014	2015
Day	80.5%	82.5%	74.3%	76.4%
Night	19.5%	17.5%	25.7%	23.6%
Weekend/Unknown	0.0%	0.0%	0.0%	0.0%

Figure 22

The evening is vastly underutilized and, because of this, there is great potential for growth by adding more sections of the CM1 courses during these hours. Figure 23 makes a comparison with the evening program at Santa Monica College during the Fall 2015 semester. Santa Monica offered twice as many evening sections as El Camino. Additionally, Santa Monica's average head count was 39.8, while El Camino's was only 33.6, so they served about 2.4 times as many evening students as us.

Night Class Comparison – Fall 2015 – Classes After 4:30pm						
Santa Monica College				**El Camino College**		
	Sections	**Students**			**Sections**	**Students**
Math 20	11	460		**Math 80**	5	175
Math 2	6	228		**Math 170**	1	32
				Math 180	2	69
Math 7	5	194		**Math 190**	2	72
Math 8	3	107		**Math 191**	1	37
Math 11	1	46		**Math 220**	1	39
Math 13	1	33		**Math 270**	2	47
Math 15	1	47				
Totals	**28**	**1115**			**14**	**471**

Figure 23

The suggestion is not to redirect resources from elsewhere. We see no need to decrease the offerings during the day. We believe that new resources should be directed to the evening program. This could benefit other STEM programs, such as Computer Science, which have many late afternoon and evening classes. It might take some advertising to get the word out that our night program can be counted on to reliably continue from semester to semester. With the aging population of the area, we may need to increase evening offerings to help older students who are coming from work. Also, now that we are synced with the Santa Monica College Spring Semester, we may be able to absorb some of their overflow.

If there are only three or four total sections of a course, such as Math 220 or Math 270, we recommend that only one section be scheduled at night. It's better to have them distributed throughout the day with one or two in the morning, one or two in the afternoon and one in the evening. This recommendation may change if we are successful in getting the word out and growing the evening program.

h) Improvement rates (if applicable)

All of the courses in CM1, except for Math 210, form a sequence: Math 170, 180, 190, 191, 220, 270. Figures 24 and 25 show the success rates for the 6 courses in the sequence over four years in the fall and the spring. Our program has a very high set of standards for our students in order to meet the requirements of the four-year universities. This manifests itself in fairly low success rates at the beginning of the sequence, but there is big improvement for those students who master the concepts of the earlier courses and make it to the later ones.

CM1 Program Success Rates - FALL TERMS					
Course	***2012***	***2013***	***2014***	***2015***	***Course Success Rate***
MATH 170	53.0%	51.8%	48.8%	42.9%	49.1%
MATH 180	59.1%	63.5%	62.1%	56.9%	60.4%
MATH 190	52.8%	53.1%	54.4%	53.4%	53.4%
MATH 191	54.0%	57.1%	46.4%	56.3%	56.0%
MATH 220	77.7%	72.2%	77.9%	71.9%	74.9%
MATH 270	75.9%	68.9%	81.5%	74.4%	75.2%

Figure 24

CM1 Program Success Rates – SPRING TERMS					
Course	***2013***	***2014***	***2015***	***2016***	***Course Success Rate***
MATH 170	45.4%	49.6%	48.8%	56.0%	50.0%
MATH 180	58.4%	53.1%	46.6%	53.7%	53.0%
MATH 190	50.7%	50.7%	51.9%	54.9%	52.1%
MATH 191	62.7%	54.8%	59.3%	59.6%	59.1%
MATH 220	69.5%	75.6%	68.7%	72.5%	71.6%
MATH 270	82.1%	74.2%	82.7%	82.8%	80.5%

Figure 25

i) Additional data compiled by faculty

AMATYC Math Contest

The American Math Association of Two-Year Colleges (AMATYC) Student Math League (SML) competition is the only national math contest for students enrolled in a two-year college. The competition consists of two one-hour exams: one in fall and one in spring. The contest is free for students and all enrolled students are encouraged to participate, especially those that have progressed to Math 170 (Trigonometry) and beyond. Last year, more than 190 colleges and over 8000 students participated in the contest nationally. The top five scores at each school make up the team score. The school with the highest score is eligible for a team award. The El Camino team has done well nationally over the past few years.

	Fall Placement	**Spring Placement**	**Overall Placement**
2011-12	25th	14th	20th
2012-13	5th	7th	5th
2013-14	10th	12th	10th
2014-15	13th	18th	13th
2015-16	6th	12th	8th

Five or six faculty members help run the practices and proctor the exams. We recommend funding for the running of the practice workshops and proctoring the exams. There would be 16 practices each semester, each requiring one hour of prep time. Six proctors are needed on the exam day. The cost per semester is $3000.

The CM1 Committee is planning to do a study that tracks how students who participate in the math contest do in their courses, including a look at majors and if there is any change in majors due to participation.

Winter Semester

The CM1 Committee supported the return of Winter Semester and the introduction of five unit courses to the Winter schedule. However, we recommend that the Winter Semester be extended by four days. The current Winter 2017 semester starts on Thursday, January 5th and ends on Tuesday, February 7th for 23 days of instruction. That forces us to schedule a 5 unit class over a 3 hour and 50 minute block. If four days are added by having the Winter start on Tuesday, January 3rd and end on Thursday, February 9th, then a 5 unit class could be scheduled into blocks of closer to 3 hours, which would be much less imposing and better for student learning. Additionally, the Spring Flex day, which is only a morning session, could be moved to Friday, February 10th. While it might not be feasible to change the 2017 schedule we hope that some changes could be instituted for 2018.

j) List any related recommendations.

1) We recommend that Review Workshops be funded for CM1 classes. One possibility is to offer a review workshop for students who are entering Math 190/Math 191 since these traditionally have lower success rates. These might work like the current Summer Academy and could perhaps be offered in the Summer or Winter Semesters (Cost:)

2) We recommend an increase in Supplemental Instruction (SI) funding so that more Math 80 sections could be covered and we could introduce the program to Math 170 and Math 180. (Cost: $2000 per section per semester)

3) We recommend the addition of boot camps prior to Math 190 be created and scheduled. (Cost: $6000 per boot camp)

4) We recommend the funding of math contest practices and proctoring (Cost: $3000 per semester).

5) We recommend the scheduling of more CM1 math classes in the evening. Advertising would be crucial to making the community aware of a growing evening STEM program (Cost per 5 unit section $10,500).

6) We recommend that the Winter Semester be extended by four days. This would not affect the start of Spring Semester. It would only require a shift of the Spring Flex day to the Friday morning before the start of Spring Semester. (Cost: none)

3. Curriculum

a) Provide the curriculum course review timeline to ensure all courses are reviewed at least once every 6 years.

There are currently six courses in the College Math for STEM majors program, referred to as CM1 in the math department. During the past four years, all of the courses have been reviewed. We have aligned courses with the C–ID, when our courses matched the approved C–ID descriptors. To date, there is not a matching C–ID descriptor for Math 210, and since our course already articulates with courses taught at both CSU and UC schools, we have maintained the same course outline.

Here is the six year review cycle, including when the courses were last reviewed, and when we plan to review them in the future.

Course	Last Course Review	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6	
		FA 15	SP 16	FA 16	SP 17	FA 17	SP 18	FA 18	SP 19	FA 19	SP 20	FA 20	SP 21
Math - Major Courses	May, 2012		P	P							P	P	
MATH-170	2014-2015									X			
MATH-180	2014-2015									X			
MATH-190	2014-2015					X							
MATH-191	2012-2013					X							
MATH-210	2014-2015												X
MATH-220	2014-2015												X
MATH-270	2009-2010	X											

Note: All courses are 5 units, except for Math 170 (3 units) and Math 210 (4 units)

b) Explain any course additions to current course offerings.

Intermediate Algebra – Math 80 – the Prerequisite for CM1

Prior to Fall 2009, there were over 100 sections of Math 80 (known as Math 70 until Fall 2009) offered each year. This intermediate algebra course, equivalent to high school Algebra II, was the only intermediate algebra course available, and was the main prerequisite for Math 170, the first of the CM1 courses.

There were 55 sections of this course in Fall 2008. However, in the Fall 2009 semester, Math 80 was drastically reduced to 9 sections. A new intermediate algebra course, Math 73 (Intermediate Algebra for General Education), was offered with 37 sections, but this course was not designed to prepare students for CM1 courses.

The creation of Math 73 was in response to California's change in the Title 5 regulations regarding associate degrees. The new guidelines raised the requirements from Elementary Algebra to Intermediate Algebra. This new course, the creation of which was not brought to a vote by the math department, removed many topics and was not deemed by the CM1 Committee to be appropriate preparation for CM1 courses. Another intermediate algebra course, Math 67, appeared in 2012, but this was designed as a pre-statistics course.

The disparity in section offerings between Math 80 and Math 73 continued in the subsequent years. The drastic decrease in the number of Math 80 course sections was of serious concern because it choked off the main access point for students to the CM1 courses, which form the backbone of a solid education in the sciences and math. With math- and science-related fields becoming an increasingly important part of the country's economy, we must ensure that students have sufficient access to the pipeline of CM1 courses that leads to these fields.

At the time of the last CM1 Program Review in 2011, the access to STEM courses was severely curtailed. In just two short years, the administration reduced the percentage of students taking Math 80 from 100% down to 22.4% (see Figure 1 below). This was not an issue of decreased demand – the fill rates for these courses routinely exceed 100% (see Figure 2 below).

Intermediate Algebra Section Offerings and Head Counts								
	MATH 80		MATH 73		MATH 67			Percent
	Sections	Students	Sections	Students	Sections	Students		Taking M80
2008	105	4582	-	-	-	-		100%
2009	57	2767	43	2157	-	-		56.2%
2010	21	1017	80	3531	-	-		22.4%
2011	30	1198	84	3682	-	-		24.5%
2012	37	1379	68	3081	9	331		28.8%
2013	64	2408	51	2349	13	393		46.8%
2014	70	2557	55	2395	12	388		47.9%
2015	71	2589	52	2120	15	501		49.7%
Spring 16	31	1076	21	780	6	171		53.1%
Sum 16	8		6		2			
Fall 16	45	1677	25	1005	7	185		58.5%

Figure 1

Math 80 Fill Rates					
	2011	**2012**	**2013**	**2014**	**2015**
Fill Rate	97.8%	106.5%	107.5%	104.4%	104.2%

Figure 2

Many faculty were shocked by this drastic decrease so, in 2011, we recommended an increase in Math 80 sections. This recommendation was heeded and, as a result, was steadily implemented over the next few years. Progress has been made, but we feel that a higher percentage of intermediate algebra offerings should be at the Math 80 level. To accommodate this, the need for alternative intermediate algebra courses can be lessened by providing more resources to students in Math 80. This would create more equity among students, especially in cases where students may not have access to sufficient resources outside of the classroom or had inadequate training in previous math courses. In turn, this would enable all students the opportunity to succeed in the course. A starting point would be Supplemental Instruction (SI) being available for every section. Along with SI, review workshops should be funded and scheduled to help students perform to the best of their ability in the course. We will seek out grant money and SEP funds to fund these workshops.

One concern is that students coming from underrepresented groups, that may have mitigating factors affecting their performance in college, could be directed to these less rigorous versions of Intermediate Algebra and they could unknowingly end up limiting their future options because of it. Since Math 80 provides students with the widest range of directions, as it satisfies the prerequisite for every subsequent math course, it should be amply available to students as well as the most supported intermediate algebra course.

In contrast, Math 67 and Math 73, which have far less rigor and depth of content than Math 80, satisfy the prerequisites of very few subsequent math courses. If students from backgrounds where their previous education in math may have been compromised are steered toward the Math 67 or Math 73 track, then it seems likely that when we do equity statistics in a few years, we will see a grave disparity in the makeup of students enrolled in Math 80 versus these alternatives.

The problem with having multiple courses at the intermediate algebra level, and the fallout from it, has already started to negatively impact students who may not have known which was the best option for them or chose Math 67 or 73 because there were not adequate sections of Math 80 available. Case in point, a challenge exam for Math 80 has been created this year for those students who take Math 73 and later realize that they need Math 80 as a prerequisite for another class. Many CM1 members do not consider this to be a practical solution. The best thing for students is to learn how to handle Math 80 in real time – this will prepare them for the courses to follow, both in math and related fields. Otherwise, they may be unused to and unable to quickly adjust to the workload that is expected when they reach Math 170 or 180.

The success rate for Math 70 in Fall 2008 was 51.4%. In comparison, the success rate for Math 80 (equivalent to Math 70) in Fall 2015 was 53% and for Math 73 was 51%. Therefore, it seems reasonable to believe that many of the students that succeeded in Math 73 could have done well in Math 80 if they had been given some extra resources to help them.

Additionally, the fill rate as of the September 9, 2016 census date for Math 80 was 106.5%. The sections were overfilled by over 100 students. There is huge demand for this course. In contrast the fill rate for Math 73 was 100.4% and for Math 67 was 77.8%.

We recommend that more sections of Math 80 be added, either by shifting from Math 67 and 73 or by increasing the overall number of intermediate algebra sections. Also, support for Math 80 should be increased by increasing the funding of the Math Study Center, increasing the number of sections being supported by Supplemental Instruction, and by offering special review workshops throughout the semester. Each Supplemental Instruction coach is paid $11 per hour and works 11 hours per week, so the cost is about $2000 per semester per section, including administrative costs.

Trigonometry and Precalculus

The CM1 Committee has been investigating various ways to redesign the Math 170 (Trigonometry, 3 units) and 180 (Precalculus, 5 units) sequence that is the prelude to all later STEM courses. One of the flaws in the current design of the sequence is that Math 180 contains a good deal of material from Intermediate Algebra (Math 80) and Trigonometry (Math 170) that is simply reviewed, but not extended. Our considerations have to take into account articulation and the state C-ID. These are the major redesigns that we have considered:

1. Add material to Math 170 and increase it to 4 units. Change parts of Math 180 so that a more integrated approach is taken, rather than just reviewing disparate topics from previous courses.
2. Redesign both courses and integrate trigonometry throughout by covering the first half of trigonometry in Math 170 and the second half in Math 180. Also, spread the other topics throughout both.
3. Create two new courses, perhaps calling them Analysis I and II (this is done at Pasadena City College and CSU Long Beach), where trigonometry is the main topic of one of the courses and every other precalculus topic is the focus of the other course. Other logistics of such a change would need to be considered, such as whether we would allow them to be taken concurrently.

The CM1 Committee will continue to explore the potential of such changes by studying what other schools are doing. However, we do not think that the two courses should be combined into one course. Santa Monica College is in the process of splitting their one semester precalculus course into two separate courses. We will keep an eye on that situation.

An experimental sequence was started in the 2015-16 academic year called Gateways to Engineering. It is intended for engineering and other STEM majors who are at the intermediate algebra level. In the fall, the students enroll in both Intermediate Algebra (Math 80) and Geometry (Math 60). In the spring, they enroll in both Trigonometry (Math 170) and Precalculus (Math 180). The goal is for these students to be able to enroll in Calculus I (Math 190) after only one year. While Math 80 and Math 60 are not part of CM1, the students who enroll in these courses are typically planning to complete the calculus sequence and major in a STEM field. Please see Appendix C for more detailed information.

c) Explain any course deletions and inactivations from current course offerings.

No courses have been deleted or inactivated.

d) Describe the courses and number of sections offered in distance education. (Distance education includes hybrid classes.)

No distance education courses are offered. Currently, CM1 has no plans to create distance education courses. We believe students are better served at this level by substantial contact with professors and fellow students in a classroom several times a week.

e) Discuss how well the courses, degrees, or certificates meeting students' transfer or career training needs.

1. **Have all courses that are required for your program's degrees and certificates been offered during the last two years? If not, has the program established a course offering cycle?**

   Yes, all courses that are required have been offered in the last two years. All required courses are now offered every spring and fall semester. Most are also available in the summer semester. During Winter 2017 we are piloting several STEM math courses (Math 180, 190, and 191) that were not taught in previous winter sessions.

2. **Are there any concerns regarding program courses and their articulation**?

   All our courses articulate with our main transfer schools.

Math 210 (Discrete Math) does not receive credit from UC Berkeley. It does not completely match the C-ID, because there are two vastly different C-IDs in existence for Discrete Math. We should add a few topics which will also require adding one unit. We will explore this over the next year.

Math 270 (Differential Equations and Linear Algebra) does not receive credit for both Linear Algebra and Differential Equations at many schools in the UC and Cal State system. We will investigate the feasibility of splitting it into two separate courses. We will investigate what other community colleges are doing, what is required in the C-IDs, and the articulation ramifications. We must also make sure we have faculty who are willing and able to teach these advanced classes. Finally, in order to maintain high standards and the integrity of the program we must ensure that future hires have the ability to handle most of the CM1 math courses.

3. **How many students earn degrees and/or certificates in your program? Do students take licensure exams? If so, what is the pass rate? If few students receive degrees or certificates or if few students pass the licensure exam, should the program's criteria or courses be re-examined? Set an attainable, measurable goal for future degrees, certificates, and/or licensure pass rates.**

   A.S. Degrees in Math Awarded

2010-11	2011-12	2012-13	2013-14	2014-15
31	38	66	49	54

   The number of degrees awarded is fairly small, but this is to be expected since most students who are taking the STEM sequence are seeking degrees in other areas, such as Computer Science, Engineering or the Natural Sciences.

   Our students do not take any licensure exams.

f) List any related recommendations.

1. We recommend a shift in the distribution of Intermediate Algebra courses so that at least 75% of students are enrolled in Math 80. This would involve a shifting of sections from Math 67 and Math 73 (Cost: none).
2. We recommend an increase in Supplemental Instruction availability to Math 80 (Cost: $2000 per section per semester).
3. We recommend the introduction of Supplemental Instruction to Math 170 and 180 (cost: $2000 per section per semester).
4. We recommend an increase in funding to MESA so that they can expand student access.
5. We recommend that a unit be added to Trigonometry, Math 170, with the commensurate addition of some topics (Cost:).
6. We recommend that Math 80 be moved to the CM1 Committee (Cost: none).

4. Assessment and Student Learning Outcomes (SLOs)

a. Provide a copy of your alignment grid, which shows how course, program, and institutional learning outcomes are aligned.

MATHEMATICAL SCIENCES
Institutional (ILO), Program (PLO), and Course (SLO) Alignment

Program: **Math (Math and Science Majors)**	**Number of Courses:** 7	**Date Updated:** 08.18.2014	

ILOs	**1. Critical Thinking** *Students apply critical, creative and analytical skills to identify and solve problems, analyze information, synthesize and evaluate ideas, and transform existing ideas into new forms.*	**2. Communication** *Students effectively communicate with and respond to varied audiences in written, spoken or signed, and artistic forms.*	**3. Community and Personal Development** *Students are productive and engaged members of society, demonstrating personal responsibility, and community and social awareness through their engagement in campus programs and services.*	**4. Information Literacy** *Students determine an information need and use various media and formats to develop a research strategy and locate, evaluate, document, and use information to accomplish a specific purpose. Students demonstrate an understanding of the legal, social, and ethical aspects related to information use.*

SLO-PLO-ILO ALIGNMENT NOTES:

Mark boxes with an 'X' if: SLO/PLO is a major focus or an important part of the course/program; direct instruction or some direct instruction is provided; students are evaluated multiple times (and possibly in various ways) throughout the course or are evaluated on the concepts once or twice within the course.

PLOs	**PLO to ILO Alignment** *(Mark with an*			
	1	**2**	**3**	**4**
PLO #1 Understanding Concepts Students will explain and demonstrate mathematical concepts relevant to the course content.	X	X		X
PLO #2 Solving Problems Students will solve problems, including application problems, relevant to the course concepts and content.	X	X	X	X
PLO #3 Graphs Students will create, interpret and analyze graphs relevant to the course concepts and content.	X	X		X
PLO #4 Proofs Students will analyze and construct proofs relevant to the course concepts and content.	X	X		X

SLOs	SLO to PLO Alignment				SLO to ILO Alignment			
	P1	P2	P3	P4	1	2	3	4
MATH 170 Trigonometry: SLO #1 Understanding Concepts Students will explain and demonstrate basic trigonometric concepts and definitions.	X				X	X		X
MATH 170 Trigonometry: SLO #2 Solving Problems Students will solve trigonometric application problems, including those involving the laws of sines and cosines.	X	X			X	X	X	X
MATH 170 Trigonometry: SLO #3 Graphs Students will create, interpret and analyze the graphs of trigonometric functions and their inverses.	X		X		X	X		X
MATH 170 Trigonometry: SLO #4 Proofs Students will analyze and construct proofs of trigonometric identities.	X			X	X	X		X
MATH 180 Pre-Calculus: SLO #1 Understanding Concepts Students will explain and demonstrate basic precalculus concepts by solving equations, inequalities and systems involving algebraic, exponential, logarithmic, trigonometric, and absolute value expressions.	X				X	X		X
MATH 180 Pre-Calculus: SLO #2 Solving Problems Students will use polynomial, rational, exponential, logarithmic, and trigonometric equations and functions to set up and solve application and modeling problems.	X	X			X	X	X	X
MATH 180 Pre-Calculus: SLO #3 Graphs Students will create, interpret and analyze the graphs of polynomial, rational, exponential, logarithmic, trigonometric, parametric, polar and conic equations.	X		X		X	X		X
MATH 180 Pre-Calculus: SLO #4 Proofs Students will analyze and construct proofs, including proofs by induction.	X	X		X	X	X		X
MATH 190 Single Variable Calculus and Analytical Geometry I: SLO #1 Understanding Concepts Students will explain and demonstrate the idea of the limit, the derivative and the integral.	X				X	X		X
MATH 190 Single Variable Calculus and Analytical Geometry I: SLO #2 Solving Problems Solve problems, including problems involving velocity and acceleration, by using derivatives and integrals.	X	X			X	X	X	X
MATH 190 Single Variable Calculus and Analytical Geometry I: SLO #3 Graphs Students will use techniques of calculus to determine maxima, minima, and points of inflection on the graph of a function.	X	X	X		X	X		X
MATH 190 Single Variable Calculus and Analytical Geometry I: SLO #4 Proofs Students will analyze and construct proofs involving limits, derivatives, and integrals.	X	X		X	X	X		X

SLOs	SLO to PLO Alignment				SLO to ILO Alignment			
	P1	P2	P3	P4	1	2	3	4
MATH 191 Single Variable Calculus and Analytical Geometry II: SLO #1 Understanding Concepts Students will explain and demonstrate advanced integration techniques and convergence of sequences and series.	X				X	X		X
MATH 191 Single Variable Calculus and Analytical Geometry II: SLO #2 Solving Problems Students will use integrals to evaluate volumes, surface area and arc length.	X	X			X	X	X	X
MATH 191 Single Variable Calculus and Analytical Geometry II: SLO #3 Graphs Students will use limits, derivatives and integration to analyze graphs of parametric equations, polar equations, and conic sections.	X	X	X		X	X		X
MATH 191 Single Variable Calculus and Analytical Geometry II: SLO #4 Proofs Students will analyze and construct proofs to determine convergence and divergence of sequences and series.	X	X		X	X	X		X
MATH 210 Introduction to Discrete Structures: SLO #1 Understanding Concepts Students will explain and demonstrate an understanding of the key principles of logic, number theory, combinatorics, probability and graph theory.	X				X	X		X
MATH 210 Introduction to Discrete Structures: SLO #2 Solving Problems Students will use logic, functions, number theory, and combinatorics to solve a variety of problems, including application problems and computer science algorithm analysis.	X	X	X		X	X	X	X
MATH 210 Introduction to Discrete Structures: SLO #3 Graphs Students will analyze and solve problems in graph theory.	X		X		X	X		X
MATH 210 Introduction to Discrete Structures: SLO #4 Proofs Students will analyze and construct proofs in logic, number theory, combinatorics, probability and graph theory.	X	X	X	X	X	X		X
MATH 220 Multi-Variable Calculus: SLO #1 Understanding Concepts Students will explain and demonstrate partial derivatives, multiple integrals and the major theorems of vector calculus.	X				X	X		X
MATH 220 Multi-Variable Calculus: SLO #2 Solving Problems Students will calculate partial derivatives for a function of more than one variable and use them to solve multivariable optimization problems; and evaluate double and triple integrals, and apply them to physical problems such as moments and centers of mass.	X	X			X	X	X	X
MATH 220 Multi-Variable Calculus: SLO #3 Graphs Students will analyze the graphs and equations of curves and surfaces in three-dimensional space, as well as vector fields.	X		X		X	X		X
MATH 220 Multi-Variable Calculus: SLO #4 Proofs Students will analyze and apply Green's, Stokes, and Gauss' Theorems.	X	X		X	X	X		X
MATH 270 Differential Equations with Linear Algebra: SLO #1 Understanding Concepts Students will explain and demonstrate the key concepts of linear algebra, including determinants, vector spaces and linear transformations.	X				X	X		X
MATH 270 Differential Equations with Linear Algebra: SLO #2 Solving Problems Students will use differential equations and linear algebra to solve a variety of problems, including application problems.	X	X			X	X	X	X

SLOs	SLO to PLO Alignment				SLO to ILO Alignment			
	P1	P2	P3	P4	1	2	3	4
MATH 270 Differential Equations with Linear Algebra: SLO #3 Graphs Students will use graphical techniques to solve differential equations or systems of differential equations.	X	X	X		X	X		X
MATH 270 Differential Equations with Linear Algebra: SLO #4 Proofs Students will analyze and construct proofs relevant to differential equations and linear algebra.	X	X		X	X	X		X

b. Provide a timeline for your course and program level SLO assessments.

SLO and PLO Assessment Timeline Division: Math Program: Math for Engineering, Science and Math Students Program Review Date: SP15/FA15		
Semester and Year	**SLO to be Assessed** **Include the SLO# and Short Title**	**PLO to be Assessed** **Include the PLO# and Short Title**
Spring 2014		
Summer 2014 **(If applicable)**		
Fall 2014	Math 170 SLO #1 - *Understanding Concepts* *Math 180 SLO #1 - Understanding Concepts* *Math 190 SLO #1 - Understanding Concepts* *Math 191 SLO #1 - Understanding Concepts* *Math 210 SLO #1 - Understanding Concepts* *Math 220 SLO #1 - Understanding Concepts* *Math 270 SLO #1 - Understanding Concepts*	PLO #1: Students will explain and demonstrate mathematical concepts relevant to the course content.
Spring 2015		
Summer 2015 **(if applicable)**		
Fall 2015	Math 170 SLO #2 – Solving Problems Math 180 SLO #2 – Solving Problems Math 190 SLO #2 – Solving Problems Math 191 SLO #2 – Solving Problems Math 210 SLO #2 – Solving Problems Math 220 SLO #2 – Solving Problems Math 270 SLO #2 – Solving Problems	PLO #2: Students will solve problems, including application problems, relevant to the course concepts and content.
Spring 2016		
Summer 2016 **(If applicable)**		

Fall 2016	Math 170 SLO #3 – Graphs Math 180 SLO #3 – Graphs Math 190 SLO #3 – Graphs Math 191 SLO #3 – Graphs Math 210 SLO #3 – Graphs Math 220 SLO #3 – Graphs Math 270 SLO #3 – Graphs	PLO #3: Students will create, interpret and analyze graphs relevant to the course concepts and content.
Spring 2017		
Summer 2017 (If applicable)		
Fall 2017	Math 170 SLO #4 – Proofs Math 180 SLO #4 – Proofs Math 190 SLO #4 – Proofs Math 191 SLO #4 – Proofs Math 210 SLO #4 – Proofs Math 220 SLO #4 – Proofs Math 270 SLO #4 – Proofs	PLO #4: Students will analyze and construct proofs relevant to the course concepts and content.

c. State the percent of course and program SLO statements that have been assessed.

Division	% of Courses With At Least One Assessment by end of Spring 2012	% of Courses With At Least One Assessment by end of Fall 2012	% of Courses With At Least One Assessment by end of Spring 2013	% of Courses With At Least One Assessment by end of Fall 2013	% of Courses With At Least One Assessment by end of Fall 2014	% of Courses With At Least One Assessment by end of Fall 2015
Mathematics	100%	100%	100%	100%	100%	100%

d) Summary of SLO and PLO assessment results over the past four years for CM1 Math 170, 180, 190, 191, 210, 220, 270 from Spring 2012 - Fall 2015

CM1 Summary of SLO Success Rates from Spring - 2012 to Fall- 2015

	Spring-2012	Fall-2012	Spring-2013	Fall-2013	Spring-2014	Fall-2014	Spring-2015	Fall-2015
Math-170	**86%**	**68.8%**	**59%**	**-----**	**------**	**84%**	**------**	**75%**
Math-180	**77%**	**73.4%**	**76%**	**75.6%**	**-------**	**83%**	**-------**	**77.2%**
Math-190	**77%**	**89%**	**79%**	**-------**	**-------**	**79.2%**	**-------**	**68%**
Math-191	**82%**	**78%**	**80.3%**	**--------**	**-------**	**75.2%**	**-------**	**64.3%**
Math-210	**87%**	**------**	**85.2%-88.9%**	**--------**	**-------**	**86%**	**-------**	**91%**
Math-220	**88.5%**	**87.9%**	**87.4%**	**-------**	**-------**	**90%**	**-------**	**83%**
Math-270	**84%**	**83%**	**73%**	**-------**	**-------**	**38%**	**-------**	**81%**

SLO Assessment and Analysis - 2012-2016 (organized by course)

SLO Assessment Summary - Math 170 - Trigonometry							
Term	**SLO Number**	**SLO Statement**	**Score 3**	**Score 2**	**Score 1**	**Score 0**	**Success Rate (scoring 2 or 3)**
Spring 2012	SLO #1 (formerly SLO #5)	Students will find the unknown side(s) and angle(s) of triangles.	68.0% (120)	18.0% (32)	14.0% (24)		86.0%
Fall 2012	SLO #2 (formerly SLO # 6)	Students will use trigonometry to work with vectors and complex numbers.	49.4% (84)	19.4% (33)	31.2% (53)		68.8%
Spring 2013	SLO #4	Prove Trigonometric Identities - Students will prove trigonometric identities.	50.0% (33)	9.0% (6)	41.0% (27)		59.0%
Fall 2014	SLO #1 (formerly SLO #5)	Understanding Concepts - Students will explain and demonstrate basic trigonometric concepts and definitions.	74.0% (157)	10.0% (22)	9.0% (19)	7.0% (16)	84.0%

Fall 2015	SLO #2	Solving Problems - Students will solve trigonometric applications problems, including those involving the laws of sines and cosines.	53.0% (127)	22.0% (53)	14.0% (33)	11.0% (28)	75.0%

Math 170 - Summary of Analysis and Actions:

Overall, we see very strong success rates ranging from 68%-86% (being defined as students earning a "2" or a "3" on the SLO assessments for the term). In Fall 2012, instructors commented that students seemed to have consistent practice with trigonometric application problems, in particular involving law of sines and cosines. In the future, more practice for the students will continue to raise success rates. We continue to encourage students to attend instructor office hours, arrange study groups, and complete similar problems to increase understanding. In Spring 2013, it was recommended by instructors to increase the number of units for Math 170 from 3 to 4 so we may fully explore the depth of trigonometry and better prepare students for STEM Precalculus. Since we observed an 84% success rate, increasing the rigor of such application problems being assessed will be effective in analyzing what our students understand. In Fall 2015, we saw good results assessing students' ability to analyze an application problem using trigonometry. Techniques that seem to help include training students to sketch appropriate diagrams and having students work on exercises collaboratively and on the board. To improve these results, we will continue to suggest instructors emphasize conceptual understanding of the mathematical ideas as well as the computational procedures. Important terminology such as 'angle of depression' or 'angle of elevation' cannot be treated lightly. These terms in conjunction with application problems will help our students improve their performance. As an action, we would like to follow up with trigonometry problems that utilize different skill sets and/or increase the rigor of the problem being assessed.

SLO Assessment Summary - Math 180 - Precalculus							
Term	**SLO Number**	**SLO Statement**	**Score 3**	**Score 2**	**Score 1**	**Score 0**	**Success Rate (scoring 2 or 3)**
Spring 2012	SLO #1	Students will find zeros of polynomial functions by factoring polynomials using polynomial division and the factor theorem.	60.0% (159)	17.0% (29)	23.0% (41)		77.0%
Fall 2012	SLO #2	Students will solve algebraic, exponential, logarithmic, trigonometric, absolute value equations, and systems of equations using matrices.	44.3% (90)	29.1% (59)	26.6% (54)		73.4%
Spring 2013	SLO #1 (formerly SLO #7)	Students will solve quadratic and rational inequalities and inequalities with absolute value.	44.6% (90)	31.2% (63)	24.2% (49)		75.8%
Fall 2013	SLO #4	Proofs - Students will analyze and construct proofs, including proofs by induction.	47.6% (121)	28.0% (71)	24.4% (62)		75.6%
Fall 2014	SLO #1	Understanding concepts - Students will explain and	47.0% (158)	36.0% (120)	9.0% (30)	8.0% (26)	83.0%

		demonstrate basic pre-calculus concepts by solving equations, inequalities and systems involving algebraic, exponential, logarithmic, trigonometric, and absolute value expressions.					
Fall 2015	SLO #2	Solving Problems - Students will use polynomial, rational, exponential, logarithmic, and trigonometric equations and functions to set up and solve application and modeling problems.	58.8% (134)	18.4% (42)	9.2% (21)	13.5% (31)	77.2%

Math 180 - Summary of Analysis and Actions:

Overall, we see very strong success rates ranging from the low-70% to mid-80%. In Spring 2012, 79% of the students successfully acquired the skill of determining zeroes of a higher degree polynomial function. Since this is an acceptable success percentage, only minor modifications are planned in teaching this skill in the future. The results were actually better than overall test scores. Students practiced solving this type of problem both in class and on homework. In Fall 2012, instructors all agreed that students struggled with problems involving radicals and fractions. We have assumed that students have been exposed to those problems for three consecutive semesters prior to this course, but the outcome was not great. We believe that periodical reviews using activities and/or quizzes on fractions and radicals will help to increase retention. Although many students understood the concept of logarithmic equations, some of them still had difficulty solving the equations because they forgot to use the properties of logarithm. In addition, we think that we could increase the success rate by spending more time on the inverse trigonometric functions and trigonometric functions in general. After many discussions among faculty members, we decided to give cumulative exams so that students do not forget what they learned at the beginning of the semester. In Spring 2013, instructors commented that the most common error when solving quadratic inequalities occurs when students solved them as if they were equations, so they did not test the correct intervals. As a suggestion, instructors should provide more in-depth examples and homework assignments, with extra emphasis given to the distinction between solving a quadratic equation and a quadratic inequality. In Fall 2014, instructors commented that the students again performed well in finding the zeros of polynomial functions. Next time, we want to increase the rigor of the SLO by using harder functions such as trigonometric, logarithmical or exponential. We will try to continue having students work in class on these problems, give supplemental handouts, and hold more review sessions before the exams.

SLO Assessment Summary - Math 190 - Calculus w/ Analytic Geometry							
Term	**SLO Number**	**SLO Statement**	**Score 3**	**Score 2**	**Score 1**	**Score 0**	**Success Rate (scoring 2 or 3)**
Spring 2012	SLO #2	Students will find derivatives of single-variable elementary functions.	39.0% (75)	38.0% (73)	23.0% (43)		77.0%

Fall 2012	SLO #2	Students will find derivatives of single-variable elementary functions.	66.0% (102)	23.0% (33)	11.0% (18)		89.0%
Spring 2013	SLO #1 (formerly SLO #6)	Fundamental Theorem of Calculus - Students will be able to use the Fundamental Theorem of Calculus	55.0% (124)	24.0% (55)	21.0% (48)		79.0%
Fall 2014	SLO #1	Understanding Concepts - Students will explain and demonstrate the idea of the limit, the derivative, and the integral.	54.2% (169)	25.0% (78)	13.4% (42)	7.4% (23)	79.2%
Fall 2015	SLO #2	Solving Problems - Solve problems, including problems involving velocity and acceleration, by using derivatives and integrals.	43.0% (100)	25.0% (57)	18.0% (42)	14.0% (33)	68.0%

Math 190 - Summary of Analysis and Actions:

Overall, we see strong success rates ranging from the upper 60s to high 80%. We are very pleased with the results and as we assess future SLOs in the terms to come, we plan to increase the rigor of the assessments to further push our students to deeper understanding of the subject matter. In Spring 2012, instructors commented on a need to spend more class time on analyzing implicit equations (in particular when taking implicit derivatives). This has been an area that many students struggled with. In spring 2013, 79% of the students performed at the excellent or satisfactory level. Some instructors noted that students had more difficulty with Part 1 than Part 2 of the Fundamental Theorem of Calculus. Most instructors will give more examples and assign more homework problems in the future, especially for those related to Part 1 of the Fundamental Theorem of Calculus. In Fall 2014, since students performed well in utilizing the definition of the derivative, we would like to change the type of function being evaluated in the next assessment. Instead of using a polynomial function, we plan to increase the rigor and utilize a basic rational function or radical function (thus changing the algebraic techniques required to evaluate the limit of the difference quotient). We hope to raise the success rate to 70% in a future assessment. Perhaps we will use a different application problem such as related rates to assess calculus problem solving techniques.

SLO Assessment Summary - Math 191 - Calculus w/ Analytic Geometry II							
Term	**SLO Number**	**SLO Statement**	**Score 3**	**Score 2**	**Score 1**	**Score 0**	**Success Rate (scoring 2 or 3)**
Spring 2012	SLO #3 (formerly SLO #5)	Students will solve problems involving parametric equations, polar coordinates, and conic sections.	60.0% (87)	22.0% (32)	18.0% (26)		82.0%
Fall 2012	SLO #2	Students will evaluate integrals, both proper and improper, using integration techniques including integration by parts, trigonometric substitutions, partial fraction decompositions and numerical techniques to approximate the values of integrals.	47.0% (85)	31.0% (57)	22.0% (39)		78.0%

Spring 2013	SLO #4	Students will construct proofs relevant to the course concepts and content.	45.9% (84)	34.4% (63)	19.7% (36)		80.3%
Fall 2014	SLO #1	Understanding concepts - Students will explain and demonstrate advanced integration techniques and convergence of sequences and series.	40.0% (64)	32.5% (52)	14.4% (23)	13.1% (21)	72.5%
Fall 2015	SLO #2	Solving Problems - Students will use integrals to evaluate volumes, surface area and arc length.	34.8% (72)	29.5% (61)	27.0% (56)	8.7% (18)	64.3%

Math 191 - Summary of Analysis and Actions:

Overall, we see strong success rates in the mid-60% to low-80% range. We are pleased with the results and will continue to increase the rigor of assessments in the future to further analyze how deeply our students understand challenging STEM material. In Fall 2012, some instructors commented that students had difficulties with integration by parts. We strongly believe that a better understanding of limits and indeterminate forms should be required for students to be successful in this course. In Fall 2014, the students who participated in this SLO assessment did well in utilizing the tests for convergence of sequences and series. Five out of the seven sections used geometric sequence and series to be tested for convergence. For the next assessment, instead of using a geometric series, we would like to use a series that requires students to use a test for convergence other than the geometric series test. We are planning to use a series that can be tested for convergence using the ratio test or the integral test. In Fall 2015, we would like to improve the success rate to 65%. Further, we should expand the question to include concepts, such as surface area and arc length. Instructors commented that it is important to train students to visualize and sketch functions, in addition to solids in three dimensions. Reinforcing basic concepts from Precalculus (such as trigonometric functions) can help alleviate some performance issues. Trigonometry is also central to many of the difficult ideas in Calculus II. Without this foundation, we run into trouble. Many instructors have commented that students have trouble setting up the problem while the integration goes pretty smoothly. Using some mathematical visualization software in classes can help bolster students' abilities to sketch appropriate diagrams and visualize the solids of revolution actually being generated. Putting students into groups can also help them develop their problem solving skills by collaborating and bouncing ideas off each other.

SLO Assessment Summary - Math 210 - Discrete Math							
Term	**SLO Number**	**SLO Statement**	**Score 3**	**Score 2**	**Score 1**	**Score 0**	**Success Rate (scoring 2 or 3)**
Spring 2012	SLO #1 (formerly SLO #3)	Students will use number theory to find factorizations, common multiples and factors, perform modular arithmetic, and prove important results.	55.0% (17)	32.0% (10)	13.0% (4)		87.0%

Spring 2013	SLO #1	Logic and Proof - Students will use logic and set algebra to analyze statements and arguments and use these ideas to write proofs using a variety of methods.	55.6% (15)	29.5% (8)	14.8% (4)		85.2%
Spring 2014	SLO #3 (formerly SLO #5)	Graph Theory - Students will solve problems and write proofs in graph theory.	51.9% (14)	37.0% (10)	11.1% (3)		88.9%
Fall 2014	SLO #1	Understanding Concepts - Students will explain and demonstrate an understanding of key principles of logic, number theory, combinatorics, probability and graph theory.	56.0% (15)	30.0% (8)	14.0% (4)	0.0% (0)	86.0%
Fall 2015	SLO #2	Solving Problems - Students will use logic, functions, number theory, and combinatorics to solve a variety of problems, including application problems and computer science algorithm analysis.	70.0% (15)	21.3% (5)	8.7% (2)	0.0% (0)	91.0%

Math 210 - Summary of Analysis and Actions:

We usually only have one section of Discrete Math each term. However, in recent terms popularity of the course has increased due to the increasing size of our Computer Science Program. We hope to have two or more sections each term. Overall, SLO success rates are very high from 85% to 91%. Students tend to be very capable at this level and show a trend of persistence. In Spring 2012, the instructor commented that 87% of the students did well in applying the Chinese Remainder Theorem to solving a system of linear congruencies using modular arithmetic. The students did well by studying important examples from class and doing practice problems before the test. In the future, more useful practice problems will be given to the students to prepare them for tests. In Spring 2013, the students did well again on graph theory proof since 85.2% succeeded at the excellent or satisfactory level. In the future, we will give them a wider variety of examples so they can tackle harder proofs. In Fall 2014, approximately 86% of the students excelled on this SLO assessment because they were exposed to several examples related to the classification of relations in detail explanations. Next time, we want to assess a different topic such as number theory, combinatorics, probability or graph theory to check for full understanding of this SLO. In Fall 2015, with a high success rate of 91%, almost everyone showed complete or almost complete understanding. For future assessment of SLO #2, we would like to possibly increase the rigor of the problem and/or change the nature of the problem to assess a different skill set for discrete mathematics.

SLO Assessment Summary - Math 220 - Calculus w/ Analytic Geometry III							
Term	**SLO Number**	**SLO Statement**	**Score 3**	**Score 2**	**Score 1**	**Score 0**	**Success Rate (scoring 2 or 3)**

Spring 2012	SLO #2 (formerly SLO #3)	Calculate partial derivatives for a function of more than one variable.	79.0% (53)	10.5% (7)	10.5% (7)		88.5%
Fall 2012	SLO #2 (formerly SLO #5)	Solve problems involving double integrals.	53.0% (35)	34.9% (23)	12.1% (8)		87.9%
Fall 2014	SLO #1	Understanding concepts - Students will explain and demonstrate partial derivatives, multiple integrals and the major theorems of vector calculus.	78.0% (66)	12.0% (10)	8.0% (7)	2.0% (2)	90.0%
Fall 2015	SLO #2	Solving Problems - Students will calculate partial derivatives for a function of more than one variable and use them to solve multivariable optimization problems; and evaluate double and triple integrals, and apply them to physical problems such as moments and center of mass.	51.6% (65)	31.0% (39)	11.1% (14)	6.3% (8)	83.0%

Math 220 - Summary of Analysis and Actions:

Overall, we see very high success rates in our high-level STEM courses. With success rates in the 80-90% in all SLO assessments, we continue to raise our standards and increase the rigor of our assessments to further challenge our advanced STEM students as they prepare for their four-year university STEM programs. In Spring 2012, instructors commented that by explaining the concept, and thorough exercises, almost all of the students were able to do excellent work with the partial derivatives. As an action for the future, we must continue to emphasize applications of the topics, including utilizing partial derivatives to solve real-world problems. In Fall 2012, students performed very well on the SLO mainly due to a huge amount of review practice time on the topic at the end of semester. Most of the errors were not due to misunderstanding of problems, but rather, carelessness. Although the question was not challenging, it did require a change of coordinate systems which some students had trouble with. Overall, the students had a firm grasp of what needed to be done and how to do it. The results indicate to us that a greater emphasis on understanding the region of integration is needed. One approach might be to include in our lectures more problems involving graphs of the region of integration. Since there are only few questions on the topic in the textbook, we will look into different supplemental resources for the topic and create activities and more practice problems. There is no recommendation for curriculum change at the course and program level. In Fall 2014, instructors commented that due to their strong foundation in differentiation from the Single Variable Calculus sequence (Math 190 and Math 191), the students were able to learn partial derivatives quickly. A brief review of differentiation was helpful to students. Possible actions may include 1. Since the majority of students understand the concept, we will continue what works well. 2. Flip-n-teach and teach-n-flip. 3. For the nine students who scored a 0 (No understanding) and a 1 (Some understanding), we need to encourage them to put in more effort and to study hard. We also need to encourage the students who have work-related issues to balance time between studying and work. For those who have health-related issues, we need to encourage them to take care of their health first before they enroll in an intense course like Math 220. In Fall 2015, students seemed to meet or exceed expectations with this SLO. Instructors found that utilizing a variety of teaching strategies, from traditional lecturing to putting students into collaborative groups, helps to strengthen student understanding of

Multivariable Calculus. Assigning a variety of homework problems and having students practice the ideas frequently will help to improve future results. Some strategies that we can try for future assessments of this SLO include using math visualization software in class to generate images and animations of the calculus at work. Optimizing quantities in three dimensions definitely takes some getting used to and having strong visual aids will help bolster student understanding. Thus, for future assessment of SLO #2, we would like to change the nature of the optimization-type problem to incorporate different skill sets utilized in the Multivariable Calculus course and/or increase the rigor of the assessed problem.

SLO Assessment Summary - Math 270 - Differential Equations & Linear Algebra							
Term	**SLO Number**	**SLO Statement**	**Score 3**	**Score 2**	**Score 1**	**Score 0**	**Success Rate (scoring 2 or 3)**
Spring 2012	SLO #1	Students will solve both linear and nonlinear 1st and 2nd order ordinary differential equations and higher order ODE and their applications.	71.0% (53)	13.0% (10)	16.0% (12)		84.0%
Fall 2012	SLO #2 (formerly SLO #4)	Students will solve systems of ODEs, especially with eigenvalues and eigenvectors in order to effectively solve linear systems of ODE.	66.2% (43)	16.9% (11)	16.9% (11)		83.0%
Spring 2013	SLO #1 (formerly SLO #4)	Students will understand linear algebra (linear systems, matrices, determinants, vector spaces, linear transformations) as a first step to generalize procedure to solve higher order linear ODEs.	55.7% (39)	17.2% (12)	27.1% (19)		73.0%
Fall 2014	SLO #1	Understanding concepts - Students will explain and demonstrate the key concepts of linear algebra including determinants, vector spaces and linear transformations.	27.0% (20)	11.0% (8)	54.0% (40)	8.0% (6)	38.0%
Fall 2015	SLO #2	Solving problems - Students will use differential equations and linear algebra to solve a variety of application problems.	47.0% (36)	34.0% (26)	19.0% (15)	0.0% (0)	81.0%

Math 270 - Summary of Analysis and Actions:

Overall, the Math 270 course has mostly high success rates (73% to 84%). In Spring 2012, the majority of students knew how to solve first order nonlinear differential equations even though they were not told which

specific technique was required to solve the problem. We think that the main reason for the high success rate is that students' differential and integral skills were well developed throughout Math 190, Math 191, and Math 220. In Fall 2012, the majority of students (about 83%) understood how to solve the system of ordinary differential equations using eigenvalues and eigenvectors. We can increase the student success rate by solving more sample problems and also giving more in-depth lectures so that students can grasp the concept to solve a linear system of ordinary differential equations with eigenvalues & eigenvectors. Also, providing more faculty office hours and practice outside classroom is absolutely necessary for this course.

In Spring 2013, the data showed that more than 50% of all the students enrolled in Math 270 have a strong understanding of the concepts of linear algebra. More exercises in linear algebra will help students grasp the concept. We should offer a separate course in linear algebra, so that the students will have a detailed understanding of the concepts in the subject before they try to understand its applications to differential equations. In Fall 2014, we had a bit of an anomaly with a lower success rate of 38% for a linear algebra problem. Due to the small sample size of such an advanced math course, we get a variety of results depending on the nature of the SLO problems and the materials used to teach the course. Different instructors emphasize different topics in this course from time to time which may have contributed to the difference in performance. One section (0970) had a bit more trouble with the SLO and this could be a due to a variety of reasons. We would like to see closer to 60% of the students reach the good to excellent understanding on the SLO when it is assessed again. The course is quite advanced and requires a substantial amount of abstract thinking for our higher-level STEM students. Continuing to have the students work individually and collaboratively on problems related to basis and vector spaces will help improve performance.

For Fall 2015, with 81% of students assessed at complete or most understanding, overall we are pleased with the results. At this level, students tend to have strong study habits. We continue to emphasize with students the need to work diligently on assigned homework problems. Using collaborative activities in class can help students strengthen their own understanding by explaining the problem solving process and techniques to their peers. We hope to continue emphasizing conceptual understanding of the ideas being studied in addition to the mathematical procedures to help students solve application problems. In the future, we plan to assess a mixed variety of differential equations problems (perhaps focusing on a different application, such as population dynamics or temperature) and increase the rigor of the problem as well.

PLO Assessment for CM1 Mathematics
(for Engineering, Sciences, and Math Students)

SPRING 2013 - PLO #4 – Students will construct proofs relevant to the course concepts and content.

Linking Course Assessments

PLO #4 was linked to these course SLOs:

Math 170 - #4(#3old), Math 180 - #1(#7old), Math 190 - #1(#6old), Math 191 - #4(#3old), Math 210 - #1 and #3(#5old), Math 220 - #3, Math 270 - #1(#4old)

Reporting Assessment:

Section	Excellent *	Satisfactory *	Unsatisfactory *	Totals*
Math 170	33 (50.0%)	6 (9.1%)	27 (40.1%)	66
Math 180	90 (44.6%)	63 (31.2%)	49 (24.2%)	202

Section	Excellent *	Satisfactory *	Unsatisfactory *	Totals*
Math 190	124 (54.6%)	55 (24.3%)	48 (21.1%)	227
Math 191	84 (45.9%)	63 (34.4%)	36 (19.7%)	183
Math 210	29 (53.7%)	18 (33.3%)	7 (13.0%)	54
Math 220	35 (53.0%)	23 (34.9%)	8 (12.1%)	66
Math 270	39 (55.7%)	12 (17.2%)	19 (27.1%)	70
Total	**434 (50.0%)**	**240 (27.6%)**	**194 (22.4%)**	**868**

PLO #4 - Summary of Analysis and Actions:

Overall, we see that 77.6% of the students performed at the Excellent or Satisfactory level. The only course that differed significantly from this percentage was Math 170 at 59.1%. This is the first course in the STEM sequence, so it is not surprising that students have a hard time adjusting to the rigors of a STEM course.
Here are some suggestions made by instructors to encourage improvements for higher student success in constructing proofs:
1. Many instructors are suggesting that we should introduce more practice problems and examples on proofs to supplement the textbooks. Some instructors are already creating extra handouts for students to use as an additional resource.
2. Also, increasingly more instructors are taking advantage of online resources like videos and online homework.
Implications and Future Directions: In order to increase the overall success rate in STEM courses, we recommend adding a unit to Math 170 to help strengthen student learning of basic concepts in trigonometry.

FALL 2014 - PLO #1 Understanding Concepts - Students will explain and demonstrate mathematical concepts relevant to the course content.

Linking Course Assessments
PLO #1 was linked to these course SLOs:
Math 170 - #1, Math 180 - #1, Math 190 - #1, Math 191 - #1, Math 210 - #1 , Math 220 - #1, Math 270 - #1

Reporting assessment:

Sections	Score 3	Score 2	Score 1	Score 0	Total
Math-170	157(74%)	22(10%)	19(9%)	16(7%)	214
Math-180	158(47%)	120(36%)	30(9%)	26(8%)	334
Math-190	169(54.2%)	78(25%)	42(13.4%)	23(7.4%)	312
Math-191	64(40%)	52(32.5%)	23(14.4%)	21(13.1%)	160
Math-210	15(56%)	8(30%)	4(15%)	0(0%)	27
Math-220	66(78%)	10(12%)	7(8%)	2(2%)	85
Math-270	20(27%)	8(11%)	40(54%)	6(8%)	74
Total	**649(54%)**	**298(25%)**	**165(14%)**	**94(7%)**	**1206**

PLO #1 - Summary of Analysis and Actions:

Overall, 79% of the students scored a "3" or a "2" and passed SLO#1. We are very pleased with the results demonstrating that we have met our standard for this PLO. The only course that differed significantly from this

percentage was Math 270 at 38%. Due to a small sample size for this advanced math course, we get a variety of results depending on the nature of the SLO problems and the materials used to teach the course (*please see full analysis in the Math 270 SLO Summary*). We will continue to use instructor feedback on their student performance to raise our success rates and help students become successful on the STEM track. Many instructors found that utilizing a variety of teaching techniques is helpful in reaching students that respond better to different learning styles - including collaborative group work, interactive demonstrations, and utilizing technology in the classroom (e.g., software, Mathematica, graphing calculators, online homework) to further illustrate challenging math concepts and engage our diverse student population. Instructors have suggested the following action for future assessment: We find it helpful to establish real world applications of the concepts being studied to further demonstrate to students that their success in STEM career fields can be bolstered with a strong understanding of mathematics.

FALL 2015 - PLO #2 Solving Problems: Students will solve problems, including application problems, relevant to the course concepts and content.

Linking Course Assessments

PLO #2 was linked to these course SLOs:
Math 170 - #2, Math 180 - #2, Math 190 - #2, Math 191 - #2, Math 210 - #2 , Math 220 - #2, Math 270 - #2

Reporting assessment:

Sections	Score 3	Score 2	Score 1	Score 0	Total
Math-170	127(53%)	53(22%)	33(14%)	28(11%)	241
Math-180	134(58.8%)	42(18.4%)	21(9.2%)	31(13.5%)	228
Math-190	100(43%)	57(25%)	42(18%)	33(14%)	232
Math-191	72(34.8%)	61(29.5%)	56(27%)	18(8.7%)	207
Math-210	16(70%)	5(21.3%)	2(8.7%)	0(0%)	23
Math-220	65(51.6%)	39(31%)	14(11.1%)	8(6.3%)	126
Math-270	36(47%)	26(34%)	15(19%)	0(0%)	77
Total	**550(48.5%)**	**283(25%)**	**183(16.1%)**	**118(10.4%)**	**1134**

PLO #2 - Summary of Analysis and Actions:

Overall, we have attained a 73.5% success rate (that is, scoring a “2” or a “3” on the assessment). This meets our target for success. Instructors across our CM1 courses have commented on many ways we are helping our students succeed and methods we can be utilizing to further help them achieve success. For our STEM track students, we hold them to a very high standard and we expect students to work hard, complete homework exercises regularly, and seek out assistance when needed using our on-campus resources, such as the tutoring center or MESA center. Utilizing a variety of technologies and online resources in the classroom continues to help provide students with different ways of seeing, interacting and learning the material. Graphing calculators and computer visualization software, such as Mathematica, help to speed up computations and bolster conceptual understanding. We continue to devise ways to utilize this technology in the classroom and strive to remain current and relevant. Exposure to technology has become increasingly important in today's modern job market. We continue to explore and utilize a variety of teaching methods to reach our diverse student population, including collaborative group activities and project-based learning. Instructors have suggested the following action: We hope to assess problem solving in our STEM courses by increasing the difficulty and rigor of assessed problems as well as changing the application area being assessed.

e) Describe how you have improved your SLO process and engaged in dialogue about assessment results.

As a committee, we continue to devise ways to increase our percentage of faculty reporting SLO data results from their classes and raising awareness (with students as well as faculty) with regards to our SLO and PLO assessment process.

Following a department-wide measure from DLOACC, we have consistently posted all assessed courses for a particular term in the department mail room as well as their associated SLO problems and methods of assessment. The rubrics are accessible to all faculty via the posted bulletin and are also distributed by email to the entire department as well.

On our department website, we have continued to post all the SLO and PLO data and summary reports from the TracDAT (since not all faculty and certainly no students have access to it). Our goal is to keep the SLO assessment transparent – keeping all faculty and students aware of the process and the results.

After collecting all the data from the term of SLO assessment, we distribute the results to the committee for further discussion. Especially when we see uniquely high or low results, we discuss modifying our assessments adequately to further gauge our students' understanding of crucial mathematical ideas.

To improve reporting rates (especially among part-time faculty), as a department and committee we continue to remind adjunct faculty that the SLO assessment process is tracked and it is a requirement for part-time faculty evaluation. In TracDAT, we keep tabs on all reporting faculty. Our reporting rate in the last two years has been 100%.

f) List any related recommendations.

Here are the recommendations for future direction of our SLO and PLO assessment process and results:

1. Increase the units for Math 170 (Trigonometry) from 3 to 4.
2. Hold more TracDat training sessions to train our part-time and full-time faculty in the new assessment and record-keeping system for our SLO and PLO data. Perhaps we can enlist experienced full-time faculty to run such sessions.
3. Continue to emphasize the importance of the assessment and reflection process to part-time faculty members.
4. Continue to involve and engage faculty (part-time and full-time) in dialogue regarding SLO and PLO results.

5. Analysis of Student Feedback

During the Spring 2016 semester, a short survey was distributed to students (*n* = 1,444) taking the following courses for engineering, science and math:

- Math 80 (Intermediate Algebra)
- Math 170 (Trigonometry)
- Math 180 (Pre-Calculus)
- Math 190 (Single Variable Calculus and Analytical Geometry I)
- Math 191 (Single Variable Calculus and Analytical Geometry II)
- Math 210 (Introduction to Discrete Structures)
- Math 220 (Multivariable Calculus)
- Math 270 (Differential Equations with Linear Algebra)

The survey contained the following questions:

1. Which math course are you enrolled in this semester?
2. What is your intended major?
3. How many units have you completed at ECC (not including this semester)?
4. Select all math courses you have completed at ECC.
5. Select all math courses you plan to complete at ECC (including this semester).
6. In previous semesters, which courses have you been unable to enroll in?
7. Which technology or computer programs have you used in your math classes at ECC?
8. What is your desired transfer college or university?
9. Which of the following campus resources do you use?
10. Which academic degrees are you interested in achieving?
11. Where do you usually buy math textbooks?
12. Which of these resources would you like to see in the MBA building?
13. Is there an appropriate range of courses offered by the Math and Computer Science Divisions?
14. Are math courses scheduled on days and times that are convenient to me?
15. Have I been able to register for the classes I need in the Math and CS division?
16. Are the courses in Math and CS helping me to achieve my academic goals?
17. Are there a variety of extracurricular activities related to this program on campus?
18. Am I satisfied with the buildings and classrooms used by Math and CS?
19. Am I satisfied with the computers and software used by Math and CS?
20. Am I satisfied with the Math Study Center (MBA119)?
21. Are the tutors in the Math Study Center able to answer my questions?
22. Have my professors adequately prepared me for the next math course?

The full results of all 22 questions are included at the end of this section, and will be referred to by question number going forward (Q1 = Question #1, etc).

a) Describe the results of relevant student feedback.

The results of the student feedback can be broken down into four sections: demographics, access to classes, technology and infrastructure/access to assistance. Items noted in **red** are to be further discussed in section (b) "Implications of the survey results" and (c) "related recommendations".

I. Results regarding the **demographics of the population** surveyed:

- Q1 - 86% of those surveyed were taking Math 80, 170, 180, 190 and Math 191 and only 11.35% were taking Math 210, 270 or 220. The remaining 2.35% were labeled as "missing".
- Q2 – 58.23% of those surveyed were majoring in either engineering (23.75%), computer science (15.65%) or science (18.83%, including life sciences at 11.77% and physical sciences 7.06%). Only 4.43% major in mathematics.
- Q8 - Over 50% (52.91%) hope to attend either CSULB, UCLA or other CSU/UC schools. The remaining stated USC or "other", with 30.12% labeled "missing".
- Q10 - Over 50% (52%) are hoping to pursue a Bachelor's or a Master's degree. While this is a positive response, it must be noted that 32.48% were noted "missing".

II. Results regarding **access to the classes** being studied in this survey:

- Q6 - Almost 10% (9.9%) of those surveyed stated that they had been unable to enroll in Math 80.
- Q13 – 72.5% either *agree* or *strongly agree* that there is an appropriate range of courses being offered by the Math and CS divisions.
- Q14 – 67.87% either *agree* or *strongly agree* that math courses are scheduled on convenient times and days.
- Q15 – 74.3% either *agree* or *strongly agree* that they have been able to register for the classes they need in the Math or CS divisions (with Math 80 being the exception as stated in Q6).
- Q16 – 77.35% either *agree* or *strongly agree* that classes in the Math and CS divisions are helping them achieve their academic goals.

III. Results regarding **technology**:

- Q7 – 38.42% stated that they have used Mathematica (17.17%) and/or online homework (21.26%) in their classes, however 51.39% of the data was "missing".
- Q19 – Over 50% (53.39%) either *agree* or *strongly agree* that they are satisfied with the computers and software used by Math and CS. However, it must be noted that 34.76% had "no opinion".

IV. Results regarding **infrastructure and access to assistance**:

- Q9 – 70.43% make use of MESA, Math Study Center, Supplemental Instruction (SI) and Instructor office hours.
- Q11 – 55.4% buy their textbooks from somewhere other than the ECC bookstore (e.g., Amazon, other students).
- Q12 – 34.21% would like to see more tables, chairs and whiteboards in the department hallways. In addition, 18.14% would like to see the expansion of the Math Study Center.
- Q20 – 41.62% *agree* or *strongly agree* that they are satisfied with the Math Study Center.
- Q21 – 35.04% *agree* or *strongly agree* that Math Study Center tutors are able to answer their questions.

- Q22 – 78.12% *agree* or *strongly agree* that their professors have adequately prepared them for the next math class.

b) Discuss the implications of the survey results for the program.

We learned from our survey results (Q2) that although most of our students are engineering majors (23.75%), there is a boom in students majoring in computer science which comprises 15.65% of the STEM students. In Spring 2016, we started to offer two sections of Math 210 (Discrete Structures) which is a requirement for computer science majors. This semester (Fall 2016), both sections of Math 210 (morning and afternoon) are full. We recommend that the Math Department continues to offer two sections of Math 210 during Fall and Spring semesters.

Sadly, only 4.43% of our students intend to major in mathematics (Q2). Most of our students are not aware that seven out of the top ten highest ranking jobs in the future are math-related (*see Vision Section for more details).* We recommend that funding for student math clubs be established so we can invite speakers from the industry to promote the usefulness for majoring in mathematics and also to establish funding for math-related field trips.

In question 10 observe that only 4.43% of our students plan to get an Associate's Degree. However, many students taking CM1 courses are not as concerned about earning this degree. Rather, they are interested in completing their transfer requirements so that they can move on to a four year institution. We should do a better a job of making the students aware that most of them meet the requirements for an AA and should stress that it's a good idea to get it even if a higher degree is their ultimate goal.

In addition, with 52.91% (Q8) of our students hoping to attend four-year colleges and 62.66% (Q2) majoring in either math, computer science, science or engineering, it does not benefit our student body that 10% of them are unable to register for Math 80 (Q6). Since Math 80 is a vital course in the mathematics sequence, we are doing our future four-year college students a disservice if we do not offer enough sections to meet their demand. We recommend increasing the number of sections of Math 80 in fall, winter, spring and summer semesters, so students can get to the appropriate transfer-level class without delay.

Also, approximately 17% of our students (Q7) mentioned in our survey that they have used *Mathematica* in their STEM classes. We recommend that funding be reserved to renew the license of *Mathematica* annually.

Furthermore, our survey data shows that while the majority of our students feel adequately prepared for the next course by their professors, it is clear that they do not feel as if the Math Study Center is beneficial to them. Only 41% (Q20) are satisfied overall with the center and only 35% (Q21) are satisfied with the quality of guidance they are receiving while there. Tutors who are hired and staffed to work in the Math Study Center should be able to help all levels of students who come into the center looking for assistance, and not just those at the developmental/algebra level. It is inequitable to our students (most of whom are transferring to four-year schools and majoring in math, computer science, science or engineering) to have a Study Center where too many tutors are unable to help those at the higher levels. We strongly recommend that we hire a full-time Math Study Tutoring Coordinator to plan, develop and coordinate a comprehensive tutoring program to support students and student success in the Mathematical Sciences Division. Moreover, in order to attract quality tutors, we need to raise the salary of student tutors at the Math Study Center from $10/hour to $12/hour. Last, but not least, most of our tutors have no experience in tutoring whatsoever. We highly recommend reserving staff development funds for instructors who conduct tutor training and materials used during tutor training every semester.

Lastly, the survey results show that only 34% (Q12) are satisfied with the layout of the MBA building space and common areas. This includes, but is not limited to, lack of chairs, tables and white boards in and around the hallways near faculty offices. With 70% of our students making use of assistance such as office hours, and with our offices already being occupied with two professors, it would only make sense that our students would at least have access to extra tables, chairs and whiteboards. We recommend that additional white boards, tables and chairs be placed in common areas (inside and outside of the MBA building) without causing fire hazards.

c) List any related recommendations

1. We recommend that the Math Department continues to offer two sections of Math 210 during Fall and two sections during Spring semester. It will cost approximately $10,500 per additional Math 210 class.
2. We recommend that funding for student math clubs (approximately $2,000 - $3,000 per year) be established so we can invite speakers from the industry to promote the usefulness for majoring in mathematics and also to establish funding for math-related field trips
3. We strongly recommend that we hire a full-time Math Study Tutoring Coordinator to plan, develop and coordinate a comprehensive tutoring program to support students and student success in the Mathematical Sciences Division. Depending on education and experience, the annual salary including benefits is approximately $90,000.
4. Raise the salary of student tutors at the Math Study Center from $10/hour to $12/hour.
5. We highly recommend reserving staff development funds for instructors who conduct tutor training and materials used during tutor training every semester. Estimated cost $4,000 per semester or $8,000 per year.
6. We recommend that funding be reserved to renew the license of *Mathematica* annually. ($8000 per year)
7. We recommend placing more tables ($90 per foldable round table), chairs ($25 per chair) and whiteboards ($200 per board) in common areas (inside and outside of MBA) without causing fire hazards.

6. Facilities and Equipment

a) Describe and assess the existing program facilities and equipment.

The current Mathematics Department consists of 40 full-time mathematics faculty members and 73 part-time instructors, and has 25 classrooms and 3 laptop computer labs available to use per semester. In the MBA building, 24 offices are designated for full-time faculty, 7 additional offices for part-time faculty, and 2 faculty workrooms. Each workroom is equipped with 3 computers, 2 printers, and only one scanner is available for 116 instructors to use. The demand for more full-time instructors persists due to increased student enrollment, faculty retirement, and attrition. Consequently, the current office space available for the Mathematics Department will be insufficient.

As part of the Mathematical Sciences Division, CM1 faculty have started to integrate new technology with their teaching methods. This requires that all computers in the classrooms and labs have software, such as *Mathematica* or *Scientific Notebook*, along with regular maintenance to support the equipment and software. Up-to-date technology (hardware and software) for instructors and classroom is still needed despite the fact that each classroom in the MBA building is equipped with a computer, a projection system, and a document reader (*Please see 7. Technology and Software for more details*).

b) Explain the immediate (1-2 years) needs related to facilities and equipment. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

Classrooms

Since we do not have a full-time technician on site to do repairs and maintenance, many of the document readers are nearing the end of their life span and will need to be replaced soon. We recommend that the Math Department purchase five backup document cameras. This would cost approximately $3,000 ($600 per document camera x 5).

Hallways

Two large magnetic whiteboards (8 ft. by 4 ft.) need to be installed in each of the hallways of the MBA building. These whiteboards would be placed in the middle of the hallway facing each other. The large boards can be designated as a place where important math department/college announcements for the day or week will be posted, as well as the place where the students are able to work on mathematics before and after class. Students would pay more attention to these whiteboards than those flyers that they typically see and ignore. Each large magnetic whiteboard costs approximately $420 with taxes and shipping. The approximate cost for 6 magnetic whiteboards would be $2520.

Faculty Workrooms

Each of the two math faculty workrooms is equipped with only three computers and two printers, but unfortunately, the printers keep getting jammed and become inoperable. It is highly recommended that a better HP printer be added in each of the workrooms. The cost of each HP printer is approximately between $575 and $675. The total approximate cost for two more HP printers would be between $1150 and $1350.

Currently, there is only one old scanner available in the second floor workroom for 116 faculty to use. Oftentimes, faculty are restricted from use of the scanner if the computer connected to it is currently being used. Also, the scanner is very slow, since it no longer allows the scanning of multiple copies – they must be scanned one page at a time. It is highly recommended that two new scanners be purchased for the second floor workroom, along with the purchase of two more scanners for the workroom on the third floor of the MBA building. Scanners offer various uses such as being able to email the students the answer key to exams/quizzes/projects and other assignments, sending notes to students who are absent, or scanning students' exams for record keeping. The estimated cost for a top of the line scanner is $1,200. The total approximate cost for four new scanners is $4,800.

Moreover, the mathematics faculty greatly recommends that a copy machine be available in the workrooms of the second and third floor since the copier in the Division Office often breaks down due to overuse. Faculty have shared their disillusionment when they have wanted to share great material with their students the next morning but were not able to do so since requesting copies of materials from the Copy Center requires a week turnaround. This creates additional stress on faculty members who want to improve student success. Also, most community colleges offer a more lenient copy quota in their math department and a faster turnaround time than ECC. The cost of a run-of-the-mill reliable copier, such as Xerox 4150 copier, is approximately $2,000.

c) Explain the long-range (2-4+ years) needs related to facilities and equipment. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

In addition, more classrooms with computers are necessary. Having only three classroom computer labs for the thousands of students that the math department serves is a tremendous disappointment. Furthermore, two out of three classroom computer labs are occupied by the Basic Skills Program. Also, the drop-in computer lab is shared with the Business Division, which wants it to be a "quiet room", which does not allow for any collaboration among students. We recommend that additional classroom computer labs be dedicated to STEM students in order to give them adequate hands-on experience and to enhance learning. The cost for each desktop computer attached to the cloud is approximately $300-$400.

Lastly, we recommend that additional classrooms in the MBA building be dedicated to the Division of Mathematical Sciences. Some faculty have shared their disenchantment with the classrooms they have been assigned in other locations outside the MBA building especially if they have back-to-back classes.

d) List any related recommendations.

1. We recommend that the Math Department purchase five backup document cameras.
Cost: This would cost approximately $3,000 ($600 per document camera x 5).

2. Purchase two additional HP printer to replace the old printers (one in each faculty workroom).
Cost: The cost of each HP printer is approximately between $575 and $675. The total approximate cost for two more HP printers would be between $1150 and $1350.

3. Purchase 4 new scanners to be placed in the faculty workrooms (two per floor).
Cost: The total cost for four new scanners is $4,800 (approx. $1,200 per scanner).

4. Purchase 2 additional copiers for faculty members to share.
Cost: The total cost for two standard copiers is $4,000 (approx. $2,000 per copier).

5. We recommend that additional classroom computer labs be dedicated to STEM students in order to give them adequate hands-on experience and to enhance learning.

Cost: The cost for each desk top computer attached to the cloud is approximately $300-$400.

6. We recommend purchasing 6 magnetic whiteboards (8ft by 4ft). Two to be installed in each of the hallways of the MBA building.

Cost: $2520.

7. We recommend that additional classrooms in the MBA building are dedicated to the Division of Mathematical Sciences based on room usage.

Cost: $0

7. Technology and Software

a) Describe and assess the adequacy and currency of the technology and software used by the program.

In today's classroom, technology and software are essential tools for teaching and learning mathematics. Not only is technology used for teaching presentations, but is often used to design, implement, and assess curriculum. With the rapid growth of the internet and technology, instructors are able to access various resources that help support mathematics instruction and enhance the students' conceptual understanding of mathematics. Moreover, by combining technology and software with real-world applications, the students will not only gain a deeper understanding of mathematics, but can also build their self-confidence, and hopefully develop an appreciation of the mathematics content that is being introduced in the course.

Many math teachers integrate technology and software into their teaching. This includes the use of Excel, Mathematica, Scientific Notebook, Texas Instruments graphing software, and Webassign/eBook/online homework. Consequently, all classrooms must have the appropriate technology equipment and software installed, but there is also a need for faculty to have such software installed on their computers. It will also be necessary to maintain and update this technology and software regularly.

b) Explain the immediate (1-2 years) needs related to technology and software. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

The MBA building offers three computer labs for instruction with 34 computer stations in each lab, but the expectation of the college is to enroll at least 35 students per class whenever possible. This means that for every class using one of the computer labs with 35 or more students, there will be a few students who will not be able to fully participate in the course activities. To address the shortfall of classroom computers for students, the Math Department has class sets of iPads which require WiFi availability in the classroom. Currently, ITS is working on establishing campus-wide and classroom WiFi availability for students.

Wolfram Mathematica (current version 11) is a robust computer algebra system enabling teachers and students to solve math problems and interactively explore math concepts using technology. While on campus, Mathematica is available for teachers in each math classroom and for students in the MBA computer lab and computer classrooms. In the past year or so, El Camino College's ITS department made Mathematica even more readily available to students and faculty so they can work from home on math projects and CAS homework assignments. Directions for any El Camino College student or faculty member: from the Math Division webpage simply click "CAS Mathematica Student Access" found in the left sidebar under Special Programs. A PDF will open with instructions on how to get access to Mathematica from a personal computer or laptop.

Approximate cost for annual Wolfram Mathematica license: $8000

c) Explain the long-range (2-4+ years) needs related to technology and software. Provide a cost estimate for each need and explain how it will help the program better meet its goals.

WiFi availability in the classrooms is critical to providing students and faculty creative options for using technology like Mathematica. WiFi in the classroom will enable more technology-related student projects or interactive demonstrations where students can manipulate the controls at their desks.

Today's learners need to be more active and engaged in the classroom. The lack of proper technological tools and software in the classrooms will impose limitations on the type of teaching and interaction that can take place. CM1 recommends funding for the aforementioned technology and software, as well as maintaining all equipment, retaining currency, and providing for new and innovative technological tools in the classroom.

d) List any related recommendations.

1. We recommend that the license for Mathematica be renewed each year (Cost: $8000 per year)
2. We recommend that the license for Scientific Notebook be renewed each year (Cost: $1000 per year)
3. We recommend that a stronger WiFi signal be made available in the MBA building.

8. Staffing

a) Describe the program's current staffing, including faculty, administration, and classified staff.

We compared the number of sections taught by full-time and part-time faculty. The staffing data is obtained from published schedules of classes and should therefore be considered approximate since changes to the official schedule are often made after the publication of the schedule.

College Level Mathematics Program

	M170		M180		M190		M191		M210		M220		M270		Total Sections
	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	FT	PT	
Fall-11	4	4	6	3	8	0	5	1	0	0	3	0	2	0	**36**
Winter-12	2	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Spring-12	5	2	8	1	8	1	7	0	1	0	2	0	2	0	**37**
Summer-12	3	0	2	0	3	0	2	0	0	0	1	0	0	0	**11**
Fall-12	3	5	6	2	8	0	6	0	0	0	3	0	2	0	**35**
Winter-13	2	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**
Spring-13	3	4	8	1	10	0	7	0	1	0	2	0	2	0	**38**
Summer-13	4	1	2	2	3	1	3	0	0	0	2	0	0	0	**18**
Fall-13	4	5	7	3	8	1	6	1	1	0	3	0	2	0	**41**
Spring-14	3	7	7	2	10	1	6	1	1	0	4	1	3	0	**46**
Summer-14	5	1	4	0	3	1	2	1	0	0	2	0	0	0	**19**
Fall-14	7	2	6	5	9	1	7	0	1	0	3	0	2	0	**43**
Spring-15	3	9	7	2	8	2	7	1	1	0	4	0	3	0	**47**
Summer-15	5	2	4	1	3	2	3	0	0	0	2	0	0	0	**22**
Fall-15	4	6	7	4	8	2	7	0	1	0	3	1	3	0	**46**
Spring-16	5	6	7	2	8	3	7	1	2	0	4	0	3	1	**49**
Summer-16	4	3	3	2	4	1	4	0	0	0	2	0	0	0	**23**
Fall-16	7	3	9	2	8	2	6	1	2	0	4	0	3	0	**47**
Full Time/ Part Time	**73**	**60**	93	32	109	18	85	7	11	0	44	2	27	1	**562**
Course Totals	**133**		125		127		92		11		46		28		
% FT	**55%**		**74%**		**86%**		**92%**		**100%**		**96%**		**96%**		**79%**

b) Explain and justify the program's staffing needs in the immediate (1-2 years) and long-term (2-4+ years). Provide cost estimates and explain how the position/s will help the program better meet its goals.

The number of sections offered by the College Level Mathematics Program is up 40% from 2012 to 2016, and the ratio of full-time to part-time faculty meets California Community College requirements.

However, looking at the waitlist situation for the fall 2016 semester, we have:

Course	M170	M180	M190	M191	M220	M270
Total On Waitlists	57	56	78	53	15	19

For 9 of the sections, the waitlist had reached 10, the maximum number allowed, which means that it is very possible/likely that the total number of waitlisted students should be greater.

Given these numbers and the general pattern of growth established, it is recommended that we hire at least two full-time tenure track professors in the immediate future (1-2 years) and at least 2 additional full-time tenure track professors in the long term (2-4+ years). It is further recommended that an additional full-time tenure track professor be hired for each full-time faculty member who decides to leave the Mathematical Sciences Division, and that the hiring process be completed as soon as possible.

STRS	607,872/45.5	13359.82
Health and Welfare	502,039/45.5	11033.82
Medicare	89,494 / 45.5	1966.90
Average Salary	83586	83586.00
SUI	3140/45.5	69.01
Workers Comp	122696/45.5	2696.62
Total Average Cost For Full-Time Faculty		**112712.17**

The basic data in the table above was obtained from accounting on August 26, 2016, and represents the average cost for existing Mathematical Sciences full-time faculty. It should be noted that the average cost for hiring new faculty would probably be significantly less, based on the assumption that they would have much less teaching experience.

c) List any related recommendations.

1. We recommend hiring 5 full-time faculty members over the next two years that are capable of teaching at all levels in the math department. This should be beyond the replacement of retirees, to take the total number of full-time math faculty from 40 to 45. The average cost of hiring a full-time faculty member including the cost of health care and pension is approximately $90,000/year.
2. We recommend having two part-time hiring panels each year to increase the part-time pool so that we can keep up with the growing demand for instructors that we will need for all programs in our department.

9. Direction and Vision

a) Describe relevant changes within the academic field/industry. How will these changes impact the program in the next four years?

The CM1 math courses form the core of a well-rounded STEM education.

As stated on the www.ed.gov website:

The United States has developed as a global leader, in large part, through the genius and hard work of its scientists, engineers, and innovators. In a world that's becoming increasingly complex, where success is driven not only by what you know, but by what you can do with what you know, it's more important than ever for our youth to be equipped with the knowledge and skills to solve tough problems, gather and evaluate evidence, and make sense of information. These are the types of skills that students learn by studying science, technology, engineering, and math—subjects collectively known as STEM.

Yet today, few American students pursue expertise in STEM fields—and we have an inadequate pipeline of teachers skilled in those subjects. That's why President Obama has set a priority of increasing the number of students and teachers who are proficient in these vital fields.

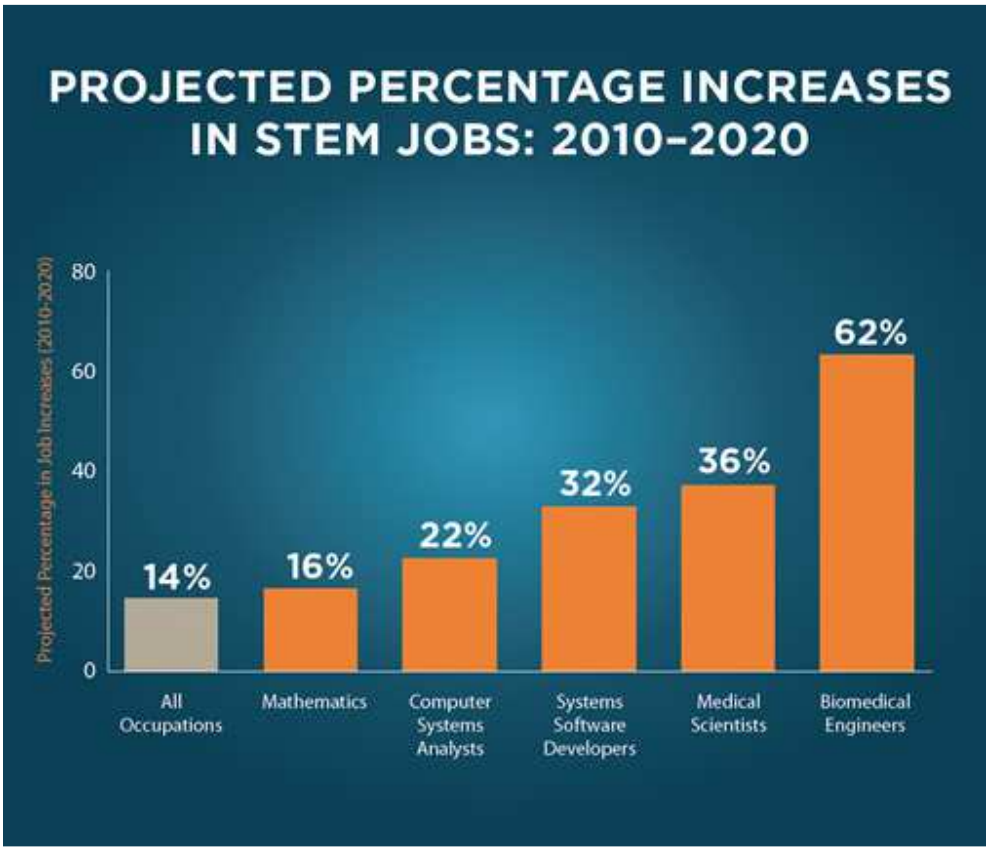
This sentiment is echoed in a CNN interview with noted astrophysicist Neil Degrasse Tyson:

Innovations in science, engineering, technology and math will be the drivers of tomorrow's economy. … And if you are not a participant on that frontier, you will trail behind it and possibly get left behind entirely.

In the same interview, Dr. Tyson addresses those who may feel that math is not a necessary component of an education for everyone and stresses the importance of STEM education beyond just the knowledge itself that is gained in the process:

There are people who say "I'll never need this math", these trig identities from tenth grade, or eleventh grade, or maybe you never learn them. Here is the catch: whether or not you ever again use the math that you learned in school, the act of having learned the math established a wiring in your brain that didn't exist before, and it's the wiring in your brain that makes you the problem solver. … Even if you don't want to become a scientist, the minimum you should ask of yourself, demand of yourself, is that you become scientifically literate. Better yet, scientifically literate and mathematically literate … because therein are the engines of problem solving in the world. … [In relation to jobs and earning money with a STEM education], now you're valuable to an employer because companies want to innovate, and the companies that don't innovate, they whither on the vine. So the connection between STEM fields and financial stability of a nation is what needs to be established. That connection is somehow broken; people don't see it. … You should be educated and, in the education, you should value science, engineering, technology, and math. If you do so, you get to innovate and invent new industries, new economies. If you invent new economies, everybody has jobs tomorrow.

In the current economic landscape, the need for STEM jobs is increasing faster than other occupations.



Source: http://www.ed.gov/stem

According to careercast.com, a site related to finding jobs and an information source for the career market, seven of the top ten jobs of 2016 have a very strong math component. They ranked the jobs based on working environment, stress levels, and job outlook. Below are the aforementioned seven along with an additional five in the top 26:

1) Data Scientist
2) Statistician
3) Information Security Analyst
6) Mathematician
7) Software Engineer
8) Computer Systems Analyst
10) Actuary
14) Biomedical Engineer
17) Network Computer Systems Admin
20) Petroleum Engineer
21) Physicist
26) Web Developer

Focusing on jobs in the STEM fields, U.S. News and World Report recently listed the top 25 best STEM jobs of 2016, pointing out that these jobs are "very diverse" and have "low unemployment rates and increased demand", with most median salaries in the high five to low six figures and demand reaching into the hundreds of thousands. Listed are the top ten, along with number of projected jobs, median salary, and unemployment rate.

Rank	Job Title	Number of Projected Jobs	Median Salary	Unemployment Rate
1	Computer Systems Analyst	118,600	$82,710	2.6%
2	Software Developer	135,300	$95,510	2.5%
3	Statistician	10,100	$79,990	4.0%
4	Web Developer	39.500	$63,490	3.4%
5	Accountant	142,400	$65,940	3.2%
6	Biomedical Engineer	5,100	$86,950	2.6%
7	IT Manager	53,700	$127,640	1.8%
8	Financial Advisor	73,900	$81,060	3.3%
9	Information Security Analyst	14.800	$88,890	1.4%
10	Mathematician	700	$103,720	4.0%

All of this points to the fact that there is currently a need for people trained in the STEM fields, which begins with a strong mathematical backbone for students. Proper and thorough training, as the students pass through the calculus sequence, will allow them to excel in their desired field of study. With the outlined characteristics of such jobs: high demand, good salary, and low unemployment, the skill set for these jobs will necessarily be in demand as well.

In 2011, the U.S. Department of Commerce's Economics and Statistics Administration released an article entitled *STEM: Good Jobs Now and For the Future*, detailing the state of STEM jobs over the first decade of the 21st century. In it, they found that the "growth in STEM jobs was three times as fast as growth in non-STEM jobs." In terms of earnings, "STEM workers command higher wages, earning 26 percent more than their non-STEM counterparts." Interestingly, they found that having a degree in a STEM field led to increased wages "regardless of whether they work in STEM or non-STEM occupations".

The common thread is that a STEM education, which comes in part from classes such as those present in CM1, leads to increased job opportunities and higher wages *even for those who choose not to pursue a career in a STEM field*. In turn, the demand for a quality STEM education is likely to be on the rise. The skills gained in taking and succeeding, for example, in higher level math courses permeates other areas that are vital to future success, such as critical thinking and problem solving.

As mathematics instructors, we play a vital role in assuring that the students that we educate receive quality instruction that will not only prepare them for future math courses, but for other fields of education, STEM-related or otherwise. With the ever-changing landscape in regard to technology, non-traditional teaching strategies, and student needs, we as instructors at the community college level need to look ahead and be prepared to best serve our population of students and guide them toward future success in life.

A useful reference on mathematics education at the college level is the publication "Beyond Crossroads, Implementing Mathematics Standards in the First Two Years of College", November, 2006, from the American

Mathematical Association of Two-Year Colleges (AMATYC). According to this document, these are the basic principles that will help to address the issues and challenges facing mathematics education in the coming years:

1. **Assessment**. The assessment of student learning in mathematics should be a fundamental tool for the improvement of instruction and student learning.
2. **Broadening**. Mathematics courses and programs in the first two years of college should broaden students' options in educational and career choices.
3. **Equity and access**. All students should have equitable access to high-quality, challenging, effective mathematics instruction and support services.
4. **Innovation**. Mathematics programs should be thoughtfully constructed to approach content and instruction with appropriate use of traditional and innovative methods.
5. **Inquiry**. Effective mathematics instruction should require students to be active participants.
6. **Quantitative literacy**. Quantitative literacy should be integrated throughout the mathematics program and the college curricula.
7. **Relevance**. The mathematics that students study should be meaningful and foster their appreciation of the discipline.
8. **Research into practice**. The practice of mathematics teaching should be guided by research on teaching and learning.
9. **Technology**. Technology should be integral to the teaching and learning of mathematics.

We believe that the courses that comprise the CM1 program address these issues very well. Student Learning Outcomes (SLO) provide an assessment tool for understanding student learning and teaching methods can be fine-tuned in response to the results. As mentioned earlier, a STEM education broadens the horizons for students, for whichever career they may choose to pursue. Technology is used in many of the CM1 courses, be it graphing calculators or even software packages such as *Mathematica*. These resources are made available to students and allow everyone to learn on equal footing, regardless of other factors such as socioeconomic status. We will continue to explore new ways to incorporate all of these ideas so as to help increase student learning and success.

b) Explain the direction and vision of the program and how you plan to achieve it.

The primary vision of the CM1 Program is to provide the community with a comprehensive and dynamic mathematics curriculum that will not only strengthen the math skills of our students, but will also bolster their efforts in all STEM courses. This will lead to higher success rates, graduation rates, and transfer rates. We must strive to be a department that will attract students from near or far. The local area population is aging and there are expected to be fewer school-aged children in future. CM1 will respond to this vision by maintaining our high standards, by continuously reviewing our curriculum, and by keeping up with educational trends both at local colleges and nationally.

Our vision is a teaching environment that encourages faculty and students to share ideas and explore. Some teachers do this by offering student projects that go beyond course content and allow interested students to learn more than what is in the course outline. The use of *Mathematica* for projects, for example, allows students the opportunity to investigate mathematical concepts on their own. This also has the added benefit of introducing students to basic computer programming, which may aid them in future courses or introduce them to related fields such as computer science that they may have not considered studying before. Encouraging faculty to share their ideas, student projects, or teaching ideas at Brown Bags, which are talks given by faculty to their peers during the college hour, would foster a more stimulating educational atmosphere.

Our vision is that more students get involved in national math associations such as the Mathematics Association of America (MAA) or AMATYC. One way to do this is for math faculty to encourage greater participation in and better preparation for the AMATYC Math Competition. Since such competitions deal largely in problem solving and critical thinking skills, participating in them can foster an interest in math that students may not have found in merely experiencing math in a classroom setting.

c) List any related recommendations.

1. Increase the number of sections of all CM1 courses, as student demand dictates
2. Increase support through MESA, Tutoring, Supplemental Instruction and the scheduling of weekly workshops.
3. Invite speakers from universities and industry to give talks on the many opportunities available to someone who majors in a STEM field.
4. Increase the number of full-time faculty that are capable of teaching at all levels in the math department. Increase the part-time faculty pool by having two part-time hiring panels each year.

10. Prioritized Recommendations

a) Provide a single, prioritized list of recommendations and needs for your program/department (drawn from your recommendations in sections 2-8). Include cost estimates and list the college strategic initiative that supports each recommendation (see Appendix A). Use the following chart format to organize your recommendations.

b) Explain why the list is prioritized in this way.

Recommendations	Cost Estimate	Strategic Initiatives
1. We recommend hiring 5 full-time faculty members over the next two years that are capable of teaching at all levels in the math department. This should be beyond the replacement of retirees, to take the total number of full-time math faculty from 40 to 45. The average cost of hiring a full-time faculty member including the cost of health care and pension is approximately $110,000/year.	$550,000	A, B, C, E
2. We recommend that the number of Math 80 sections be increased and sections of Math 67 and 73 be reduced until the percent of students taking Math 80 is back over 75% (it had been 100% in 2008 and dropped to 22% in 2012 and is around 55% now).	No cost for shifting sections, $12000 per section for new sections	A, D
3. We recommend that new sections of CM1 courses be added to the evening program. We also recommend that El Camino College dedicate special advertising to make students aware of the growing evening STEM program.	$7500-$1300 per section	A, B, D
4. We recommend the hiring of a full-time tutoring coordinator in our Math Study Center to plan, develop and coordinate a comprehensive tutoring program to support students and student success in the Mathematical Sciences Division. Depending on education and experience, the annual salary including benefits is approximately $90,000.	$90,000	A, B, C, E
5. We recommend that funds be established (perhaps from staff development) for instructors who conduct tutor training and for materials used during training each semester.	$4000 per semester, $8000 per year	A, B, C
6. We recommend that Winter Semester be expanded by four days by starting on a Tuesday instead of a Thursday and ending on a Thursday instead of a Tuesday. Also, move the Spring Flex morning to Friday before the Spring Semester to accommodate this.	No Cost	B, D, E

7. We recommend increasing support for Math 170 and Math 180 with the addition of Supplemental Instruction.	$2000 per section	A, B, C
8. We recommend the purchase of four new document scanners for the faculty work rooms, two for each floor.	$1200 each, $4800 total	A, F
9. We recommend the purchase of two new HP Printers for the faculty work rooms, one for each floor.	$600 each, $1200 total	A, F
10. We recommend the purchase of five backup document cameras to prepare for the inevitable decline of the current cameras, which are a vital part of the instructional approach of most faculty.	$600 each, $3000 total	A, F
11. We recommend the purchase of two additional copiers for the faculty work rooms, one for each floor.	$2000 each, $4000 total	A, F
12. We recommend that the school shorten the turn-around time for documents submitted to the Campus Copy Center from one week to 24 hours.	unknown	E, F
13. We recommend that additional computer labs be dedicated to STEM students in order to give them adequate hands-on experience and to enhance learning. The computers would be desktops that are connected to the cloud.	$400 per computer terminal	A, B, F
14. We recommend an increase in the number of sections of all courses in the CM1 program as indicated by demand and fill rates.	$7,500-13,000 per section	A, B, D
15. We recommend renewing the campus license for Mathematica.	$8000 per year	A, B, F
16. We recommend renewing the campus license for Scientific Notebook.		A, B, F
17. We recommend an increase in funding for MESA		A, B, C
18. We recommend that Math 80 (Intermediate Algebra for STEM and Business) be moved from Committee D to CM1.	No cost	B, C, E
19. We recommend that the number of units of Math 170 be increased from three to four so that the course can be exposed to a greater breadth and depth of topics that will make students more successful in later classes.	$2500 per unit per section	A, B
20. We recommend that two sections of Math 210 (Discrete Math) continue to be offered each Fall and Spring Semester to keep up with the demand from the growing Computer Science program. Also, increase these to three if there is demand.	$10,500 per additional class	A, B
21. We recommend that funding for student math clubs be established so that we can invite speakers from industry and to fund field trips.	$3000 per year	B, C, D

22. We recommend that the salary of tutors in the Math Study Center be raised from $10 to $12 per hour.		A, B
23. We recommend that CM1 be allowed to add topics to Math 210 (Discrete Math) and increase units from four to five so that the course will better match the C-IDs for the course and so that it will earn full credit at all major transfer schools in California.	$2500 per unit per section	A, B
24. We recommend that faculty be given access to electronic student educational plan data so that classes can be scheduled more effectively.	No cost	A, E
25. We recommend having two part-time hiring panels each year to increase the part-time pool so that we can keep up with the growing demand for instructors that we will need for all programs in our department.	No cost	A, B, C, E
26. We recommend that additional lecture rooms in MBA be allocated exclusively for the Division of Mathematical Sciences. Allocation of rooms could be based on room usage data that should be made available to faculty.	No cost	A, E
27. We recommend that more tables and chairs be placed in the common areas inside or outside the MBA building or other accessible areas.	$90 per folding table, $25 per chair	B, C
28. We recommend that more whiteboards be installed in some hallways, such as on the wall outside the Math Department Office.	$200 per whiteboard	B, C
29. It is recommended that we work to increase participation of faculty, both full time and part time, in the administration, reporting and analysis of SLOs. Additionally, we should continue to develop and review the SLO statements and assessments and update relevant course outlines on a regular basis.	no cost	B, C
30. We recommend the more money be allocated for faculty development, including training on software such as Mathematica and Scientific Notebook.		A, F
32. We recommend that faculty computer laptops be replaced by Spring 2019 to keep up with classroom technology. The last time faculty got new laptops was January 2016.	$1500 per laptop	A, F
33. We recommend the funding of the AMATYC math contest practices and proctoring.	$3000 per semester	B, C

APPENDIX A
COLLEGE MISSION AND STRATEGIC INITIATIVES

ECC MISSION STATEMENT:

El Camino College makes a positive difference in people's lives. We provide excellent comprehensive educational programs and services that promote student learning and success in collaboration with our diverse communities.

STRATEGIC INITIATIVES for 2015-2020

A. STUDENT LEARNING
Support student learning using a variety of effective instructional methods, educational technologies, and college resources.

B. STUDENT SUCCESS & SUPPORT
Strengthen quality educational and support services to promote and empower student learning, success, and self-advocacy.

C. COLLABORATION
Advance an effective process of collaboration and collegial consultation conducted with integrity and respect.

D. COMMUNITY RESPONSIVENESS
Develop and enhance partnerships with schools, colleges, universities, businesses, and community-based organizations to respond to the educational, workforce training, and economic development needs of the community.

E. INSTITUTIONAL EFFECTIVENESS
Strengthen processes, programs, and services through the effective and efficient use of assessment, program review, planning, and resource allocation.

F. MODERNIZATION
Modernize infrastructure and technological resources to facilitate a positive learning and working environment.

Appendix B: Demographic and Enrollment Statistics

Fall						ECC Student Population	District Boundary Population
		Term					
		2011	2012	2013	2014	Fall 2014	2010 Census
Term Headcount		1,382	1,316	1,489	1,587	*24,263*	*556,400*
Gender	F	30.1%	29.8%	30.4%	30.2%	*51.6%*	*51.0%*
	M	69.8%	70.1%	69.6%	69.8%	*48.4%*	*49.0%*
Ethnicity	African-American	5.5%	6.0%	5.9%	6.2%	*16.1%*	*15.1%*
	Amer. Ind. or Alask. Native	0.1%	0.0%	0.1%	0.1%	*0.1%*	*0.2%*
	Asian	36.0%	33.4%	32.8%	30.8%	*15.1%*	*13.6%*
	Latino	34.1%	35.4%	39.6%	42.7%	*49.5%*	*34.5%*
	Pacific Islander	0.7%	0.4%	0.3%	0.6%	*0.5%*	*0.5%*
	White	16.6%	17.9%	14.9%	14.9%	*13.6%*	*32.8%*
	Two or More	3.4%	5.2%	5.3%	4.3%	*4.4%*	*2.9%*
	Unknown or Decline	3.8%	1.8%	1.0%	0.5%	*0.7%*	*0.4%*
Age/ Age Group	<17	0.9%	0.6%	0.4%	0.3%	*1.8%*	*24.2%*
	17	2.1%	3.8%	2.7%	3.1%	*2.2%*	
	18	13.1%	14.1%	12.6%	14.6%	*12.4%*	*2.5%*
	19	22.1%	20.7%	19.3%	19.8%	*14.0%*	
	20	17.9%	18.0%	17.0%	18.8%	*12.6%*	*1.2%*
	21	9.8%	10.6%	12.7%	11.3%	*9.9%*	*1.2%*
	22	7.5%	6.7%	6.8%	7.1%	*7.5%*	*3.9%*
	23	5.7%	5.3%	5.2%	5.4%	*5.6%*	
	24	4.1%	4.4%	5.1%	4.0%	*4.7%*	
	25-29	9.9%	9.5%	11.1%	9.9%	*13.0%*	*7.4%*
	30-39	4.4%	4.1%	5.7%	4.2%	*8.9%*	*14.9%*
	40-49	1.8%	1.5%	1.0%	0.9%	*3.8%*	*15.9%*
	50-64	0.5%	0.5%	0.5%	0.4%	*3.0%*	*18.1%*
	65+	0.1%	0.2%	0.0%	0.1%	*0.7%*	*10.6%*
Class Load	Full-time	65.1%	63.3%	64.1%	65.3%	*34.5%*	
	Part-time	34.9%	36.7%	35.9%	34.7%	*65.3%*	
Academic Level	College degree	7.0%	6.2%	6.9%	5.2%	*11.7%*	
	HS Grad	90.6%	91.0%	89.0%	90.7%	*82.3%*	
	Not a HS Grad	0.9%	0.4%	0.3%	0.2%	*0.3%*	
	K-12 Special Admit	0.8%	0.9%	0.7%	0.8%	*2.3%*	

	Unknown	0.7%	1.5%	3.2%	3.1%	*3.4%*	
Educational Goal	Intend to Transfer	40.7%	40.8%	40.2%	41.0%	*31.5%*	
	Degree/Certificate Only	1.2%	1.7%	1.1%	1.3%	*3.5%*	
	Retrain/recertif.	1.4%	1.8%	1.1%	1.0%	*3.2%*	
	Basic Skills/GED	7.8%	7.9%	8.9%	7.6%	*5.7%*	
	Enrichment	4.1%	3.2%	3.4%	2.6%	*2.2%*	
	Undecided	17.4%	16.7%	17.4%	16.3%	*15.8%*	
	Unstated	27.4%	27.9%	27.8%	30.3%	*38.0%*	

Spring						**ECC Student Population**	**District Boundary Population**
		Term					
		2012	**2013**	**2014**	**2015**	**Spring 2015**	**2010 Census**
Term Headcount		1,359	1,415	1,552	1,611	*22,667*	*556,400*
Gender	F	31.1%	30.1%	29.4%	28.9%	*51.7%*	*51.0%*
	M	68.9%	69.9%	70.6%	71.1%	*48.3%*	*49.0%*
Ethnicity	African-American	5.9%	6.1%	6.1%	6.3%	*15.3%*	*15.1%*
	Amer. Ind. or Alask. Native	0.0%	0.0%	0.1%	0.0%	*0.1%*	*0.2%*
	Asian	37.8%	33.2%	31.2%	28.8%	*15.1%*	*13.6%*
	Latino	32.6%	38.2%	40.6%	44.8%	*50.0%*	*34.5%*
	Pacific Islander	0.5%	0.4%	0.4%	0.5%	*0.5%*	*0.5%*
	White	16.9%	15.8%	15.7%	14.5%	*13.8%*	*32.8%*
	Two or More	3.5%	4.3%	5.1%	4.8%	*4.5%*	*2.9%*
	Unknown or Decline	2.9%	2.0%	0.8%	0.3%	*0.7%*	*0.4%*
Age/ Age Group	<17	0.8%	0.8%	0.5%	0.4%	*1.0%*	*24.2%*
	17	1.3%	1.3%	0.8%	1.0%	*1.0%*	
	18	13.8%	14.6%	12.8%	15.0%	*4.2%*	*2.5%*
	19	20.5%	20.1%	20.7%	20.9%	*8.5%*	
	20	19.2%	17.2%	17.5%	16.0%	*7.2%*	*1.2%*
	21	11.1%	11.4%	12.0%	12.2%	*5.2%*	*1.2%*
	22	6.8%	7.6%	8.2%	7.4%	*3.6%*	*3.9%*
	23	6.5%	5.3%	5.9%	5.8%	*2.8%*	
	24	3.3%	5.4%	4.8%	4.4%	*2.2%*	

	25-29	10.8%	10.2%	10.8%	11.3%	*13.6%*	*7.4%*
	30-39	4.0%	4.7%	4.9%	4.3%	*8.9%*	*14.9%*
	40-49	1.4%	1.2%	0.9%	0.8%	*3.8%*	*15.9%*
	50-64	0.4%	0.3%	0.3%	0.3%	*3.0%*	*18.1%*
	65+	0.0%	0.1%	0.1%	0.1%	*0.7%*	*10.6%*
Class Load	Full-time	63.4%	56.8%	63.3%	64.4%	*32.6%*	
	Part-time	36.6%	41.9%	36.7%	35.6%	*66.2%*	
Academic Level	College degree	6.0%	5.3%	6.1%	6.0%	*11.6%*	
	HS Grad	91.5%	91.2%	90.7%	89.9%	*82.3%*	
	Not a HS Grad	1.0%	0.4%	0.2%	0.3%	*0.3%*	
	K-12 Special Admit	0.4%	0.5%	0.6%	0.5%	*2.0%*	
	Unknown	1.0%	2.7%	2.4%	3.3%	*3.7%*	
Educational Goal	Intend to Transfer	41.7%	41.1%	40.5%	40.6%	*30.8%*	
	Degree/Certificate Only	1.0%	1.6%	1.3%	1.3%	*3.7%*	
	Retrain/recertif.	1.1%	1.6%	1.4%	1.2%	*3.3%*	
	Basic Skills/GED	7.9%	7.8%	9.1%	8.3%	*5.9%*	
	Enrichment	4.6%	3.4%	3.2%	2.5%	*2.3%*	
	Undecided	17.7%	16.5%	15.9%	15.1%	*16.6%*	
	Unstated	26.0%	27.9%	28.7%	30.9%	*38.0%*	

Appendix C: Student Survey Results

College Math Student Survey

N= 1,444 **Spring 2016**

1. Which math course are you enrolled in this semester?

Response	Frequency	Percent
Math 80	373	25.83
Math 170	269	18.63
Math 180	162	11.22
Math 190	236	16.34
Math 191	206	14.27
Math 210	35	2.42
Math 220	77	5.33
Math 270	52	3.60
Missing	34	2.35

2. What is your intended major?

Response	Frequency	Percent
Mathematics	64	4.43
Physical Sciences	102	7.06
Life Sciences	170	11.77
Computer Science	226	15.65
Engineering	343	23.75
Business/Economics	221	15.30
Humanities	15	1.04
Other	257	17.80
Missing	46	3.19

3. How many units have you completed at El Camino (not including this semester)?

Response	Frequency	Percent
Less than or equal to 15 units	518	35.87
From 16 to 30 units	299	20.71
From 31 to 45 units	223	15.44
From 46 to 60 units	236	16.34
More than 60 units	155	10.73
Missing	19	1.32

4. Select all math courses you have completed at El Camino:

Response	Frequency	Percent
College Algebra [M 130]	42	2.91
Trig [M170]	412	28.53
Arithmetic [M12]	55	3.81
Int Algebra [M 70 or 80]	228	15.79
Prealgebra [M23]	59	4.09
Precalculus [M 180]	222	15.37
Calc I [M190]	199	13.78
Calc II [M191]	86	5.96
Basic Accelerated Math [M37]	64	4.43
Calc III [Math 220]	26	1.80
Linear Alg/Diff Eq [M 270]	6	0.42
Discrete Math [M210]	1	0.07
Missing	535	37.05

5. Select all math courses you plan to complete at El Camino (including this semester)

Response	Frequency	Percent
Math 80	220	15.24
Math 170	187	12.95
Math 180	254	17.59
Math 190	328	22.71
Math 191	332	22.99
Math 210	118	8.17
Math 270	198	13.71
Math 220	192	13.30
Missing	441	30.54

6. In previous semesters which courses have you been unable to enroll in?

Response	Frequency	Percent
Math 80	143	9.90
Math 170	76	5.26
Math 180	92	6.37
Math 190	91	6.30
Math 191	41	2.84
Math 210	18	1.25
Math 220	21	1.45
Math 270	24	1.66
Missing	1010	69.94

7. Which technology or computer programs have you used in your math classes at ECC?

Response	Frequency	Percent
Graphing Calculator	34	2.35
Mathematica	248	17.17
Online homework	307	21.26
Excel	11	0.76
Geogebra	1	0.07
Other	101	6.99
Missing	742	51.39

8. What is your desired transfer college or university?

Response	Frequency	Percent
CSULB	174	12.05
CSUDH	49	3.39
UCLA	168	11.63
USC	52	3.60
CSU [other than CSULB and CSUDH]	180	12.47
UC [other than UCLA]	242	16.76
Other	144	9.97
Missing	435	30.12

9. Which of the following campus resources do you use?

Response	Frequency	Percent
MESA	234	16.20
Math Study Center [MBA]	287	19.88
Counseling	371	25.69
SI [Supplemental Instruction]	121	8.38
Computer Lab [MBA 115]	231	16.00
Instructor Office Hours	375	25.97
Missing	365	25.28

10. Which academic degrees are you interested in achieving?

Response	Frequency	Percent
Associate's	64	4.43
Bachelor's	489	33.86
Master's	262	18.14
Doctorate	129	8.93
Other	31	2.15
Missing	469	32.48

11. Where do you usually buy math textbooks?

Response	Frequency	Percent
ECC Bookstore	644	44.60
Amazon.com	573	39.68
From other students	87	6.02
Other online source	503	34.83
Missing	34	2.35

12.Which of these resources would you like to see in the MBA building?

Response	Frequency	Percent
Expansion of Math Study Center [MBA 119]	262	18.14
More tables/chairs in hallways	277	19.18
More whiteboards in hallways for students to use	217	15.03
Creation of patio space outside MBA	230	15.93
Missing	670	46.40

13. There is an appropriate range of courses offered by the Math and Computer Science Divisions.

Response	Frequency	Percent
Strongly Agree	356	24.65
Agree	691	47.85
No Opinion	173	11.98
Disagree	64	4.43
Strongly Disagree	12	0.83
Missing	148	10.25

14. Math courses are scheduled on days and times that are convenient to me.

Response	Frequency	Percent
Strongly Agree	272	18.84
Agree	708	49.03
No Opinion	149	10.32
Disagree	175	12.12
Strongly Disagree	25	1.73
Missing	115	7.96

15. I've been able to register for the classes I need in the Math and CS Division.

Response	Frequency	Percent
Strongly Agree	371	25.69
Agree	702	48.61
No Opinion	139	9.63
Disagree	102	7.06
Strongly Disagree	24	1.66
Missing	106	7.34

16. The courses in Math and CS are helping me to achieve my academic goals.

Response	Frequency	Percent
Strongly Agree	403	27.91
Agree	713	49.38
No Opinion	190	13.16
Disagree	38	2.63
Strongly Disagree	10	0.69
Missing	90	6.23

17. There is a variety of extracurricular activites related to this program on campus.

Response	Frequency	Percent
Strongly Agree	136	9.42
Agree	393	27.22
No Opinion	677	46.88
Disagree	153	10.60
Strongly Disagree	19	1.32
Missing	66	4.57

18. I am satisfied with the buildings and classrooms used by Math and CS.

Response	Frequency	Percent
Strongly Agree	400	27.70
Agree	761	52.70
No Opinion	152	10.53
Disagree	49	3.39
Strongly Disagree	10	0.69
Missing	72	4.99

19. I am satisfied with the computers and software used by Math and CS.

Response	Frequency	Percent
Strongly Agree	256	17.73
Agree	515	35.66
No Opinion	502	34.76
Disagree	82	5.68
Strongly Disagree	28	1.94
Missing	61	4.22

20. I am satisfied with the Math Study Center [MBA 119].

Response	Frequency	Percent
Strongly Agree	184	12.74
Agree	417	28.88
No Opinion	681	47.16
Disagree	88	6.09
Strongly Disagree	20	1.39
Missing	54	3.74

21. The tutors in the Math Study Center are able to answer my questions.

Response	Frequency	Percent
Strongly Agree	182	12.60
Agree	324	22.44
No Opinion	785	54.36
Disagree	80	5.54
Strongly Disagree	22	1.52
Missing	51	3.53

22. My professors have adequately prepared me for the next math course.

Response	Frequency	Percent
Strongly Agree	486	33.66
Agree	642	44.46
No Opinion	205	14.20
Disagree	47	3.25
Strongly Disagree	17	1.18
Missing	47	3.25

Appendix D: Gateways to Engineering

Currently there is a pilot program with the goal of accelerating students to calculus curriculum, which is called "Gateways to Engineering." It is intended for engineering and other STEM majors, who are at the Intermediate Algebra level. In the fall, the students enroll in both Intermediate Algebra (Math 80) and Geometry (Math 60). In the spring, students enroll in both Trigonometry (Math 170) and Precalculus (Math 180). The goal is for these students to be able to enroll in Calculus 1 (Math 190) after one year. While Math 80 and Math 60 are not part of CM1, the students who enroll in those courses are typically planning to complete the calculus sequence and major in a STEM field. The 2015–2016 year was the first for the program, which involved one cohort of 33 students, who were enrolled in the fall semester, and another 33 students who enrolled in the spring semester (not everyone continued from the fall semester, but more students were added in the spring semester).

For the pilot program, students enroll in two linked sections, which are taught by two different instructors. Students attend classes as a cohort and also attend Supplemental Instruction (SI) to support the accelerated curriculum. Students who are interested in the program apply online, then are contacted and given information about the program. We have not turned away any students who are interested and willing to enroll in two math courses concurrently, provided they have completed the prerequisite courses. During the fall semester, 18 out of 33 students, or 55%, passed both Math 60 and Math 80. Thirteen of those student moved on to the next class and five chose not to continue for various reasons, including the fact that the courses were very intense and they wanted to focus on other classes. One person moved and was thus not able to continue. Two additional students failed Math 60, but had completed high school Geometry, so they were able to move on to the next class. Eighteen new students added the class in the spring semester.

The first cohort was composed primarily of Latino/Latina students, 73% in the fall, and 56% in the spring. It appealed to older students who wanted to complete classes sooner or felt behind because of a long absence from college. There were 10 out of 33 or 30% of the students in both classes were 24 years older or older. A complete breakdown of the students enrolled in the program along with the success rates is on the next page.

There are plans to offer this same program again during the 2016–2017 academic year. There is discussion about creating two new math courses, Math for STEM 1, which would include curriculum from both Math 60 and Math 80, and Math for STEM 2, which would include curriculum from both Math 170 and Math 180 for students involved in this program. However, we do want to make sure that students enrolled in this accelerated curriculum are successful in the Calculus sequence. Additionally, many faculty are hesitant to create courses with more than five units, especially if some topics are omitted. Students will continue to be tracked to see how they fare in Math 190 and beyond, which will determine the success of this program.

Fall semester:

Fall, 2015: Math 80 was taught by Anna Hockman, Math 60 was taught by Alice Martinez

- 33 students were in the program at Census date.
- 18 students passed both Geometry & Algebra (55%)
- 5 chose not to continue with the program – one moved out of country, others felt like it was too much work/stress or decided to focus on science classes, but there may be other reasons as well.
- 15 students enrolled in the next class (2 of these did not pass Geometry, but had completed high school Geometry). (45%)
- Only 1 Veteran enrolled in the program. He did not continue, but returned to active duty.

Breakdown by Major:

Major	Initial Enrollment	Passed both classes	Continued to next class
Biology	4	0	1
Chemistry	2	2	1
Computer Science	7	3	3
Engineering	11	9	7
Mathematics	4	2	1
Other	4	1	1
Physics	1	1	1

Breakdown by Gender:

Gender	Initial Enrollment	Passed both classes	Continued to next class
Male	14	8	5
Female	19	10	10

First Person in Family to go to College:

First Person in Family to go to College:	Initial Enrollment	Passed both classes	Continued to next class
Yes	14	10	8
No	19	8	7

Breakdown by Ethnicity:

Ethnicity	Initial Enrollment	Passed both classes	Continued to next class
African (Black)	3	1	2
Arab	1	0	0
Asian	2	0	1
Caucasian	1	1	1
Latino	24	14	10
Prefer not to Say	2	2	1

Breakdown by Age:

Age Range	Initial Enrollment	Passed both classes	Continued to next class
17 – 19	17	9	7
20 – 23	6	2	2
24 and above	10	7	6

Spring Semester:

Spring, 2016 Class – Math 170 is taught by Anna Hockman and Math 180 is taught by Susan Taylor

- 18 new students enrolled in the program
- 33 total students at Census Date

Spring Class Statistics (includes former students and new students) – This data (except for gender) does not include 1 student who did not fill out the application, and dropped the course early in the spring semester.

- 12 female, 21 male
- First person to go to college: 16
- Veterans: 3

Major:	
Biology	4
Chemistry	2
Computer Science	5
Engineering	15
Mathematics	4
Other	1
Physics	1

Ethnicity:	
African (Black)	3
Asian	3
Caucasian	4
Latino	18
Pacific Islander	1
Prefer not to Say	3

Age Range:	
17 – 19	12
20 – 23	10
24 and above	10