California Mathematics Council Community Colleges

The 22nd Annual Recreational Mathematics Conference at Lake Tahoe

By Larry Green, Lake Tahoe Community College

CMC^3 will host the 22nd annual Recreational Mathematics Conference on Friday and Saturday, April 27 and April 28 this year. For the second year, the conference will be held at Lake Tahoe Community College which is nestled in a beautiful area surrounded by forest and a meadow with a meandering creek. We have secured a large block of rooms at the Beach Retreat and Lodge that is just a mile or so 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 of the talks are recreational in nature, focusing on applications and other mysteries of mathematics.

This year we have an amazing lineup of speakers. The conference begins at 7:30 pm on Friday, April 27 with an opening get-together with some munchies and games. The CMC^3 Foundation will be holding some fun activities that will help raise money for scholarships for our students. Then Carlo Sequin from UC Berkeley will show us the beauty and power of geometry and topology. On Saturday morning, April 28, the conference resumes with two sessions filled with more amazing uses, facts, and problems from mathematics. For example, we will learn about how to use math to win at poker, how conics come from orbital elevators and other cool things about math. Next there will be a catered lunch followed by an outdoor geocaching contest for those who want to explore the surrounding beauty. On Saturday after the geocaching event, we are delighted to announce that Janko Gravner from UC Davis will present on how randomness and order can help us understand both nature and society. Two more sessions on recreational mathematics will follow Gravner's talk where we will all learn more about recreational mathematics, including artificial intelligence, optimization and math contests. The grand finale of the conference will be this year's Student Keynote presenter. If you have a student who may be interested in being this year's Tahoe Student

(see "Tahoe Conference" on p. 4)

Table of Contents

Executive Board & Special Committees

Volume 47, Number 1 Spring 2018

CMC³ Newsletter is the official newsletter of the California Mathematics Council, Community Colleges, and is published three times a year--in the spring, summer, and fall.

Mark Your Calendar:

46th Annual CMC³ Conference

December 7th and 8th, 2018

Hyatt Regency Monterey Hotel and Spa

What's Happening at Chabot College

Matt Davis

There have been many changes at Chabot College over the last few years. Long time full-time faculty members Marcia Kolb, Indrani Chaudhuri, and Cynthia Stubblebine have retired. Fortunately, we have been able to add to our full-time ranks as well. Christine Coreno, Kyle Ishibashi, Antonio Gonzalez, Najla Abrao, and Erin Kelly are currently going through the tenure process.

A few years ago, we completed the process of remodeling all of our math classrooms. We gained some terraced lecture halls, smart teacher stations and new projectors and screens in all classrooms, and several computer labs with the ability to close the computers up into the desk to create a better lecture environment when needed.

We have also been making some substantial changes to our curriculum. A few

years ago, we added a new option for students placing into Elementary Algebra. The new option was a 6-unit Applied Algebra and Data Analysis course. Students passing this course can then move on to take a transfer level Statistics course. For students placing into Elementary Algebra, this redesigned and accelerated pathway greatly increased their chances of completing a transfer level math course.

One of the drawbacks to this new option is that, if a student discovered a passion for mathematics along this journey or a Calculus

requirement for their ed goal, they would have to backtrack to the traditional Algebra pathway if they wished to continue to the STEM pathway. Over the past year, we have been working hard to remedy this issue.

Starting in the Spring 2018 semester, the Applied Algebra and Data Analysis course will become the common starting point for students placing at the Elementary Algebra level, regardless of whether they are headed on to statistics or up the STEM pathway. To make this work, adjustments have also been made to our Intermediate Algebra, Trig/Geometry, and PreCalculus courses to make sure that students coming from Applied Algebra will be ready for Calculus after these next three courses.

In addition to this new applied Algebra course, we have been making several adjustments to help our students advance through the curriculum in a more timely manner. We have introduced a greater use of multiple measures to help students start their math journeys with a higher initial placement using

their high school transcript. We have been holding Math Jams to help students maximize their placement or to get in some review to increase their chances in an upcoming course.

We have also been trying some other new innovative strategies for our students. In the last few semesters, we have been offering students the opportunity to take an 8-week PreCalc class followed by an 8-week Calculus class during a single semester. Following the success of that program, we have recently added an option for an 8-week Trig course followed by an 8-week PreCalc course.

Our newest efforts have been to offer a CoReq Statistics course that allows students placing one level below statistics to sign up for a CoReq version of Statistics where a workshop is attached to give just-in-time Algebra lessons. This new CoReq course is being taught for the first time this semester. We will soon be trying out this CoReq option for the College Algebra course in our Business Calculus pathway.

If you run into any Chabot faculty members in Monterey this December, feel free to ask for further details on our recent changes.

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.

Tahoe Conference

(continued from front cover page)

Speaker, please encourage them to apply. The committee will begin reviewing the applications on March 1. Students can apply online at: www.cmc3.org/conference/callForStudentProposal.html.

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. For more information, please contact your CMC^3 campus representative or Larry Green, Tahoe Conference Program Chair, at DrLarryGreen@gmail.com. For the latest information and details about the conference and for the registration form, please visit the CMC^3 website at www.cmc3.org.

Please consider putting one or two newsletters in the copy room for other instructors to read.

President's Report

Katia Fuchs, CMC³ President, City College of San Francisco

As my term as your CMC³ President-Elect comes to a close, I look back at the last two years and feel an overwhelming sense of gratitude. It has been a humbling experience to organize the last two Monterey conferences. I learned first hand the extent to which our speakers are dedicated to delivering insightful, informative, and innovative talks, and I was overwhelmed with the amount of support I received both from fellow CMC³ board members and the membership as a whole. The past two years have truly shown me that CMC³ is an important and vibrant organization whose goals are to inform and educate but also to foster a sense of community among mathematics instructors at local community colleges. I enter into my first year as CMC³ president excited to be a part of such a wonderful group of colleagues.

I'm excited to look ahead to the 2018 Monterey Conference. We will continue to work on streamlining the online registration process. We will also continue our partnership with the Hyatt Regency in Monterey; having the conference at the Hyatt has allowed us to have a central area to hold our sessions.

I would also like to encourage anyone reading this to consider speaking at the conference. Furthermore, if you know of someone you would like to see on the program, please encourage them to submit a proposal. The proposal form for the 2018 Monterey conference is already available at www.cmc3.org/conference/callForProposalsMonterey.html.

Our annual spring conference in Lake Tahoe is just around the corner! This is our 21st Tahoe conference, and we are excited to once again hold it on the beautiful campus of Lake Tahoe Community College. We changed the location of the conference last year after conducting a membership survey, and the change was such a positive one that we have decided to stick with it.

The spring conference is a "recreational" one because our speakers typically focus on topics outside of pedagogy. For example, this year our talk topics will include Geometry and Topology, Artificial Intelligence, more discussion on AB705, and Poker! I very much hope to see you there! While the program is complete for this year's conference, I would like to invite you to consider giving a talk next year. The proposal form is available at www.cmc3.org/conference/callForProposalsTahoe.html

Both our conferences give great opportunities for community college mathematics faculty to learn about what's happening in their profession and interact with colleagues from across the region. Of course, the fact that they are held in two of the most beautiful areas on the planet is not to be forgotten! Please come and join us this year in Tahoe and Monterey!

Math Nerd Musings: Showing I Care

Jay Lehmann, Newsletter Editor, College of San Mateo

In some ways, I don't get people. Seriously. There are things I assume are obvious that others don't assume. This can get me into trouble in all sorts of situations.

Take teaching. For the past 27 years, I've assumed that it's painfully obvious that I care about my students because I'm the instructor. I mean, who in their right mind would go to all the trouble of earning a master's degree in mathematics, working as an adjunct at multiple colleges while trying to sort out the art of teaching, and juggling the many responsibilities of a full-time instructor if you didn't care about students?

But really, the main point is that I've found a way to show students that I truly care.

Yet in some classes, I would click with students, in others, not so much. In classes that I really connected with students—often through humor—students were much more likely to respond to my suggestions about how to go about studying mathematics, including visiting my office to get help.

Three years ago, I attended a six-day training by CAP, which included facilitating affective domain activities that address the whole student. The activities inspire students to have grit, transform math anxiety into action, teach study skills, promote metacognition, foster a sense of belonging, and so on. In one of my favorites, "Broken Escalator," some people get stuck on an escalator, and instead of walking up the frozen stairs, they cry for help over and over: https://www.youtube.com/results?search_query=broken+escalator

After students watch the video, I have them consider four obstacles/challenges to learning (stuck on homework, lecture is confusing, car is broken, poor test performance) and have them describe how someone could respond as a victim and as a person who's proactive.

I started facilitating a couple of these activities early in the semester in my prestatistics classes, although it was difficult to assess if my students were being affected.

I had the nagging feeling that I needed to do more affective domain activities to see an impact. I was well aware that many instructors teaching prestatistics at other colleges were using the activities as frequently as every other week, but I'd been resisting this, assuming surely two activities would do the trick.

Finally, this semester, I've been making copious use of the activities. The impact on my students is palpable. The resonance of the class is high, and they are quite responsive to my requests. For example, attendance was starting to slack off. On a quiz day, when attendance was good, I said that they really needed to come to class every day—the kind of comment that would have had little or no impact in a typical lower math course. Yet attendance greatly improved the following week and has stayed consistently good.

Only after using quite a few of the activities did it hit me what was really going on. I'd thought that the point of the activities was to improve students' attitudes and behaviors around math. But really, the main point is that I've found a way to show students that I truly care.

2017 Monterey Conference Wrap-Up and Look Ahead

Katia Fuchs, President, City College of San Francisco

The 45th annual CMC3 Fall Conference was held on Friday December 8 and Saturday December 9, 2017, at the Hyatt Regency Monterey Hotel and Spa. The conference was wonderful, and we were happy to see 250 of you there! We continued to offer online registration and will continue to work to streamline that process as well as make updates to the website to ensure that it works smoothly for everyone.

The conference featured two keynote speakers, like the year before. Our Friday night keynote, Konstantinos Batygin of CalTech gave a talk about the elusive Planet 9. He spoke about indications that such a planet must exist based on the shapes of the orbits of the objects in its vicinity. Our Saturday Keynote, Brandy Wiegers of Central Washington Universoty, spoke about ways in which Mathematics and mathematical intuition can be powerful tools during disasters. Brandy's talk left us with many ideas for examples and discussion topics to use in our classrooms, appropriate for students of many levels. The regular sessions were very well attended, and we offered feedback forms for both the break-out sessions and the conference as a whole. The feedback was generally very positive, but we also received some constructive suggestions that we look forward to implementing in the future. We will continue using the feedback forms for next year.

This was our fifth conference at the Hyatt Regency, and like last year, all of our break-out sessions were held on the main level of the conference center. While the weather was beautiful, we were able to set up lunch indoors due to a smaller attendance. Lunch was generally very well received.

Like in years past, we offered a shuttle running from the Hyatt hotel to downtown Monterey on Saturday evening. With construction at the Portola completed, we resumed our former drop-off location, and scheduling issues from the year before were rectified resulting in smooth service. We hope to draw more attention to the shuttle service in future years.

Planning is already underway for next year's conference, which will take place December 7th and 8th 2018. I am excited to pass the torch of planning the conference to our illustrious new conference chair, Jennifer Carlin-Goldberg, and I am confident that we have quite a treat in store for us!

If you are even a little bit interested in speaking, or know someone who might be, please check out the speaker proposal form: www.cmc3.org/conference/callForProposalsMonterey.html!

Thank you for your continued support, and we hope to see you at our beautiful new location for the Tahoe Conference, Lake Tahoe Community College, on April 27-28, 2018!

What's Happening at College of San Mateo

Christopher Walker

AB 705: Just-In-Time Co-Requisite Courses

In response to the pending deadline for compliance with AB 705, the mathematics department here at College of San Mateo (CSM) has decided to accelerate our developmental course overhaul to begin in Fall 2018 (one year ahead of the deadline). We are currently in the process of redesigning our course sequence in the spirit of the highly successful co-requisite model at Cuyamaca College in Southern California.

Starting in Fall 2018, we are removing arithmetic, pre-algebra, and elementary algebra from our course offerings. In place of these courses, we will be placing students in either pre-statistics or intermediate algebra, both with additional units of support for under-prepared students (called a "+" course). The general theme in these "+" courses is to remediate students with a just-in-time approach. This means that the "+" course will still cover the required material in the course outline, but instructors will be afforded extra hours per week to identify and fill gaps in prerequisite knowledge for each unit. We are still intently working on what these just-in-time activities will look like, but we are clear that they will not just be more lecture. We have already formed working groups containing both full-time and part-time faculty to work on the curriculum of these new courses.

While this is a massive change in how we do things, we are excited about the possibility of real improvement in student success. If all goes well, we have a long term plan of implementing the "+" course options in some of our transfer level courses like statistics, precalculus, business calculus, and calculus.

Math Jam

This year, we have adopted the Math Jam program created by our sister school, Cañada College. The program is a one week, intensive math review designed to prepare students for the upcoming semester. We offer the Jam's three times a year; the week before fall, the week before spring, and the week before summer. Students are divided into groups with an instructor based on their class in the upcoming semester. They work on material in a self-paced manner, but with lots of support from instructors and tutors. As a reward at the end of the week, students are allowed to retake their assessment test to potentially place into a higher level. We have had close to 100 students attend each Jam.

The success of the program has actually prompted other departments on campus to join in! Last semester we held a Physics Jam, and there are plans to add a Biology Jam and Chemistry Jam to the rotation for the summer.

(see San Joaquin Delta College on p. 11)

A Recent Trip to India

Dean Gooch, Santa Rosa Junior College

Last fall semester, 2017, I took a trip to several parts of India to learn about the Indian traditions that shape our modern mathematical thinking. I visited universities, museums, historical sites and even visited a documents library. I had the pleasure of giving a talk and enjoyed attending two conferences.

I plan to write several articles about my trip and related topics. I hope to correctly represent the Indian perspective on its history and contributions to mathematics. The history of Indian mathematics is a very long and well documented one. It is not a history that is well known in the West.

A Book Review

I wish to begin with a review of what I think is a very important resource for Mathematical Indianologists. The author of this book is George Gheverghese Joseph. He previously authored the book, "The Crest and the Peacock: Non-European Roots of Mathematics." This

book is in its third edition and the publisher is Princeton University Press. This is a good read and the author is thoroughly entertaining and edifying.

The author has a tendency to be a little rancorous in his treatment of the subject. He is an excellent advocate for the importance of mathematics that comes to us from sources other than that of Europe. His unapologetic advocacy of non-European rooted mathematics is what makes this a very good book. Everyone should put this book on their short list of books to read. This is not the book I am here to review though.

While I was on the Connaught Circus shopping in New Delhi, I came upon a small but very good bookstore, Amrit Book Co. There I asked if they had any books on the history of Indian mathematics and the owner graciously brought out, "Indian Mathematics: Engaging with the World from Ancient to Modern Times," by George Ghevergese Joseph. I asked the price and was told that it was 995. This price is in Indian rupees and is the equivalent of less than $16 US. The price and the author intrigued me and I bought the book. Books are highly subsidized by the Indian government to increase the erudition of its population. The paperback version of this book is about $50 and the hard bound version is about $100 in the US. This book is published by World Scientific Press.

The author, Joseph, does not disappoint the reader at all. This book is a tome that is very easy to read. Joseph's book begins with the very earliest of the known civilizations in the Indus Valley and the archeological evidence for an early sophisticated culture there that had a standard system of weights and measures extending from modern-day Pakistan to as far south as the Gujarati Desert State of India. This has become known as the Harappan civilization and can be traced to at least 3500 years ago.

Joseph also explains the Vedic traditions beginning in about 500 BCE. The Vedic period was the antecedent of the Jain and Buddhist periods. These were followed by what is classified as the Classical Period of Indian mathematics starting about 50 CE and later followed by the Kerala period in about 1100 CE. The author does not hesitate to explain the controversies about these and other timelines and gives his best guess about the actual consensus when there is one.

Joseph explains that much of India's ancient mathematical writings were incorporated in religious writings. Many of these writings were in poetry form. Original mathematical problems and explanations incorporated in religious writings were later quoted in texts and commentaries written about these earlier texts. Further commentaries were then made on the commentaries and so on.

As different conquerers ruled India, these mathematical documents were protected and maintained. Joseph comments a little about how Indian mathematics was affected by these changes in rule. A discussion of the how British rule changed the teaching traditions in India is also discussed.

At the end of the book, Joseph includes the contributions of modern Indian mathematicians such as Srinivasa Ramanujan. Mathematics is still an important part of Indian education and Indian mathematicians continue to make important contributions of the world of mathematics.

George Ghevergese Joseph is a very good writer, and I enjoyed this book so much that there were times that I could not put it down. "Indian Mathematics" is a wonderful chronicle of the subject. Joseph's writing is not as angry and preachy as it is in his "The Crest and the Peacock." Although, I enjoyed the vehemence of "The Crest and the Peacock," I think that Joseph's writing in "Indian Mathematics" works better for this book.

As with all mathematics books, there are errors in this book that any writer of mathematics, including test writers, are all too familiar. The book could use more editing and I think that this is happening since I have found a list of errata online.

I noticed one error that the author makes in combinatorics. It is minor and anyone familiar with combinatorics would find the actual solution quickly. The accompanying solution translated from ancient texts does explain how to find the answer, but not everyone would realize this unless they had worked on these kinds of problems before.

Overall, "Indian Mathematics: Engaging with the World from Ancient to Modern Times," by George Ghevergese Joseph is a wonderful read. The problems presented and explained would be a good addition to anyone's problem toolbox. If you love mathematics history or just love mathematics, this book is a must read.

The Pleasures of Problems

Kevin Olwell, San Joaquin Delta

Spring 2018: If $g(x)$ is a non-negative, real-valued function defined on the real line, then every solution of the following ODE is bounded:

$$y + y'' = -x\, g(x) y'.$$

Fall 2017: A triangle with vertices at $A = (0,0)$, $B = (3,0)$ and $C = (3,4)$ is rotated about A until C lies on the positive y axis. Find the area of the region R formed by the intersection of the original triangle and the rotated triangle.

Solutions were submitted by Fred Teti, Carlos Valencia and Joe Conrad.

Since the right angle of the rotated triangle lies inside the original triangle, R is also a right triangle. Let θ be the angle between the base of the rotated triangle and side AC of the original triangle. Then the area of R is

$$|R| = \frac{1}{2} \cdot 3 \cdot 3 \tan\theta.$$

The angle of rotation, α, is the angle from side AC of the original triangle to the positive y axis. It is also the angle from the positive x axis to the base of the rotated triangle.

$$\frac{\pi}{2} = \theta + 2\alpha.$$

Notice that α is the angle ACB in the original triangle so $\tan\alpha = 3/4$. Trig identities yield

$$\tan\theta = \frac{7}{24} \quad \rightarrow \quad |R| = \frac{21}{16}.$$

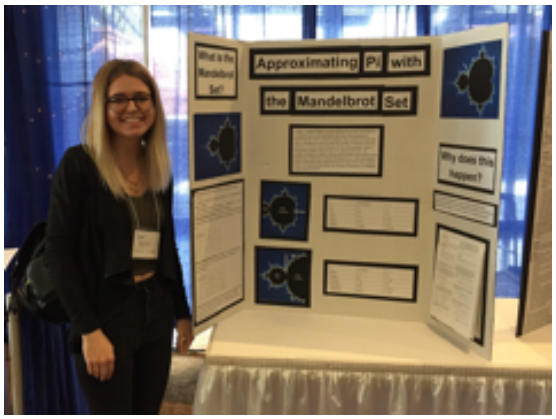
All are invited to submit a solution to the Spring 2018 problem either via email or US mail at the address below.

Kevin Olwell
San Joaquin Delta Community College
Agriculture, Science and Math Division
5151 Pacific Avenue
Stockton, CA 95207
kolwell@deltacollege.edu

CMC^3 Foundation Report

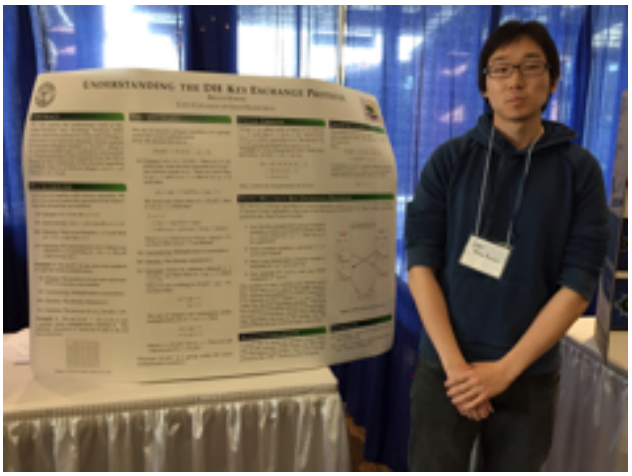
James Sullivan, Foundation President, Sierra College

The CMC^3 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. For the 2017 Monterey Conference, the Foundation Board set a fundraising goal of $3,000. We are delighted to report that we achieved our goal. A total of $3,100 was raised for the CMC^3 Foundation Scholarship Fund through the purchase of conference merchandise (t-shirts, hats, and sweatshirts), participation in



the foundation raffle, and direct cash donations by Monterey conference attendees. The CMC^3 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 our generous members whose donations make the monetary awards for these programs possible.

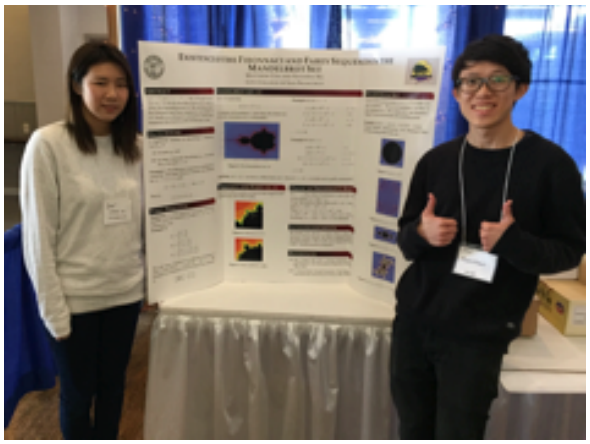
The Student Poster Contest takes place during the Annual Fall Conference in Monterey. The winner of the 2017 Student Poster Contest



was Kelci Fernandez from Santa Rosa Junior College. She was awarded a $350 scholarship for her poster "Approximating Pi with the Mandelbrot Set". John Martin of Santa Rosa Junior College was Kelci's faculty sponsor. Three Student Poster Contest entries received runner-up recognition. Devin Serna and James Plain from Bakersfield College shared a $250 scholarship for their poster "New Heuristics for Pokémon GO". They developed a better mathematical model for determining optimal move-sets for attackers and single number heuristics for the augmented reality game Pokémon GO. Their faculty sponsor was Jonathan Brown of Bakersfield College. Ming Cen and San Kong Ng from City College of San

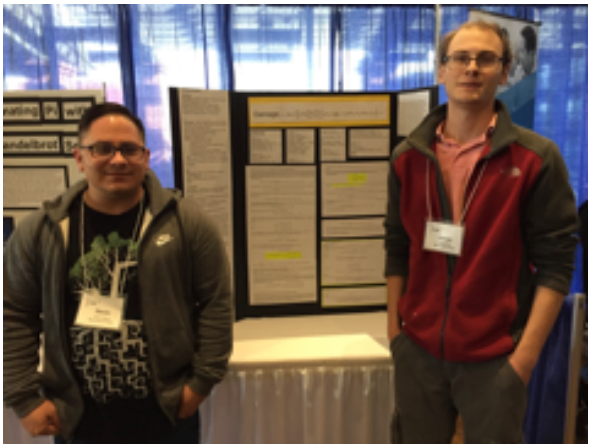
Francisco shared a $250 scholarship for their poster "Existence of Fibonacci and Farey sequences in the Mandelbrot Set". Brian Kwon also from City College of San Francisco was awarded a $250 scholarship for his poster "Understanding the Diffie-Hellman Key Exchange Protocol". He presented the mathematics behind a protocol which allows two parties to create and exchange a secret key over insecure channels. Ekaterina Fuchs was the faculty sponsor for both of the Student Poster Contest entries from the City College of San Francisco. The Foundation Board offers its congratulations to the 2017 Student Poster Contest award recipients and appreciation to their faculty sponsors for contributing to the success of the Student Poster Contest. We would also like to acknowledge the significant contributions Jennifer Carlin-Goldberg and Tracey Jackson of Santa Rosa Junior College have made to improving and enhancing the CMC³ Student Poster Contest.

The Student Speaker Award recipient will be recognized at the Annual Spring Recreational



Mathematics Conference held at Lake Tahoe Community College on April 22, 2018. Students interested in submitting a proposal for the Student Speaker Award must complete the online form at http://www.cmc3.org/conference/callForStudentProposal.html by February 28, 2018.

The CMC³ Foundation is pleased to announce the offering of $6,000 in total scholarship funds available to qualified and deserving mathematics students. We encourage you to share this scholarship opportunity with worthy students. Students eligible for nomination



must have successfully completed a minimum of 30 college units, including at least 8 units at a CMC³ member college, are currently enrolled in a minimum of 6 units at a CMC³ member college, and have completed at least one mathematics course at the level of second semester engineering calculus or higher. Application packets must be completed and submitted by April 1, 2018. Application materials and instructions are available for download on the CMC³ Foundation webpage http://www.cmc3.org/foundation.html .

CMC³ 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 the "Donate" button on the CMC³ Foundation webpage or by mailing a check to Leslie Banta, CMC³ Treasurer, Mendocino Community College, 1000 Hensley Creek Rd, Ukiah, CA 95482.

Statistics is Not Mathematics

J. B. Thoo, Yuba College, jthoo@yccd.edu

[This is a personal opinion. This opinion does not necessarily represent the views of the Yuba College Department of Mathematics and Statistics or any group or any person in particular. I hope to receive your thoughtful reactions, and perhaps you may send them to this newsletter.]

Got math?

1. Archimedes (ca. 287–212 BC) is claimed by mathematicians and by physicists. He is certainly known to us as perhaps the greatest mathematician of antiquity. In physics, he is credited with establishing the fields of statics and hydrostatics.

   Is physics mathematics?

2. Ada Lovelace (1815–1852), Alan Turing (1912-1954), and John von Neumann (1903–1957) are considered to be among the pioneers of computer science. They are all also eminent mathematicians.

   Is computer science mathematics?

3. Statistics grew out of probability theory, and so the earliest to study the subject were mathematicians: Cardano (1501–1576), Fermat (1607–1665), and Pascal (1623–1662), to name but three.

   Is statistics mathematics?

I believe that statistics is not mathematics any more than physics or computer science is mathematics. I have already alluded to why I think this is so. Others hold this opinion as well. Listen, for example, to John W. Tukey (1915–2000):[1]

> Statistics is a science in my opinion, and it is no more a branch of mathematics than are physics, chemistry and economics; for if its methods fail the test of experience—not the test of logic—they are discarded.

So, while statistics has its roots in mathematics, and much of it does rest on mathematics (notably probability, but also measure theory and so on), statistics, like physics and computer science, has matured as a subject to become a separate discipline in its own right. Yes, there are departments of mathematics and statistics (for example, at San Jose State University), but there are also departments of mathematics and computer science (for example, at Santa Clara University) and separate departments of statistics (for example, at UC Berkeley). Moreover, colleges that have departments of mathematics and statistics often offer separate undergraduate majors in statistics or separate graduate degrees in statistics; that is to say, statistics is not always offered as a concentration under mathematics. In addition, the statistics community has its own professional organizations such as the American Statistical Association[2] and the Institute of Mathematical Statistics[3] that are distinct from the mathematics professional organizations such as the AMS, MAA, and AMATYC. These facts strongly suggest that we ought to treat statistics as its own discipline and not as mathematics, just as we do physics and computer science.

A proposal

The CCC should define a specific minimum qualification (MQ) to teach statistics, just as physics and computer science each has its own specific MQ.[4] Currently, anyone who meets the mathematics MQ is qualified to teach statistics.[5]

[1] Quoted from https://www.stat.berkeley.edu/~brill/Papers/life.pdf. According to this paper, Tukey was a "chemist, topologist, educator, consultant, information scientist, researcher, statistician, data analyst, [and] executive."

[2] http://www.amstat.org

[3] http://imstat.org

[4] http://californiacommunitycolleges.cccco.edu/Portals/0/Reports/2017-Minimum-Qualifications-Handbook-r1-ADA.pdf

[5] At least a statistics course that corresponds to C-ID Math

Mathematics MQ:

Master's in mathematics or applied mathematics

OR

Bachelor's in either of the above AND Master's in statistics, physics or mathematics education

OR

the equivalent.

Along these lines, I propose the following MQ for statistics, understanding that I am not a statistician, nor have I ever taught statistics, and that this would be better defined by statisticians.

Statistics MQ:

Master's degree in statistics

OR

at least eight semester-units in undergraduate upper-division or graduate degree coursework in statistics AND Master's in mathematics or applied mathematics or mathematics education

OR

the equivalent.

Of course, anyone who currently teaches statistics would be grandfathered and allowed to continue to teach statistics, but anyone who does not currently teach statistics should meet the statistics MQ.

Defining a separate MQ for statistics would not only recognize statistics as its own discipline, but it would also provide for better instruction in statistics, as well as encourage the development of other CCC statistics courses in addition to the single introductory statistics course that is now commonly offered. I think that its time has come.

Thank you.

110 Introduction to Statistics; but what is the MQ to teach a statistics course that corresponds to C-ID SOCI 125 Introduction to Statistics in Sociology, for example?

Math and Quantitative Reasoning Task Force

Leslie Banta, Mendocino College

Last Fall, the ASCCC reached out to CMC^3 and CMC^3-South to participate in a Math and Quantitative Reasoning Task Force formed to address the changes community college math departments will be facing as a result of the passage of AB705. The task force is co-chaired by Ginni May, math faculty at Sacramento City College and ASCCC Area A representative and Leslie Banta, math faculty at Mendocino College and CMC^3 Treasurer. Also representing CMC^3 are Katia Fuchs (SF City College and CMC^3 President), Mark Harbison (Sacramento City College), and Wade Ellis (West Valley College, retired).

The task force is formally charged with the following:

- Research the various and diverse perspectives on appropriate content for math/quantitative reasoning education for non-STEM majors;
- Develop recommendations on math/QR standards for non-STEM majors;
- Develop a plan for how to provide opportunities for more students to consider STEM fields (since the United States is producing fewer and fewer STEM graduates, especially in groups that are disproportionately impacted);
- Provide a report to the ASCCC, CMC^3, and others, such as the California Community Colleges Chancellor's Office and Board of Governors, to consider that includes the research results and recommendations; and

(see "Task Force" on p. 17)

Through the History Glass

J. B. Thoo, Yuba College, jthoo@yccd.edu

For those of us who are blessed to have the opportunity to teach about different number systems, it is common for us to introduce the Babylonian, Egyptian, Roman, Mayan, and maybe also the Chinese number systems. Seldom, I would bet, do we say anything about the number systems of native North Americans. Yet, according to Eells [1], "The linguistic diversity of the Indians inhabiting the North American continent is one of the most remarkable features of world ethnology.... These languages differ as widely in *number words* and *number systems* as they do in other features. This is in marked contrast with the languages of the great Indo-European family...." We give a brief survey of the number systems of native North Americans. (All of the examples in this column are taken from [1], which you should see for a fuller account.)

It has been found to be quite common for numbers from 1 to 10 to be counted on the fingers in sequence, beginning with the little finger of one hand and progressing to the little finger of the other hand. Examples for the numbers 1, 2, 5, 6, 7, and 10 are given in the table below.

	Native American translation
1	"very small" (Massachusetts), "end is bent" (Montagnais)
2	"another bent in" (Montagnais), "that (finger) put down with its like" (Zuni)
5	"gone," "spent" (Ojibwa), "completely turned down" (Hidatsa), "hand" (Comanche)
6	"once-on next- (and) five" (Point Barrow), "hand and piece of next" (Tano), "one I have bent over" (Klamath)
7	"to point" (the index finger; Zuni), "on the other hand-two" (Greenland)
10	"little finger" (Hudson), "all of the fingers" (Zuni), "two hand" (Wintun), "hand double" (Konkau)

There is evidence of the use of the **additive principle** in forming some numbers. For example, the Coahuiltecan have 1, *pil*, 2, *ajtic*, and 3, *ajtic-pil*; that is, $3 = 2 + 1$. Within the Maidu, we find 16, "one with man," 17, "two with man," and so on until 20, "man"; the idea is that 16 is "15 and one more toward entire man," and so on until "man." Less used is the **subtractive principle**; for example, 14, "I have not quite fifteen" (Point Barrow), 19, "twenty less one" (Alaska), and 39, "forty, one not" (Kulanapo). Some tribes also expressed certain numbers as "two less," "three less," or "ten less."

Eells [1] tells us that a "striking feature of the Indian numeral systems is the frequency of occurrence of a **duplicative** or **pairing principle**" [my emphasis], where the numbers 4, 6, 8, 10, and even 12 are expressed as doubles; for instance, $6 = 2 \times 3$. According to Eells, "The large number of natural pairs, such as the eyes, hands, arms, wings, etc., suggests that counting by pairs might be the course of evolution followed by some languages." Besides the duplicative principle, more generally the **multiplicative principle** is found to be used. Very rarely, however, was evidence found of the use of the **divisive principle**. The few examples found include 10, "upper half of the body" (Unalit) and 5, "hands half" (that is, "half of the two hands"; Pawnee).

Eells informs us that although we can find many tribes that counted into the thousands and even millions, very few had any notion of fractions. Indeed, Eells says, "It is worth mentioning that the few instances we find are all of 'unit fractions.' Onondaga shows the best development of fractions, but how meager for a language whose numerals are given to one million. Its fractions are: $\frac{1}{2}$ ... uncertain; $\frac{1}{3}$ ... 'thrice divided'; $\frac{1}{4}$ ... 'four times divided.'"

Of the numeration systems that have been found to be in use is, most familiar to us, the **decimal system**, but generally not consistently. For example, Eells points out that "we find 'one hundred' expressed by a unique word or by such forms as 'completed,' 'stock of tens,' '10×10'; 'thousand' by '$10 \times 10 \times 10$,' '10×100,' 'big hundred,' 'old man hundred,' 'large stock of tens'; 'million' by '$1,000 \times 1,000$,' 'big thousand,' 'too many to count.'" However, Eells goes on to say, "While there are many variations, intermediate numbers as a rule are formed as in English." Other numeration systems that have been found to be in use include the **quinary system**, **quinary-decimal system**, **vigesimal**, **quinary-vigesimal**, **decimal-vigesimal**, **quinary-decimal-vigesimal**, **quaternary**, **ternary**, and **octonary** sytems, and traces of yet other systems, such as binary, sexanary, base of nine, base of forty, and base of sixty.

Finally, it is a common view that the vigesimal system is found among peoples living in tropical and hot climates because they go about barefoot; however, Eells points out that the fullest development of the vigesimal system north of Mexico is found among the Eskimo!

———————◇———————

Previous columns are on the Web at <http://ms.yccd.edu/history-glass.aspx>. Thoo is coauthor with Amy Shell-Gellasch of *Algebra in Context: Introductory Algebra from Origins to Applications*, Johns Hopkins University Press, Baltimore (2015), that presents introductory algebra using history as the vehicle.

References

[1] W. C. Eells, "Number systems of the North American Indians," *Amer. Math. Monthly* 20 (1913), in *Sherlock Homes in Babylon and Other Tales of Mathematical History*, eds. Marlow Anderson, Victor Katz, and Robin Wilson, The Mathematical Association of America, Washington, D.C. (2004), pp. 83–93.

[2] Karl Menninger, *Number Words and Number Symbols: A Cultural History of Numbers*, Dover Publications, Inc., New York (2014).

Task Force

(continued from p. 15)

- Request a response from ASCCC, CMC[3], and other stakeholders.

With these goals in mind, the task force has had several meetings to develop recommendations for math and quantitative reasoning pathways for non-STEM majors. The first set of recommendations, designed to address short-term goals, will be presented to the Academic Senate at their March meeting and for discussion at the plenary in April.

These recommendations will address math pathways that include a traditional STEM sequence as well as statistics and QR pathways that meet the 1-year to transfer-level requirement established by AB705 and meet the needs of students who do not have a transfer goal; changes to C-ID descriptor formats that will be needed to implement pathway courses; the need for students to be able to have access to remediation opportunities outside of acceleration and co-requisite models, where appropriate; and the need for professional development for community college math faculty – both full-time and adjunct – that is designed by faculty to address the instructional strategies needed for the paradigm shift that AB705 requires.

Minutes from the task force meetings can be found at https://www.asccc.org/directory/math-and-quantitative-reasoning-task-force.

Bull: Bundle with care

Ken Bull
College of San Mateo

That deliberately obscure title refers to a presentation at the recent AMATYC conference in San Diego. The presentation, entitled *A Case Study of Departmental Change*, by Chris Rasmussen of San Diego State University, was an account of how the mathematics department at SDSU had made significant changes in the structure of the teaching of Precalculus through Calculus II. An account of their experience can also be found in Apkarian et. al. (2018).

The story

Some of the members of the department had been involved in a large study of the teaching of Calculus I; see Rasmussen and Ellis (2015) and Rasmussen et. al (2014). From that study they concluded that for PhD granting institutions there were seven elements that appeared strongly associated with successful Calculus I instruction. These were:

- Collection and use of local data to guide decisions about programs.
- Effective placement procedures.
- Coordination of instruction amongst sections by using the same text, syllabus and assessments and also having active course coordinators.
- Course content that challenges and engages students.
- Student centered pedagogy, including active learning.
- Teaching development programs for teaching assistants.
- Pro-active student support services, such as tutoring centers.

At San Diego State, all of these elements were either lacking or deficient; the surprising thing is that the department decided and ultimately managed to implement changes that involved *all* of the elements. In their words: "...we changed *everything*", and hence the word "bundle" in the title. The implication from the research and their decision to "change everything" is that it is the interaction of all of these factors that makes for calculus success. Rasmussen, in the presentaion, emphasized the importance of the bundle of changes in this way:

> If we were to choose a single guiding principle for our process it would be taking a holistic approach. While daunting, it meant that all initiatives could be designed to work together from the beginning, ensuring greater coherence and that the changes were distributed and shared across levels, which required communication between many different people.

Implementing all of these is no mean feat, and if they are successful in the long run, they may be said to have changed the culture of their department. So, it is important to see how they made these changes, and indeed, a large part of Rasmussen's presentation was devoted to the way the changes came about, and the lessons learned. That will be the focus on this report as well. The short answer to "how did they do it" is that they implemented the bundle of changes "with care".

. . . with care

We might have substituted the word "collegiality" for care, for a large part of the carefulness had to do with collegiality. First of all, they appear to have had a small group from within the department that initiated the effort, and this group "...prepared proposals for consideration by the department leading to open debate and discus-

sion." So efforts were made to heighten buy-in by the department as a whole with clear, consistent and transparent commuication amongst members of the faculty, as well as between faculty and administrators. At SDSU, course coordination also involves weekly meetings of the course coordinator, instructors and TAs to discuss "course content, pacing, assessment instructional approaches, as well as any emergent concerns.". Another feature of the implementation at SDSU was a high level of adminstrative suppport. One got the impression from the presentation that sometimes there was fortuitous adminstrative support as well as support sought after. At just the time the changes were being made, there was a supportive departmental chair, several grants given to the depatment for innovation that allowed smaller section sizes for TAs, for example, and building a tutoring center – opportunities that the small group made use of. They were able to take advantage of new faculty hires who were open to the changes being mounted. The initiative for the changes came from within the department, and there was support from the university administrative structure.

Bull's reading of the papers and the presentation is that, on top of careful planning and administrative support, much attention was paid to one part of academic culture that potentially resists the kinds of changes they were making: we call that trait *teacher sovereignty*.

Sovereignty in the classroom

The idea of teacher sovereignty is: "Instructors are the monarchs of their classes". Instructors are not completely sovereign, of course, but they may regard themselves as such. The culture says that the instructor should be able to control most everything that happens in class. And therefore, using a common text, common final exam and a common syllabus can be seen as a threat to that soverignty, sometimes phrased as a threat to academic freedom. At SDSU as well as at the successful research institutions the sovereignty was countered by pursuing what Rasmussen called "coordinated independence". As an illustration, Rasmussen referrred to the way in which jazz musicians fit in with what is being performed, but at the same time doing their own thing. Elements of coordinated independence appear to be: (a) a defined structure, (b) effective communication and (c) (in the teaching environment) "pedagogical autonomy". How coordinated independence can work out in particular departments is probably the main question raised by the presentation. A few illustations were given in the presentation, primarily from the research into successful Calculus I programs. Here is one further illustration of the way coordinated independence may work.

Shooting the bull, or . . .

While in the midst of writing this, the retired Bull visited his old colleagues at College of San Mateo, and had a conversation with two colleagues teaching the same course and using the same text. The course in this instance was pre-stats. The conversation was about an activity that one of them (H) had used to introduce the course in the first week of the term, and planned to use again later in the course. The activity – unquestionably an instance of active learning – can be said to embody and illustrate the goals of the course; that is one reason H used it early on, and one reason he will re-use it (in perhaps modified form) later in the course. H also intended the activity to introduce aspects of "course culture": expectations surrounding group work, and the relationship between the instructor and

student. The other colleague (J) had not used this activity, though he was aware of it, and part of the conversation turned to whether what J was doing in the first week or so of the course was likely to attain the same goals as the attractive activity that H had used. J had used other active learning strategies. Of course, the conversation did not come to a definite conclusion, but it was an instance of the kind of conversations that should be happening amongst colleagues all the time (and one hopes, at the coordination meetings at SDSU). Let us add that J has taken on the role of "lead" for this pre-stats course, and is organizing meetings (a planned face-to-face gathering as well as electronic communication) built around "coordinating" how the course is taught. In rough form, this little story illustates something of a defined structure, communication, and at the same time, "pedagogical autonomy".

The question remains of whether the kind of change seen at SDSU is able to be implemented at community colleges, generally. The application is likely to be different, but why and how is it likely to be different? What are the challenges?

Make it so? Part 1

The meeting described above was completely unplanned; H had his office door open for student office hours, and J had just returned from a good class session, and Bull was just visiting. At SDSU the weekly communication between coordinators, instructors and TAs was built in to the structure of coordination. At many community colleges, the logistics of weekly face-to-face meetings, especially where adjunct faculty or faculty at satallite campuses are involved, will be formidable. So the structure of course coordination would probably look different, with possibly less frequent face-to-face meetings, and much more done via e-mail, and other electronic means.

Course coordination at community colleges will potentially involve proportionately more faculty who are accustomed to traditional sovereignty as instructors. At SDSU, for the courses involved (Precalculus, and Calculus I and II), there are large lecture sessions handled by two to four lecturers or tenured faculty, and then many break-out sections of thirty or so students primarily handled by TAs, although some of the lecturers also have break-out sessions. It is in the break-out sessions that the innovations in active learning were made. So, for the most part, these innovations were done by TAs. However, TAs can easily be seen and see themselves as apprentices, and thus open to training sessions and innovations. In a typical community college each section of 30 - 40 students is headed by a "sovereign" instructor, who does . . . by tradition, at least, everything. In some colleges, there may be just a small number of instructors involved, but where there are many, there is the potential for more more push-back to coordination.

Make it so? Part 2

The section just above listed some challenges to coodination and innovation that stem from the structure of community colleges. On the other hand, the kind of interaction that happens in the kind of meeting described above between H, J and Bull should be what what instructors thrive on, and even amongst those with much experience. After all, community college instructors are meant to be experts at pedagogy! Moreover, adjunct instructors often welcome shared work, such as making exams, where the major initial work is done by a colleague, as long as they are given a chance to have a say. That kind of shared work frees

adjunct faculty either of the job of creating something new (a new test, for example), or more likely, modifying something from another course or campus. Much depends upon the right kind of communication. We are helped these days by technology that has made non-face-to-face communication easier, and acccess to common resources easier.

The way in which coordination and innovation is handled will necessarily vary greatly amongst colleges. (There were many differences in the ways the elements of the bundle were implemented at the research institutions Rasmussen and his colleagues studied; see Ellis et. al. (2015)). Much depends upon the wisdom and enthusiam of those taking on the role of course coordinators. With the right degree of structure, and the right kind of freedom (pedagogical autonomy), and, above all, lots of communication, it may just work.

References

[1] Apkarian, N., Bowers, J., O'Sullivan, M. E. and Rasmussen, C., (2018), "A Case Study of Change in the Teaching and Learning of Precalculus to Calculus 2: What We're Doing With What We Have", *PRIMUS*.

[2] Ellis, J., Hanson, K., Nuñez, G. and Rasmussen, C. (2015), "Beyond Plug and Chug: An Analysis of Calculus I Homework", *International Journal of Research in Undergraduate Mathematics Education*, 1: 268 - 287.

[3] Rasmussen, C. and Ellis, J. (2015), "Calculus coordination at PhD-granting universities: More than just using the same syllabus, textbook and final exam." In Bressoud, D., Mesa, V. and Rasmussen, C. (eds), *Insights and Recommendations from the MAA National Study of College Calculus* (107 - 116) Washington, D.C.: Mathematical Association of America

[4] Rasmussen, C., Ellis, J., Zazkis, D. and Bressoud, D, (2014), "Features of Successful Calculus Programs at Five Doctoral Degree Granting Institutions" in Nicol, C., Oesterle, S., Liljedahl, P. and Allen, D. (eds.), *Proceedngs of the Joint Meeting of PME 38 and PME-NA 36*, Vancouver, British Columbia.

Calendar

March 3, 2018: Sacramento Valley Community College Math Conference, Yuba College. Website: https://ms.yccd.edu/sacvalleyccm.aspx.

March 2—3, 2018: CMC^3 South Conference, Kellogg West Conference Center & Hotel. Contact: Cheryl Vallejo, e-mail: vallejocheryl@hotmail.com

March 15–18, 2018: ICTCM 28th Conference, Washington, DC. http://www.pearsoned.com/events-and-webinars/ictcm/

April 13—15, 2018: 51st Annual NYSMATYC Conference, Glens Falls, NY. Contact: Phil Loud. Website: www.nysmatyc.org

April 27—28, 2018: 21st Annual Recreational Mathematics Conference, Lake Tahoe Community College. Contact Larry Green (530) 541-4660 ext. 341, drlarrygreen@gmail.com

November 15–18, 2018: AMATYC Conference, Orlando, FL. Website: https://amatyc.site-ym.com/?2018ConfHome.

November 30—December 2, 2018: CMC North Conference, Student Voice: Let's Hear It!, Pacific Grove, CA. Website: http://cmc-math.org/cmc-north/

December 7–8, 2018: CMC^3 45th Annual Conference, Hyatt Regency Monterey Hotel and Spa, Monterey, CA. Contact Jen Carlin-Goldberg, Santa Rosa Junior College (707) 527-4746, jcarlingoldberg@santarosa.edu

Jay Lehmann
Editor
CMC^3 Newsletter
MathNerdJay@aol.com