



California Mathematics Council Community Colleges

**President’s Report**

*Jen Carlin-Goldberg*



The 47<sup>th</sup> CMC<sup>3</sup> Fall Conference was held on Friday December 6 and Saturday December 7, 2019, at the Hyatt Regency Monterey Hotel and Spa. We had a wonderful program that was enjoyed by more than

220 attendees. Our Friday keynote was Omayra Ortega from Sonoma State University. She shared with us changes that she made in her pedagogy to create a more inclusive and equity-focused classroom environment. She

created math courses that incorporate social justice. Our Saturday keynote was Jo Boaler from Stanford University. She spoke about her team’s research into a limitless approach to learning and how to improve a student’s math mindset. She shared methods that we can use to help this approach to learning and life take root in our students’ minds. The breakout sessions this year were popular and well attended. We hosted talks ranging on many subjects: statistics, equity, AB 705, and Open Educational Resources, just to name a few. In one of the last sessions of the day, many attendees gathered to discuss how and what research we could gather about our student success in this post AB 705 world.

AB 705 was still present at our conference, but in a different form than what we provided in 2018. We saw how one department redesigned their curriculum with co-requisite courses and established a community of practice. They incorporated more Open Educational Resources into their courses, further supporting their students’ educational goals by making math classes more affordable.

Larry Green and Cindy Moss unveiled another Open Educational online homework course in My Open Math for AB 705 – related support courses.

Our fabulous Adjunct Advocate, Chantal Cimmiyotti tried out a new approach to the

(see “President’s Report” on p. 16)

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## Mark Your Calendar:

### 48th Annual CMC<sup>3</sup> Conference

December 11th and  
12th, 2020

Hyatt Regency Monterey  
Hotel and Spa

## The 24<sup>th</sup> Annual Recreational Mathematics Conference at Lake Tahoe

*Larry Green, Lake Tahoe Community College*



CMC<sup>3</sup> will host the 24<sup>th</sup> annual Recreational Mathematics Conference on Friday and Saturday, April 24 and April 25, 2020. The conference will be held at Lake Tahoe Community College (LTCC),

which is nestled in an area surrounded by forest and a meadow with a meandering creek. It is close to Lake Tahoe and the casinos in case you think luck is on your side. We have secured a large block of rooms at the Beach Retreat and Lodge that is just about a mile away from the college. The Beach Retreat and Lodge sits right on the shore of Lake Tahoe and is an ideal place to enjoy the Jewel of the Sierras. This conference is unique in that all the talks are recreational in nature, focusing on applications and other mysteries of mathematics. This year, we have an amazing lineup of speakers.

Friday registration goes from 6:30 pm to 7:30pm and the conference begins at 7:30 pm on Friday with an opening get-together with some munchies and games. The CMC<sup>3</sup> Foundation will be holding fun activities that will help raise money for scholarships for our students. After the opening get-together, Dr. Marion Campisi from San Jose State University will show us how mathematics has been used to help us identify gerrymandering by those in power and how to mathematically find a fair redistricting method. On Saturday morning, the conference resumes with two sessions filled with more

amazing uses, facts, and problems from mathematics. Next, there will be a catered lunch followed by an outdoor geocaching contest for those who want to explore the beauty surrounding LTCC. The geocaching will involve mathematical problem solving in order to discover the GPS coordinates of the prizes. Next we will be treated to a delicious lunch. After lunch, we are delighted to announce that Dr. Elena Fuchs will take us on a journey from the geometry of 3000 BC to the number theory of quantum computers of the future. Two more sessions on recreational mathematics will follow Dr. Fuch's talk in which we will all learn more about recreational mathematics. The conference will close with a mathematics presentation by this year's Tahoe Student Speaker. If you have a student who may be interested in being this year's Tahoe Student Speaker, please encourage them to apply. The committee will begin reviewing the applications on March 17. Students can apply online at: <http://www.cmc3.org/students/speaker/>.

The conference will conclude by 5:45 pm on Saturday, April 25. You can register online or you can use the traditional registration form. Registration will include a catered lunch. Full-time students may register onsite for the nominal fee of \$10, which includes the catered lunch. Students can also receive a half unit of college credit if they register for the applications of mathematics course, MAT 119, at LTCC. For more information, please contact your CMC<sup>3</sup> campus representative or Larry Green, Spring Conference Chair, at [DrLarryGreen@gmail.com](mailto:DrLarryGreen@gmail.com). For the latest information and details about the conference and for the registration form, please visit the CMC<sup>3</sup> website at [www.cmc3.org](http://www.cmc3.org).

## Math Nerd Musings: Increasing Office Visits



*Jay Lehmann, Editor,  
College of San Mateo*

In some semesters, I've had lots of students visit me during office hours, but in most semesters the number of office visits has been low. In the last few semesters, a significantly greater number of students have been coming by.

There are several reasons why I think this has happened. It helps that I facilitate a lot of group work in the classroom.

As a result, students get to know me and other students better. This helps in two ways because students don't feel as intimidated to see me outside of class and they are more likely to come with other students to my office. This effect has been enhanced in the

past few semesters by me having students work in pairs at whiteboards in the classroom.

Working in pairs (rather than with three or four students) fosters more interaction and working at white boards leads to more shared problem solving (rather working privately on a piece of paper). See more details in Hal Huntsman's column in this newsletter (on page 7).

The transition from my classroom to my office hours is smooth in terms of dynamics because if at least two students come to my office hours at the same time, I have them work on one of the many white boards posted in the hallway outside my office. Because I use random assignment to form groups for at least

the first half of the semester, my students in one course all know each other, so often a subset will come to my office hours together. With students coming together, they feel less intimidated. In fact, students with stronger personalities often bring along shyer students who I suspect never would've come otherwise.

One might wonder if students utilizing my office hours so much might create too great of a dependence on me, but as the semester progresses groups of students who visit my office hours tend to ask fewer questions of me and rely more on each other. And the students' confidence increases, both in terms of discussing and solving math problems.

After each test, I have students share what study tactics they use. They do this in small groups and then I call on some students to share with the entire class. The theme of study

groups and visiting office hours emerges (along with other themes). This accelerates the increase in office visits. I also write comments on weekly quizzes and tests, encouraging students who are struggling to study harder. Many of these students seek me out in office

hours. Students tend to respond to my encouragement because they know me so well from group work.

Not all office hours are equally utilized. Because I give quizzes and tests on Fridays, the number of student office visits increases throughout the week. Because I'm required to offer 10 hours of office hours per week (rather than the typical 5 hours), I see a significant percentage of my students each week. To give my feet a rest, I'll wheel about in my office chair, giving help when needed but spending a good amount of time observing, which is both fascinating and instructive to see how students think and communicate.

As the semester progresses groups of students who visit my office hours tend to ask fewer questions of me and rely more on each other.



## What's Happening at Cuesta College

*Denise Chellsen and Mark Turner*

The Cuesta College Mathematics Division has been busy with the implementation of AB705. We are very excited about the initial positive impact the AB705 changes have already had on our non-STEM students.

MMAP placement began Fall 2018, followed by AB705 implementation Spring 2019. Beginning Fall 2019, guided math course placement based on academic background and area of interest has been embedded within the online orientation. Students who do not meet the MMAP qualifications for the appropriate course(s) related to their area of interest are given additional information about a support course and/or the appropriate preparatory course.

Regular dialogue in our division via pre-semester retreats and frequent meetings has been the key to implementation for us. We have recently hired three new full time faculty members with experiences from other colleges, which has enhanced the diversity of thought in our planning. Course level faculty regularly share ideas and troubleshoot challenges. In all our courses we have increased the incorporation of just-in-time review and have developed shared Canvas shells with resources. Many of our faculty utilize an embedded tutor to directly support their course, which has also helped increase the number of course-specific trained student tutors available for drop-in tutoring in the math lab.

Our initial data from Fall 2019 for our statistics course has been remarkable, with similar success rates to pre-AB705, but with over a 60% increase in the actual number of students successfully completing statistics compared to previous fall semesters. An

enormous amount of work has been done to support success in statistics. We have created a one-unit statistics support course associated with a parent statistics course. Initial results are promising, with students in the support course having the same passing rate in statistics as the overall passing rate. In collaboration with the Success Center and with administrative support, we have established a full time statistics lab in our Success Center for drop in tutoring. Statistics faculty regularly meet with the academic success coach who runs the StatLab and give her access to their course materials and student communications as an observer in Canvas. Incentivized workshops are offered about study strategies specific to statistics and there is a collaborative pro-active early alert.

Other non-STEM courses that have had positive results from AB705 placement include our brand new course, mathematics for elementary school teachers and our long standing course, math for the humanities. We have significantly increased the number of offerings of our math for humanities course and the number of students who successfully completed this course Fall 2019 tripled over previous fall semesters. Anecdotally, we have had students who began the course with only basic algebra skills succeed in the course. In addition to serving humanities students intending to transfer, it is becoming a popular course for local associates degrees.

The greatest challenges for our program have been in our more algebraic intensive courses like college algebra and precalculus. The majority of the students in these courses had their Algebra II experience in high school, generally two or more years prior, and we are finding that many are significantly lacking in college study skills. We have increased the incorporation of soft skills like time management and building homework habits in addition to the just-in-time review. Course level

faculty regularly meet to discuss content focus, pedagogy, textbook choice and solutions for supporting students. We've increased first week counseling in our courses, making ourselves available to discuss which level course the student feels is the best fit. We are still offering a small number of pre-transfer level courses, including the STEM prep with traditional algebra courses, as well as our alternative accelerated pathway. Students may transfer down a level through week five.

We do not currently offer a co-requisite for STEM related courses, but we will continue to weigh that option along with strengthening the guided placement recommendations. We continue to talk with colleagues at other campuses, and we welcome any messages from you about ideas that have worked for your program.

In addition to AB705 support discussions, we have also added an equity focus to many of our gatherings, including our recent book discussions on *Grading for Equity* by Joe Feldman. Some members of our division are exploring alternative grading scales or implementing other recommendations from this book. It's been a challenging time with so many changes, but it's been extremely rewarding to see a positive impact on so many students' lives.

## What's Happening at Mendocino College

*Leslie Banta, Mendocino College*

State Senator Mike McGuire recently announced that Mendocino College has been awarded a \$1 million grant to expand the college's construction program. The program is critical to the fire recovery efforts in Lake and Mendocino counties. Home rebuilding has been slow due to a shortage of construction workers in the area. The funding will help expand our construction program and train students in a career that allows them to earn a living wage.

You might wonder what this has to do with math. The college has been working on developing a Sustainable Construction Technology certificate that includes a number of non-credit mathematics courses designed specifically for the construction field. Each cohort of students will take a trade overview course accompanied by training in industry relevant certificates such as first aid/CPR and fork lift operation. Along with this, they will take math classes, using lab-style curriculum, to help them develop their skills in measurement, fractions, and basic algebra as it pertains to construction.

Math faculty provided input to the construction faculty program lead and suggested low-cost curriculum that includes access to content videos in both English and Spanish. Choosing a non-credit option for the course allows for some flexibility in teacher assignment and availability.

Mendocino College has a strong programs in applied academics and 75% of students who participate in career education programs either gain employment or see an increase in wages within six months of completing their program. The math department has responded to the needs of these programs by working with faculty in the applied academic disciplines to provide relevant and accessible curriculum for our students.

## Thinking Classrooms, Part 1: Vertical Non-Permanent Surfaces

*Hal Huntsman, Antelope Valley College*

We all know that students learn better when they are doing math, rather than watching us—their teachers—talk about and do math. The cause of the improved learning may be many things, but one likely reason is that when students are doing math, they are thinking; that is, more thinking means more learning. But creating a classroom in which students think about and do more math is easier said than done.

Enter the work of Peter Liljedahl, from Simon Fraser University. In his article, “Building Thinking Classrooms: Conditions for Problem Solving,”<sup>1</sup> Liljedahl tells the story of his more than ten-year journey to promote problem solving in the classroom, which “led first to the notion of a thinking classroom and then to a research project designed to find ways to help teachers build such a classroom.”<sup>2</sup> Early on, in classroom after classroom, Liljedahl observed “an assumption, implicit in the teaching, that the students either could not, or would not think.” He also saw that classroom norms often prevented a thinking classroom from emerging. He sought “a collection of teacher practices that had the ability to break students out of their classroom normative behavior.”

Liljedahl’s project focused on nine elements of mathematics teaching:

1. The type of tasks used, and when and how they are used;
2. The way in which tasks are given to students;
3. How groups are formed, both in general and when students work on tasks;

4. Student workspace while they work on tasks;
5. Room organization, both in general and when students work on tasks;
6. How questions are answered when students are working on tasks;
7. The ways in which hints and extensions are used while students work on tasks;
8. When and how a teacher levels their classroom during or after tasks;
9. Assessment, both in general and when students work on tasks.

Each of these elements deserves its own discussion. In this column I focus on element 4. Liljedahl’s work on student workspace suggests that one of the best ways to get students to do math in class is to get them up out of their seats and working on problems at what he calls Vertical Non-Permanent Surfaces (VNPS) – aka, white boards and chalk boards. Not only is it effective for students, it is relatively easy to implement.

To learn more about what this looks like in practice at a California community college, I turned to Sophia Lee, full-time math instructor at Citrus College, located northeast of downtown Los Angeles. Lee has been using VNPS in class for two years, and every class looks pretty much like this:

- Class begins with a “meaty” problem that students can relate to.<sup>3</sup>
- All students stand around the room at boards in pairs, chosen randomly at the beginning of each class.<sup>4</sup>
- They are all working on the same problem, showing their work on the board. They are not allowed to work on their paper before they work on the board.

- Students who are stuck often turn to look at what their classmates are doing. They also discuss ideas with other classmates.
- Groups that “finish” are given an extension to the problem and/or are encouraged to walk around and help their classmates still working.
- In the best classes, a debate breaks out between groups that have different solutions to the problem. “It can be quite lively,” says Lee.
- Once all groups meet a minimum threshold on the problem, students sit in groups and do a few “drill and kill” problems similar to the one they’ve already done on the boards.
- Lee calls all this work the students’ “first draft.”
- Toward the end of class, Lee leads the class through a discussion of the methods they used, summarizing and making connections to the larger abstractions and definitions they are learning.

“It’s been a game changer,” says Lee. “It’s completely transformed the mathematical experience for my students.” Moreover, Lee believes using VNPS has real equity implications. Even less-confident students are more likely to try something when they know they can erase it with one swipe. For low-income students, paper is a relatively precious commodity that is hard to erase, because they bought cheap, ineffective pencils and erasers; the board costs them nothing. The fact that they are standing

up, with everyone else, also reduces the anxiety of not being sure how to do it. Liljedahl observes that it’s hard to “disappear” in this classroom, since moving away from the board means moving to the middle of the classroom, where everyone, including the teacher, can see them.

“The biggest downside,” says Lee, “is that students don’t come away from class with good notes.” She’s alleviating that issue by providing copies of the book publisher’s fill-in-the-blank notes.

“I’d like to try this,” you might be thinking, “but I don’t have boards on every wall in my classroom.” You can ask your administrator for boards, but that’s a resource issue, and it takes time. In the meantime, here are some things you can do:

- Get some small portable white boards – much cheaper and easy to use.
- Put up butcher paper around the room – not as good as boards, but better than leaving students at their desks.

Or you might be thinking that using VNPS sounds great, but you don’t have time because there’s so much material to cover. “Actually,” says Lee, “We don’t spend more time on each topic. We do a few problems more deeply, and that is enough for most students to understand how to do most other problems.” In addition, I’m thinking, because of the active learning in class, students have learned how to be more independent learners.



Finally, there's the issue of student resistance. Lee admits that some students are hesitant at first with VNPS, but they all buy in as the term progresses. You might also share and discuss the Harvard study showing that even though students think they learn more from lecture, they actually learn more from active learning.

For my own part, I've begun experimenting with limited use of VNPS in class. The student response was almost uniformly positive, and the learning that happened was obvious. It was also just fun to be in a class of students all working at the board together. I wandered, providing hints from time to time, but mostly listening and helping students connect with each other. The experience was so positive that I'm shifting to this approach entirely for my precalculus class in the spring semester.

If you'd like to try it out, too, contact me and we'll compare notes. Few things are better than learning together about teaching our students.

*Questions? Comments? Want to connect? Reach Hal at: [shuntsman1@avc.edu](mailto:shuntsman1@avc.edu).*

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<http://peterliljedahl.com/wp-content/uploads/Building-Thinking-Classrooms-Feb-14-20151.pdf>

<sup>2</sup> His story is instructive and illuminating. I highly recommend reading his article to understand the way that he went about his work. It is a demonstration of the way we should probably all be working.

<sup>3</sup> More on "meaty" problems in a future column.

<sup>4</sup> According to Liljedahl, visible random grouping is the most effective method for student learning and engagement. Any other method is seen as having a hidden agenda by most students and does not lead to the same positive classroom environment.

## Campus Rep Network Revitalization

*Leslie Banta, Mendocino College*

The campus representatives for CMC<sup>3</sup> serve a vital purpose to the organization. They give us the ability to easily communicate with our members and provide a local face for the organization. Additionally, they have the ability to provide the CMC<sup>3</sup> Board with information about what our members would like to see in the organization.

This year, we have plans to revamp our campus rep program so that we are making the most of this important resource. Chantal Cimmiyotti (Mendocino College) and I have taken on the duties of campus rep coordinators. We are looking forward to some exciting changes for the campus rep network!

We will be meeting with campus reps via zoom in the near future so that we can all put faces to names. We'll be sending out regular emails to the campus reps to share with math department faculty at each college and we'll be asking questions about what our members want to see at our conferences. We will be highlighting CMC<sup>3</sup> activities and opportunities that help us to stay connected during the times between our newsletters and conferences.

Don't know who your campus rep is? You can find the list [on our website](#). Are you interested in being a campus rep? It's a great way to get involved with the organization. Send me an e-mail at [lbanta@mendocino.edu](mailto:lbanta@mendocino.edu). I look forward to hearing from you!

## Some Mathematics in Music

*Dean Gooch, Santa Rosa Junior College*

Mathematics is often used as a theme in music. I have a few favorites I would like to talk about that I have enjoyed over the years.

**Density 21.5** As a flutist, I have always been drawn to pieces in the flute repertoire. One of my favorites is a piece by Claude Debussy entitled, "Syrinx." It is a short piece that is fun but difficult to play. When in high school, I sought a recording and was directed to one made by the famous Italian flutist Severino Gazzelloni. On this recording, I discovered the delightfully challenging piece, "Density 21.5" by Edgar Verèse. This piece is moody and dissonant rising to a high D natural that most flutists refuse to play. The name, "Density 21.5," refers to the density of platinum. Verèse wrote this piece for a friend who had had a flute maker create a flute for him out of platinum. As far as I know, Verèse's friend never performed the piece publicly, but flutes made of platinum have become one of the standards for flutists worldwide.

**Einstein on the Beach** Philip Glass wrote an unusual opera about Albert Einstein. Although Einstein is not a mathematician, the opera has long repetitive stretches of choruses repeatedly reciting numbers in interrupted sequences of "one, two, three, four, five, six, seven, eight." Discussions of numbers can be heard in the background as well. I suppose Philip Glass is trying to relate to the public's confusion between mathematics and physics by having numbers recited. A Music Department colleague once asked me my opinion on string theory. When I told him that I had no opinion, interest nor any ideas about string theory because string theory was physics. He seemed put off. Not wishing to leave the conversation without a nice symmetry, I asked him his

thoughts on Mucus. We no longer talk. If you want to listen to "Einstein on the Beach," I suggest that you listen while doing something you enjoy. The music is lengthy and gamelan-like. It is pleasant but difficult to sit through without being otherwise occupied.

**Einstein on the Fritz** One of my favorite comedic composers is Peter Schickele, aka PDQ Bach. Schickele was at Julliard majoring in composition at the same time as Philip Glass. PDQ Bach composed "Einstein on the Fritz" as an ode and humorous parody of Philip Glass' compositional style. It is a lot of fun, but you should listen to some of Glass' other operas to fully enjoy the humor. It is a little hard to find but well worth it.

**4'33"** John Cage has written many wonderful pieces and has a very strange sense of humor. When this piece was first performed, the pianist walked to the piano, closed the lid to the keyboard and proceeded to make little noise over the course of the four minutes and thirty-three seconds. At the end, the keyboard was re-exposed with no keys ever being played. The piece can be played by any ensemble. The music simply says "Tacit" which means "don't play." I am especially fond of the recordings on the album "Deep Listening Band, Non Stop Flight" with Julie Steinberg. She has both a studio and a live recording on the album so that the listener can enjoy the contrast between the two settings.

**Sequenza 1 for Flute** Another strange piece that I love listening to for solo flute is this piece by Luciano Berio. He wrote a series of Sequenzas each featuring a different solo instrument. I especially like "Sequenza V" for solo trombone. This is one is great to see performed. It has a nice visual sense with the musician using a derby as a mute. At least, this is how I saw it performed.

**String Quartet No. 4, “The Ramanujan Notebooks”.**

This is a piece by the Ethnic Irish, South African composer, Kevin Volans. Usually, his pieces are quite mellow, reflecting the rich choral traditions of Southern Africa. This string quartet seems to dwell in the dissonances of people’s conflictual feelings about mathematics or perhaps reflecting the tortured life that Srinivasa Ramanujan lived in order to bring his wonderful mathematics to the world. I like to think of it as being the eruptions of the mathematical inspirations that must have come to Ramanujan as a young man while meditating in his favorite temple.

**Proof of Erdős** Elliott Sharp composed this piece for dissonant electric string orchestra. The only recording that I am aware of features Orchestra Carbon & David Bloom. I am not sure what Sharp was thinking, but I assume that he was either trying to capture the noise of Erdős’ incredibly creative and active brain or the strangenesses of mathematics and mathematicians as perceived by the public. I could not say. You must be in the right mood for this one. It can be hard to listen to, but I will crank it up on my office computer whenever I am correcting a particularly disastrous set of exams. If the end of the semester is nigh, I opt for Alice Cooper’s “School’s Out” though.

**Calling All Speakers! (This means you.)**

*Leslie Banta, Mendocino College*

The CMC<sup>3</sup> board has been busy planning for our Fall Conference in Monterey. We are very excited to be expanding our speaker opportunities by developing new session strands. Who can send in a speaker proposal? You can! We take proposals from faculty (full-time, adjunct, and retired) and others who are interested in math education at the community college level.

A common question we hear is, “What would I talk about?” Don’t underestimate what you have to offer! Do you have a teaching strategy that you have found effective? Do you have activities that you use in your classes that your students enjoy? Share those! Are you an ACCESS Fellow or will you be speaking at AMATYC? Come share with us! Have you facilitated professional development trainings on your campus? We’d like to hear from you!

We are updating our speaker proposal form so that we have a better idea about the content and goals for each presentation. We’re also asking you to identify which strand you think best fits your content. This year, we plan to have strands in each of the following areas: Equity, Diversity & Inclusion; Math Intensive (STEM track); Statistics; Quantitative Reasoning & Liberal Arts Math; Technology & Accessibility; Math Education (Andragogy); Student Support and Success/AB705; and Potpourri (General Interest).

Having been a conference speaker myself, I know that it can be a bit intimidating to think about standing up in front of your peers. After your first talk, you’ll find it a rewarding experience! Our audiences are welcoming, friendly, and are interested in what you have to share. If you haven’t given a session talk before, I encourage you to do so!

# The Pleasures of Problems

*Kevin Olwell, San Joaquin Delta*

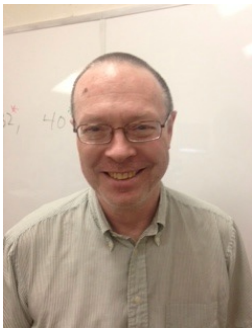
Spring 2020: Define a sequence of polynomials recursively by

$$P_n(x) = P_{n-1}(x - n),$$

where  $P_0(x) = x^3 + 313x^2 - 77x - 8$ .  
What is the coefficient of  $x$  in  $P_{20}(x)$ ?

Thanks to Sab Matsumoto, Mel Hom, Fred Teti, Joel Siegel and Chuck Barnett for submitting a solution to the Fall 2019 problem.

Fall 2019: A parking lot has 12 spaces arranged in a line. A large pickup needs two adjacent spaces in order to park. If 8 of the spaces are already occupied, what is the probability the truck will be able to park?



First some notation. We shall use 0 or 1 to indicate whether a parking space is vacant or occupied. For example, (1,1,0,1) denotes a parking lot that has 4 spaces with space #3 vacant. We shall compute the probability that the truck cannot park. This requires counting the number of strings with four 0's and eight 1's such that no two 0's are adjacent. Consider the following string of nine 0's and eight 1's:

$$(0,1,0,1,0,1,0,1,0,1,0,1,0,1,0)$$

Deleting any number of 0's from this string yields another string such that no two 0's are

adjacent. Thus the number of ways to the pickup will be unable to park is equal to the number of ways to delete five of the nine 0's from the string:

$$\binom{9}{5} = 126.$$

The total number of ways to park 8 cars is:

$$\binom{12}{8} = 495.$$

Consequently  $P(\text{truck can't park}) = \frac{126}{495}$ .

Finally

$$P(\text{truck can park}) = 1 - \frac{126}{495} = \frac{41}{55}.$$

All are invited to submit a solution to the Spring 2020 problem via email at the address below:

[kevin.olwell@icloud.com](mailto:kevin.olwell@icloud.com)



## OERCommons.org – Available for All

*Barbara Illowsky, PhD*

Have you created materials for your courses that you are willing to share? Most of us have.

Usually, though, we share only among our small group of department colleagues who we are friendly with. Even with that, the majority of locally developed content that are created by full-timers rarely reach the adjuncts. Here's a way to get into the sharing spirit!!

With a generous grant from the Michelson 20MM Foundation, all California Community Colleges (CCC) now have a free place to create, collaborate, share, and search for locally-developed content. There is a CCC hub with quick access to several national repositories. In addition, every CCC has its own group. You can easily join your college's group. Create a free account, go to your college's group, and click on "Ask to join." It's that simple! As an added bonus, CCC has a separate group for mathematics across the system. You can join that group, too, and post content there, as well. Currently, the mathematics group hosts Dr. Larry Green's (Lake Tahoe CC) instructions for accessing all the MyOpenMath templates that are synchronized to each OpenStax mathematics text as well as to open linear algebra and differential equations texts. Imagine that! Students no longer needing to pay for either their textbooks or access codes for homework grading systems!

You will also find a hub for OpenStax. Colleagues from around the country have posted resources they developed that you can download, modify, and use for your classes. If you want, you can then share your modified content with everyone else by uploading them back into OpenStax, your college's group, or the

mathematics group. It's that easy!! A few years back, several of us (including Cindy Moss, Larry Green, Lena Fineman, Lenore Desilets, James Sullivan, and me) were involved with a Gates Foundation grant through University of Texas Arlington. We developed several collaborative labs to go with the OpenStax *Elementary Statistics* (free, OER) text. The labs are geared towards both online and face-to-face classes and use a spreadsheet application Larry developed instead of a graphing calculator. You can find those labs directly at [https://www.oercommons.org/courseware/lesson/13691?\\_hub\\_id=27](https://www.oercommons.org/courseware/lesson/13691?_hub_id=27) or go to the OpenStax hub and Elementary Statistics group.

If you'd like more info, go to [OERCommons.org/CCC](https://www.oercommons.org/CCC). You will see "Tools and Templates" at the bottom of the landing page. There are short and not-so-short videos to help you get started. Remember to use tags when you upload new content! Have fun and share with all of us!

If you have any questions, please contact me at: [illowskybarbara@fhda.edu](mailto:illowskybarbara@fhda.edu)

## The History Corner

Joe Conrad, Solano Community College

Last summer this column looked at the history of solving quadratic equations as far back as the Babylonians. In the fall, we saw the beginning of the use of complex numbers which was actually a consequence of the solution of cubic equations. In the interest of writing a trilogy, this column will relate the story of solving all the higher polynomial equations. This account includes stories of people working on such problems despite great difficulties and could be inspirational for us and our students.

In the last column, we saw that the general cubic equation was solved completely by Cardano (aka Cardan) in his *Ars Magna* in 1545 after an interesting path through other Italians, namely, del Ferro, Fiore, and Tartaglia. Cardano also gave the solution to the quartic in *Ars Magna*, but mentioned that it “is due to Luigi Ferrari, who invented it at my request.” The solution that Cardano reported was separated into 20 separate cases reflecting the contemporary aversion to negative coefficients and a lack of understanding of how complex numbers work in the solution of cubics. (Recall that Bombelli cleared this up a few years later.) The process Cardano gave was an algebraic *tour de force* that used completing the square and the discriminant to produce an associated cubic, now called the resolvent cubic, which could be solved by his cubic method. These solutions were used to transform the original quartic to a quadratic which, of course, could be solved with the quadratic formula. (I should note that Descartes, Euler and Lagrange developed other methods to solve quartic equations in later years.)

Now attention turned to solving quartic equations. Not much progress was made over the next 250 years. As just mentioned, Joseph-Louis Lagrange (1736 – 1813) around 1770 developed a new way to solve quartics involving permutations on the roots. This was a precursor to group theory and the work of Abel and Galois. His method involved resolvent polynomials, but when he studied quintics, he found his resolvent to be sixth degree rather than less than five as hoped. Consequently, he conjectured that such polynomial equations could not be solved in the usual sense. (It is probably a good idea, at this point, to explicitly state what the “usual sense” means. The standard meaning is that a polynomial equation is solvable if its roots can be expressed as a finite combination of radicals and the other algebraic operations involving the coefficients of the polynomial.) Lagrange could not prove his conjecture and no one else did either for several decades.

The first paper published with a proof of the unsolvability of the quintic was published in 1799 by Paolo Ruffini (1765 – 1822). Unfortunately, the proof was not complete and the paper went virtually unnoticed. The Norwegian Niels Henrik Abel (1802 – 1829) and the Frenchman Évariste Galois (1811 – 1832) are the mathematicians who resolved the issue and much more. Unfortunately, both of these men died very young having already accomplished a great deal in the field of mathematics. Their lives also illustrate the difficulty of the times for the poor and those who wish for a better life.

Abel was the second child in a large family. His father was a pastor, but died when Abel was 18. Fortunately, Abel had been sent off to school when he was 13 and had

discovered mathematics. His teacher, Berndt Holmboe, noticed Abel's abilities and challenged him with reading some of the masters. One of these was Lagrange. This piqued Abel's interest in solving the quintic. In 1821, he entered Royal Frederick University. This was just after his father had died leaving him without the finances to continue, but Holmboe provided a scholarship for him. (We teachers should hold this Holmboe in high regard for noticing and nurturing a talented student even when it hit his wallet!) At about this same time, Abel thought he had developed a method of solving the quintic that he sent to several professors around Norway. They found no issues, but one of them asked him to provide a numerical example of the method. In attempting to do so, Abel found a mistake in his proof which led him to the proof of the impossibility of any general solution in 1823. This result has come to be known as the Abel-Ruffini theorem.

The rest of Abel's short life was fraught with financial difficulties. He had graduated in 1822, but could not find a paying position. He also was trying to get his work on quintics and other matters published, but needed money to do so. He received some funds from the Norwegian king allowing him to travel to France and Germany. He was able to publish his work on the unsolvability of quintics in French as a memoir, but he had to limit it to six pages due to the cost. Consequently, it was very hard to read and was not appreciated. It was noticed eventually and a full proof was published in 1826 in *Crelle's Journal*. By the end of 1828, still without a position, he developed pneumonia. Sadly, he died back in Norway on April 6, 1829 just two days before a letter

arrived from Crelle with an appointment as a professor at the University of Berlin.

Évariste Galois also had a short life filled with issues reflecting the times he lived. His parents were well-educated and his father was active in politics at the time of Galois' birth on October 25, 1811. Political activism was a part of Galois' life until the end. About the age of 12, he entered school and by 15 was reading advanced mathematics including Lagrange's work on solving equations. He hoped to enter the École Polytechnique to cultivate his mathematics, but was rejected. When he was 17, he wrote up much of his work which would become Galois theory and sent it to Cauchy who lost it. He tried again to get into the École Polytechnique, but was rejected again. About this time, his father had some issues with a local cleric which led to his suicide. Despite these setbacks, Galois continued his research and entered the less-prestigious École Normale. In 1830, he sent a paper to Fourier for consideration for a prize from the French Academy. Fourier took the paper home, died shortly thereafter and the paper was lost. Coincidentally, the prize was won posthumously by Abel and also by Carl Jacobi.

At this point, Galois had had enough. He sent a biting letter to the École Normale which resulted in his expulsion. He tried again to submit his paper which now went to Poisson. Poisson returned it because he found it "incomprehensible." In 1831, Galois joined the National Guard in opposition to the government. He was arrested twice and served time in jail. He apparently became involved with a woman whose honor was questioned. He felt he could not refuse the ensuing duel. The night before the duel, he spent time writing up notes and

entrusted them to a friend for later publishing. He was shot in the duel and died the following morning, May 31, 1832, not yet 21 years old.

His notes eventually found their way to Joseph Liouville (1809 – 1882) who edited some of them and had them published. Liouville was able to piece together Galois' reasoning and found that Galois had found precisely when polynomial equations could be solved by radicals. The method was the beginning of what we now call Galois theory which was to be one of the most influential mathematical developments of the early nineteenth century. It provided another approach to the proof of the Abel-Ruffini Theorem and yielded more information about the equations and their solutions.

It is staggering to think what would have happened to the development of mathematics had Abel and Galois had the longevity of Euler or Gauss.

I would like to finish this trilogy by remarking that despite the fact that we say that fifth degree and higher polynomial equations do not have general solutions, we really should note the qualifier that they don't have general solutions in radicals and algebraic operations. Just like saying the angles can't be trisected depends upon the condition that the trisection has to be done following the rules, namely, using only straightedge and compass, the lack of a general quintic formula depends upon using only radicals and algebraic operations. Since the time of Abel and Galois there have been some methods developed, Bring radicals for instance, that can be used to solve quintics or higher degree polynomial equations, but this topic is way beyond the scope of this column!

## President's Report

(continued from p. 1)

session geared toward supporting our Adjunct faculty attendees. Chantal set up stations in her room to work on CV's, job applications, interviews, and more. I was excited to see this bold reinvention to the adjunct session. Keep watch for it again in 2021. We value our adjunct attendees and members and will do all we can to support you. If you are interested in more information, please feel free to contact Chantal. You can find any CMC<sup>3</sup> Board member's contact information on our website, [www.cmc3.org](http://www.cmc3.org).

For the first time in a long time, perhaps ever, we had more Student Poster Contest entries than we could accept. It was difficult choosing which applications to select for the conference. We gave out many awards to students, which was made possible only because of all of the generous donations made to the Foundation in the past year.

It is with some reluctance that I pass the Conference Chair job off to our well-deserving, President-Elect, James Sullivan. I enjoyed running the Monterey Conference in 2018 and 2019; perhaps a little bit more than normal human should. I am deeply and humbly grateful for all of the people who worked tirelessly to put this conference together. It takes months and months of intense work, attention to details, and drive from many people to get it done. I am grateful for my turn building all of you a conference that we strived to make both valuable and enjoyable. Two key goals were to support you in finding ways to develop yourself professionally and to recharge your professional batteries for another year, or at least until the Spring Conference comes along this April.

We are living in interesting times. CMC<sup>3</sup> is here to support community college math faculty as we continue to meet these challenges and continue to find better ways to support our students.



## MyAMATYC and More

*Leslie Banta, Mendocino College*

I am excited to be the new AMATYC Liaison for CMC<sup>3</sup>. As a Project ACCCESS Fellow, AMATYC has had a big impact on my experience as a member of community college faculty. If you aren't part of AMATYC, I encourage you to become a member. In addition to their conferences, they offer a number of great resources that can support your teaching.

AMATYC recently launched MyAMATYC, a place to network with faculty at community colleges across the nation. You can share resources, ask questions, subscribe to blogs (or create them yourself) and make connections you might not otherwise have the opportunity to make. To get started, visit [my.amatyc.org](http://my.amatyc.org) and set up your profile.

Do you have a group of students who are excited about research? The Student Research League (SRL) might be just what you're looking for to provide them with a challenging and fun research competition. The two main goals of the SRL are:

- To encourage research problem solving and to motivate an interest in extracurricular mathematics activities among two-year college students, and
- To reward outstanding student research problem-solvers through a scholarship and prizes to be given to the top participants, both individual and team, in League competition, and to recognize colleges with outstanding mathematics students through national awards.

Registration is open through March 15 each year. If you are interested in the program, visit the [SRL web page](#).

AMATYC also has a number of exciting professional development opportunities. One of them might be just what you are looking for. Are you looking for professional development activities for Flex or just for fun? Check out the [AMATYC webinar series](#). Are you looking for PD on your campus? AMATYC offers [traveling workshops](#) as well as grants to help fund them. Are you in your first four years of full-time community college teaching? [Project ACCCESS](#) is a mentoring and professional development initiative that provides experiences that help new faculty become more effective teachers and active members of the broader mathematical community.

[AMATYC 2020](#) will be in Spokane November 12 —15, and I hope to see you there. The deadline for speaker proposals has already passed but you can still sign up to be a [presider for a session](#) (this is especially fun if you know someone who has applied to present). Hotel and transportation information has been posted for the conference, and registration will be live soon. I hope to see you there!

Anyone is welcome to attend our board meetings. If you'd like to attend, please contact anyone on the board. We'll be happy to tell you the date and location of our next meeting.

## CMC<sup>3</sup> Foundation Report

*James Sullivan, Foundation President, Sierra College*



The CMC<sup>3</sup> Foundation conducts fundraising events and solicits donations in order to award scholarships and prizes to qualified and deserving California community college

students who demonstrate promise and interest in the area of Mathematics and Mathematics Education. The CMC<sup>3</sup> Foundation Scholarship fund sponsors the Student Poster Contest, Student Speaker Award, and California Community College Mathematics Student Scholarships. The Foundation Board offers its gratitude to all our generous members whose donations make the monetary awards for these programs possible. One such member, Guy DePrimo of City College of San Francisco, was

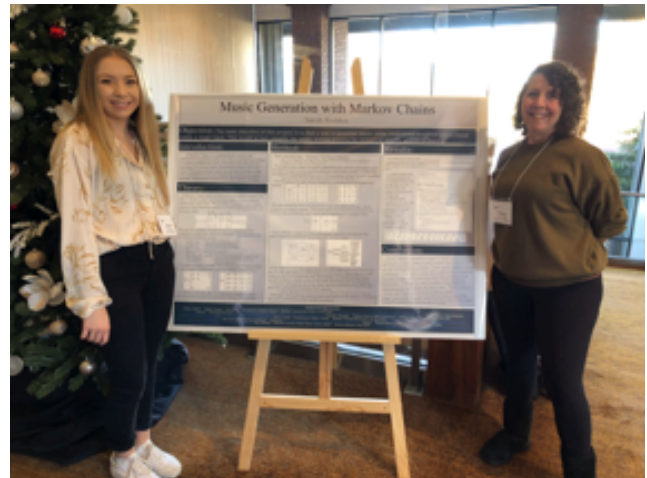


recognized at the Monterey conference as the 2019 CMC<sup>3</sup> Foundation Legacy Donor. Guy's continued and longtime support of the CMC<sup>3</sup> Foundation has made a significant impact on the work of the Foundation.

The Student Poster Contest takes place during the Annual Fall Conference in Monterey. Eleven proposals, the most ever, were submitted by students for the 2019 Student Poster Contest. The selection committee had the challenging task of picking the top four proposals. The task was so difficult that, ultimately, the decision

was made to increase the available scholarship award funds to \$1,250 and invite five student groups to present their poster at the Monterey conference.

Sarah Redden from the College of the Sequoias earned top honors and was awarded a \$350 scholarship for her poster "Generating Music with Markov Chains". Sarah's poster and presentation demonstrated how someone could input common chords and musical notes and



produce a "song" created by a series of those inputs using a Markov chain. She concluded her presentation by playing a Markov chain generated song on a ukulele. Tracy Redden of the College of the Sequoias was Sarah's faculty sponsor.

Jerri Schorr and Rosario Araujo from Hartnell College split a \$250 scholarship for their joint poster entry titled "Mathematical Modeling of Management Variables in Agriculture." They presented a summary of their contributions as members of a team who worked on a project that constructed mathematical models to be used by farmers to better prepare and manage the fields for maximum crop yields and to help distributors in managing sales contracts and protecting price integrity. Their faculty sponsor was Brian



integrity. Their faculty sponsor was Brian Palmer of Hartnell College.

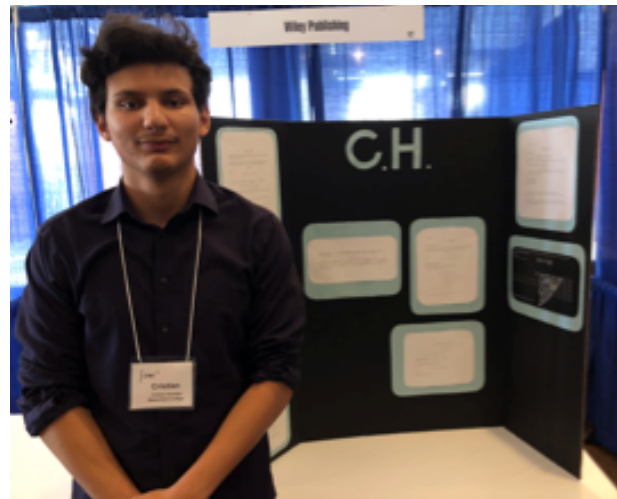
Nico Kokonas from Cuesta College was presented with a \$250 scholarship for his poster “The Most Important Algorithm in Signal Processing”. Nico provided an overview of the Fourier Transform and discussed how this extremely powerful tool can be used in signal processing to decompose any real waveform in



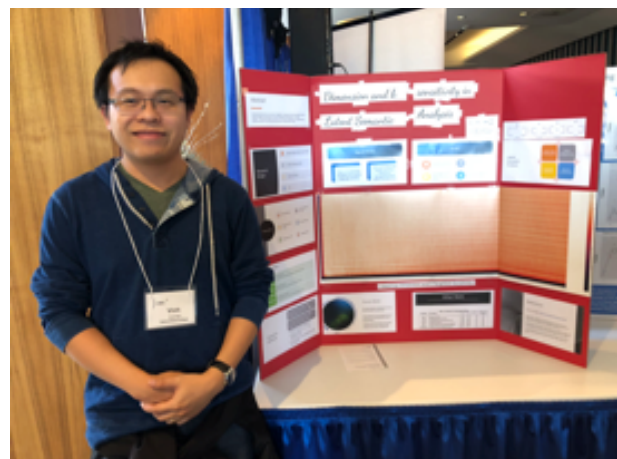
the time domain into the constituent frequencies that make it up. His presentation was very interesting and informative. Shelby Burnett of Cuesta College was Nico’s faculty sponsor.

Dr. Jonathan Brown of Bakersfield College was the faculty sponsor of two Student Poster Contest Award recipients, Cristian Ocampo and Vinh Bui, from Bakersfield

College. Cristian Ocampo was awarded a \$200 scholarship for his poster “A Survey of Classic



and Recent Results on the Continuum Hypothesis”. Cristian’s poster explored the Continuum Hypothesis and addressed how it has challenged mathematicians for over one hundred years. He illustrated how this enigma has exposed and pushed the edges of our very systems of logic. Vinh Bui received a \$200 scholarship for his poster “Dimension and k Sensitivity in Latent Semantic Analysis”. His presentation on machine learning shared



empirical results on Singular Value Decomposition based k-Nearest Neighbors approaches to natural language processing tasks



as part of developing an automated essay grading assistant for the Philosophy Department at Bakersfield College.

The Foundation Board offers its congratulations to the 2019 Student Poster Contest award recipients and deep appreciation to their faculty sponsors for contributing to the success of the CMC<sup>3</sup> Student Poster Contest.

Submissions for the Student Speaker Contest are currently being accepted online at [http://www.cmc3.org/students/speaker/call\\_for\\_speakers/](http://www.cmc3.org/students/speaker/call_for_speakers/). Please encourage your outstanding students to submit a proposal. The Student Speaker Award recipient has the honor of concluding the CMC<sup>3</sup> Spring Recreational Mathematics Conference held at Lake Tahoe Community College on April 25, 2020 by giving a 20-minute presentation on a topic related to Mathematics. They will also receive a \$500 Scholarship. The deadline to apply for the Student Speaker Contest is March 17, 2020.

The CMC<sup>3</sup> Foundation is pleased to announce the offering of \$6000 in total scholarship funds available to qualified and deserving California Community College mathematics students. As a member of CMC<sup>3</sup>, you have the opportunity to nominate one worthy student for a CMC<sup>3</sup> Foundation Scholarship. Students eligible for nomination must have successfully completed a minimum of 30 college units, including at least 8 units at a CMC<sup>3</sup> member college, are currently enrolled in a minimum of 6 units at a CMC<sup>3</sup> member college, and have completed at least one mathematics course at the level of second semester engineering calculus or higher. Nomination packets must be completed and submitted by April 1, 2020. The nomination packet is available for download on the CMC<sup>3</sup> Foundation website <http://www.cmc3.org/students/scholarships/>.

CMC<sup>3</sup> Foundation scholarships are made possible through generous donations from our

members like you. Please consider supporting our scholarship fund this year by making a tax deductible cash donation either by credit card or



PayPal using this QR code, the “Donate” button on the CMC<sup>3</sup> Foundation website <http://www.cmc3.org/foundation/donate/>, or by mailing a check directly to Leslie Banta, CMC<sup>3</sup> Treasurer, Mendocino

Community College, 1000 Hensley Creek Rd, Ukiah, CA 95482.

Finally, I will conclude this article by saying that it has been an extremely valuable and rewarding experience serving on the CMC<sup>3</sup> Foundation Board these past four years. As I transition from my role as CMC<sup>3</sup> Foundation President to CMC<sup>3</sup> President-Elect, I want to express my deep gratitude and sincere appreciation to my fellow board members Leslie Banta, Joseph Conrad, Casey Terrill, Shawn Lanier, and Manny Kang. They have dedicated their time, energy and resources to support the mission of the foundation and, over the course of their tenure on the board, the CMC<sup>3</sup> Foundation was able to award more scholarships to more California Community College students than in previous years. I am very proud of what we were able to accomplish together.



# Calendar

March 13—14, 2020: CMC Central Symposium, Bakersfield, CA. Contact: <https://www.cmc-math.org/cmc-central-registration>

March 12—14, 2020: ICTCM 32nd Annual Conference at Orlando, FL. Website: <https://www.pearson.com/us/about/news-events/events/2020/03/ictcm-2020-conference.html>

March 14, 2020: SVCCM Conference at Sacramento City College. Website: <https://www.scc.losrios.edu/mathlab/svccm-scc-2020/>

March 27—28, 2020: CMC<sup>3</sup>-South 35th Annual Spring Conference at Kellogg West Conference Center, Pomona, CA. Contact: Jack Appleton at [jappleman@ivc.edu](mailto:jappleman@ivc.edu). Website: [www.cmc3s.org](http://www.cmc3s.org)

April 3, 2020: ALAMATYC Conference: Shooting for the Stars, Contact: Dr. Nathan Winkles Website: <https://alamatyc.wixsite.com/alamatyc>

April 3, 2020: 20th Annual NEBMATYC Conference, Northeast Community College Contact: Aubrey Weitzenkamp Website: <https://nebmatyc.weebly.com/>

April 3 - 4, 2020: WYMATYC: 2020 Math and Stats Articulation, Rock Springs, WY Contact: Sarah Pauley Website: <https://wymatyc.blogspot.com/>

[alamatyc.org](http://alamatyc.org)

Website: <https://www.cmc-math.org>

2020 Contact: Jay Lehmann

Editor: [JayLehmann@mathnerd.com](mailto:JayLehmann@mathnerd.com)

CMC<sup>3</sup> Newsletter

[MathNerdJay@aol.com](mailto:MathNerdJay@aol.com)

April 23 - 25, 2020: ORMATYC Annual Conference, Inn at Spanish Head, Lincoln City, OR Contact: Liz Hylton Website: <http://www.ormatyc.org/>

**April 24-25, 2020: CMC<sup>3</sup> 24th Annual Recreational Mathematics Conference, Lake Tahoe CC, South Lake Tahoe, CA. Contact: Larry Green, Lake Tahoe Community College, (530) 541-4660 ext. 341, [drlarrygreen@gmail.com](mailto:drlarrygreen@gmail.com)**

November 6—7, 2020: CMC South 61st Annual Conference, Palm Springs, CA. Website: <http://www.cmc-south.org/conference.html>

November 12—15, 2020: AMATYC 46th Annual Conference, Spokane, WA. Website: <https://amatyc.site-ym.com/page/2020ConfHome>

December 4—6, 2020: CMC North 63rd Annual Conference, Pacific Grove, CA. Website: <https://www.cmc-math.org/cmc-north-conference>

**December 11—12, 2020: CMC<sup>3</sup> 48th Annual Conference, Hyatt Regency Monterey Hotel and Spa, Monterey, CA. Contact James Sullivan, Sierra College, (916) 660-7973, [jsullivan@sierracollege.edu](mailto:jsullivan@sierracollege.edu)**

[jsullivan@sierracollege.edu](mailto:jsullivan@sierracollege.edu)

Sierra College, (916) 660-7973, and Spas, Monterey, CA. Contact James Sullivan, Hyatt Regency Monterey Hotel December 11—12, 2020: CMC<sup>3</sup> 48th Annual