California Mathematics Council Community Colleges

President's Message

Mark Harbison, Sacramento City College

This is your last chance to nominate yourself or someone else for the upcoming CMC^3 Election: the ballots will be sent late this Summer. I've said it before and I'll say it again: people on the CMC^3 board are people **just like you** who are interested in improving math and statistics education for CA community college students.

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There will also be important appointed positions next January, even if you are not an elected officer. Please contact any board member for more details.

Please read about the Travel Grants program in this newsletter. It's a new opportunity to recruit new membership: 1 person from each of the 57 CCs in Northern CA is eligible for the 2016 Monterey conference to get free registration, membership and half of a hotel room 1 night.

But that's not all! The CMC^3 board is so excited about recruiting new members that it is also giving all first-time-attendees half price registration. This is the same discount that has always been given to part-time instructors and was given to retirees in 2014. (Sorry that the discounts do not 'add up' if you are more than 1 category at a time. Even a retired part-timer who is new to the conference. gets just the half-price rate).

Also, the annual membership dues have been dropped from $ 35 to only $ 10. Is that amazing? How often do you hear of prices decreasing like that? For those loyal members of CMC^3 who have dutifully sent in $ 35 / year for a long time who may be disappointed that they don't get to support CMC^3 as much as they used to, your $ 90 for 3 years is now actually good for 9 years. Or you could send in $ 80 for 8 years. Or pay $ 200 for 20 years. All multiples of 10 are welcome. No worries.

(see "President's Message" on p. 2)

Executive Board & Special Committees

Volume 44, Number 2 Summer 2015

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.

President's Message

(continued from front p. 1)

This ought to make membership easier for those who join during the Spring for the first time who only get half of a year of membership instead of a full year. It should make people happy where colleges reimburse for registration but not for membership. And it just seems like the friendly, nice thing to do.

Another good article to read in this newsletter is the Poll Results. Many thanks to the representatives from 71 community colleges in CA who participated in the Poll. I couldn't have gathered the data without you.

Finally, the 5-question quiz on page 8 is another tribute that I wrote to celebrate the history of CMC³. The answers are on page 20 of this Newsletter.

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

2015 Monterey Conference Announcement

Joe Conrad, President Elect, Solano Community College

The 43rd CMC3 Fall Conference will be held this year on Friday December 11 and Saturday December 12 at the Hyatt Regency Monterey Hotel and Spa. We are looking forward to the conference and are planning another great program! At this point, we still have many details to work out, but much has been determined even now.

Last year we returned to the Hyatt and attendees again enjoyed having all the talks in one area and the quality of the food. This year all the talks will be held upstairs in the conference center rather than the basement. This will allow larger session rooms while still keeping us together. Over 100 people took advantage of the free continuously running shuttle to downtown over the course of the weekend and we plan to have it back this year. Our room rate will start at $130 per night with free parking and wifi. Reservations can be made even now at https://resweb.passkey.com/go/2015CMC3. For more details about the hotel you can go to its website at: http://monterey.hyatt.com/en/hotel/home.html.

On Friday night we will be having an Ignite! session in lieu of a keynote. We did this two years ago and it was an enjoyable way to start the conference. For those of you who missed it or have never experienced an Ignite! program, it consists of ten or so speakers who each have five minutes to present their talk. They use PowerPoint slides that advance automatically which adds to the excitement. If you would like to be a presenter, please contact Larry Green at drLarryGreen@gmail.com. Saturday's lunch keynote speaker will be Erica Flappan from Pomona College. Her title is "How I Developed My Teaching Style." In addition to being a noted mathematician, Erica has won teaching awards locally and nationally including the MAA's Haimo Award and is eager to share with us her journey as a teacher.

Saturday will feature our usual lineup of talks spread over six threads. We still have many openings for speakers and would love to have our own members present, so if you are interested in giving a talk in any area of community college mathematics, from basic skills, to statistics, to calculus, to methods or innovations in teaching, please submit a proposal on the website at: http://www.cmc3.org/conference/callForProposalsMonterey.html. We especially need talks for the pre-calculus or above thread and would also appreciate hearing about your experiences with acceleration to statistics courses.

One other thing to keep in mind is the student poster session. Please encourage your students early this fall to develop a poster for presentation at the conference.

As we work on finalizing details, the latest will be posted on the conference website at http://www.cmc3.org/conference/Monterey15/Monterey15.html. We expect the conference registration form will be posted before the end of the summer.

We look forward to seeing you in Monterey for another fabulous fall conference!

Another Great Conference at Lake Tahoe

By Larry Green, Lake Tahoe Community College

This spring's 19th annual recreational math conference in Lake Tahoe was another outstanding success. Unlike last year, the weather treated us well and everyone easily arrived without snow chains.

The staff at MontBleu was once again welcoming making sure out time there was packed with recreational mathematics and wonderful people. We participated in the Friday evening and Saturday all day program by learning about the cool things that can be done with mathematics. The conference began with Michael McGinnis showing us his pleasantly pleasing parapsychological Perplexus Puzzles. Some of these puzzles were as large as those attempting to solve them and all of them had nearly infinite possible paths.

Immediately after the keynote talk, we went to the suite at the top of MontBleu for the second annual CMC^3 Foundation Gala. The quality food and drinks were only rivaled by the amazing CMC^3 math faculty and friends and family who came to support the Foundation. The proceeds from the CMC^3 Foundation Gala were put directly into the CMC^3 scholarship fund to give to our best math students.

On Saturday morning, we returned to attend presentations on mathematics of Happy Meals, Rover and Fido, and curves, patterns and puzzles. After lunch, the keynote was given by Frank Farris who showed us how to surf the waves of wallpaper groups. Farris's keynote was followed by another round of mathematical appetizers. This included math competitions, mathematic awareness and other math tidbits.

The climax of the conference was orchestrated by our honored student JoeAnna McDonald from Sacramento City College. JoeAnna taught us all about elliptic curves and how they are used to build some of the most complex cryptographic codes around. So next time we use Internet banking we can thank elliptic curves for keeping our data secure. We have the generosity of Debra Landre, the leadership of the CMC^3 Foundation president Debbie Van Sickle, and the hard work from the rest of the CMC^3 Foundation for making the student speaker scholarship a reality. I also want to give special thanks to Mark Harbison who recruited all of the conference speakers.

Mark your calendars for the twentieth annual CMC^3 recreational math conference at Tahoe in 2016. If you have a recreational talk to give at next year's Tahoe conference please submit a talk proposal using the CMC^3 Tahoe call for proposals web form at: http://www.cmc3.org/conference/callForProposalsTahoe.html

The dates next year will be April 22 and April 23 and will be held at the same place, the MontBleu Resort Casino and Spa in Tahoe. I am sure it will be as wonderful as Tahoe 2015 was.

CMC³ Upcoming Board Elections

Susanna Gunther, Solano College

How would YOU like to get involved with the activities of CMC³? Stay in the loop of all those high-stake mathematics discussions happening around the state and country? Help plan the Monterey or Tahoe conferences? Make some great friends?

I bet you just shouted "yes!" to these questions! Put that enthusiasm into action by submitting your name as a candidate for the CMC³ board, 2016-2017. Every two years, the CMC3 membership votes on its elected board for the next two years. The elected positions are president-elect, secretary, treasurer, four at-large members, and CMC³ Foundation president. There are also several appointed positions. The president, who next year will be Joseph Conrad, makes those appointments in January, after the election results.

How can you get involved? Consider joining the board. There are some positions that require very little time and other positions that require a bit more time. The responsibilities that everyone on the board shares include attending the three in-person and one virtual meetings per year, participating in discussions, and assisting at the Monterey conference. Each position then has its specific requirements. To learn about the responsibilities associated with each position, read the by-laws on the CMC³ web site: http://cmc3.org/news/CMC3BylawsAndConstitutionApproved.pdf.

So, how does this work? If you have questions about volunteering and/or submitting your name, feel free to contact me. If you would like a specific position, please let me know. Maybe you do not know what position you would like, but just want to get involved. That is great, too! You could run for "at-large" or ask to be appointed in January. Contact me and we will set up a time to chat. (susanna.gunther@solano.edu) You are welcome to attend our next meeting, in September, to get some first-hand information. I will collect names through August 31st and submit the slate of candidates to the current board at its September board meeting. The actual ballots will be mailed to the membership in early October. Please contact me with any questions about joining the board. This is a fabulous organization. It is YOUR organization. There is a lot of opportunity to become involved. I hope you consider becoming a leader.

Mark Your Calendar:

43rd Annual CMC³ Conference

December 11 and 12, 2015

Hyatt Regency Monterey Hotel and Spa

The Pleasures of Problems

Kevin Olwell, San Joaquin Delta Community College

Summer 2015 Problem: At halftime the school band marches onto the field in the shape of a square. After some maneuvers, the band forms a rectangle with 5 more rows than the original square. How many members does the band have?

Spring 2015 Problem: Square ABCD overlaps a circle of radius r in such a way that side AB is tangent to the circle with points C and D lying on the circle. How long is one side of this square?

Solutions to the Spring Problem were submitted by Carlos Valencia, Fred Teti, Joel Siegel, Pat Hammer, Paul Cripe, and Joe Conrad.

The most thorough solution (by Fred Teti) proved several facts the other solvers took to be obvious. Let O be the center of the circle and M the midpoint of side CD. Then $|MC| = |MD| = \frac{1}{2}s$, where s is the length of a side of the square. Since side $|OM| = r - s$ is shared by triangles OMD and OMC, and since $|OC| = |OD| = r$, the two triangles are congruent. It follows that angles $OMC = OMD = {}^{\pi}/_{2}$. Apply the Pythagorean Theorem to triangle OMC.

$$(r-s)^2 + \left(\tfrac{1}{2}s\right)^2 = r^2.$$

Some routine algebra gives $s = \frac{8}{5}r$.

All are invited to submit a solution either via email or US mail at the address below. I will be out of the office for much of the summer so my response to submissions will likely be tardy.

Kevin Olwell
San Joaquin Delta Community College
Agriculture, Science and Math Division
5151 Pacific Avenue
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Call for Speakers

We still have openings for speakers at the Monterey conference (12/11 – 12/12) especially in the pre-calculus and above area, but we welcome talks in any area of community college mathematics.

Call for Presiders

Would you be willing to be a presider at the fall conference in Monterey (12/11 – 12/12)? If so, please contact Mark Harbison at harbism@scc.losrios.edu with your availability. Speaker – presider pairings will be made in the fall when the speaker grid is complete.

Call for Ignite! Speakers

Do you have something that you want to share with your colleagues, but don't think it will work as a full talk? Consider speaking at the Ignite! session Friday night (12/11) at the Monterey conference. These talks will last five minutes using twenty PowerPoint slides that automatically advance during the talk. This is an exciting experience for speakers and audience members alike! If you would like to participate, please contact Larry Green at drLarryGreen@gmail.com.

Poll Results

Mark Harbison, Sacramento City College

Please visit www.cmc3.org/news/IntAlgSurveyResults.html for the results of a poll that was administered from late Jan. to early May, 2016. I personally reached out to all 112 math departments of CA community colleges at least twice. If your college was not listed in the credits then please contact me and I will tell you who to blame that you didn't get to vote.

I am grateful for the 71 representatives that did reply to me with the results of the short poll: do you agree with the attached position statement (yes? no? abstain?):

Whereas
* The prerequisites of a mathematics course should be those appropriate to providing a foundation for student success in that course;
* The course description and learning outcomes of a mathematics course determine the prerequisite level of mathematical literacy, skills, and knowledge necessary for successful completion of the course;
* The equivalent content in intermediate algebra courses is generally required to master the content of algebra-based courses leading to calculus; and,
* The equivalent content in intermediate algebra courses is not required to master the content for most college-level mathematics courses not leading to calculus.
Therefore
*Prerequisite courses other than intermediate algebra can prepare students for courses of study not leading to calculus.

The comments received were especially useful.

People who disagreed with the statement tended to send more comments than those who agreed with it. CMC^3 is not formally taking a position either way, though I think that it should be noted: some very well-funded foundations are working on some well-organized campaigns to give students non-algebra pathways, yet there is no corresponding organized effort to maintain the standard of intermediate algebra as a general education requirement for college students.

Please everybody respect people that you meet during CMC^3 conferences, no matter what their opinion is. Become well-informed by reading both of the papers under "**Statements Regarding Alternative Pathways**, Statways for example:" in www.cmc3.org/news.html but do maintain a civil discourse with each other. There were some colleges that voted 20-0-0 in favor of the statement, and some that voted 0-25-0 against it. But most colleges were split quite evenly, with many people abstaining. In fact, if you use 1048 (the number of full-time faculty who could have voted of the 71 colleges) as the denominator, then the 326 votes in favor of the statement really does not seem like such a majority, does it?

This is an open question that should be carefully considered by all involved.

Travel Grants

Mark Harbison, Sacramento City College

The CMC^3 Foundation, intending to recruit new members, is proud to introduce a new Travel Grants program for the 2015 CMC^3 Annual Conference in Monterey, with the help of a very generous **donation** from Wei-Jen Harrison.

Applications are being accepted now for one nominee from each of our 57 colleges for free membership, conference registration and a 1-night stay in a shared hotel room.

One year of CMC^3 membership will be covered. Registration is complimentary either as full registration or as first-time-attendee reg, depending on whether or not this is their first CMC^3 conference. Lodging is provided for one night, as a double, with the hope to build camaraderie and networking with your Travel Grants roommate. Program participants do have the option to pay for his or her own private room for half of $140 , plus taxes and fees on Friday, or the full amount on other days. For example, they could pay for 2 1/2 nights on their own (Thu.+Fri.+Sat.), but 1/2 of Friday will be covered.

We encourage the dept. chair or dean or CMC^3 Campus Rep at each cc math dept. in Northern CA to nominate the 1 person who would benefit the most from this program by filling out the form here <www.cmc3.org/conference/montereyConferenceGrant.html> with both their info. and their mentor's information. The application deadline is Nov. 1.

It is recommended (but not required) that the applicant is a new full-time faculty member who has not yet attended a CMC^3 conference. The conference will feature a special *Intro. to CMC^3* session on Friday evening, Dec. 11. The 2016 conference should be a great opportunity to professionally bond with a colleague through CMC^3. Get to know each other more personally with a road trip to Monterey.

Full names of the 57 colleges are on www.cmc3.org/Reps.html , but abbreviated they are:
AHC, ARC, BC, BCC, Butte, Cabrillo, Cañada, Chabot, CCSF, Alameda, Marin, CSM, CR, COS, Siskiyous, Columbia, CCC, CRC, Cuesta, De Anza, DVC, EVC, FRC, FLC, FC, FCC, GC, HC, LTCC, Laney, LPC, Lassen, LMC, Mendocino, Merced, Merritt, Mission, MJC, MPC, NVC, OC, PC, RC, SCC, SJDC, SJCC, SBCC, SRJC, Shasta, Sierra, Skyline, Solano, TC, WHC, WVC, WCC, and YC.

CMC³ Foundation Report

Debbie Van Sickle, CMC³ Foundation President, Sacramento City College

Scholarships

We have completed the process of awarding our CMC³ Scholarships for the 2014/205 academic year. We invited all CMC³ members to nominate students from their colleges (see http://www.cmc3.org/foundation.html#scholarships). I would like to thank our two judges, Wade Ellis and Steve Blasberg from West Valley College.

The following biographies and pictures were submitted by the faculty nominators of this year's winners.

First place and receiving $3,000:

Christian Castaneda, American River College. (Shown here with American River

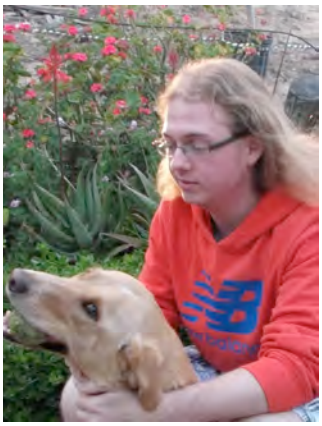
College professors Rocio Owens and Glenn Pico)

Faculty nominator Glenn Pico writes, "Christian Castaneda has done an amazing job at American River College (ARC). After starting out in beginning algebra at ARC, Christian has now gone through the entire calculus sequence, linear, DE and honors problem solving with a 4.0 GPA in mathematics. Last year Christian served as Math Club president and he has also been given a summer internship at NASA. In addition to his academic achievements, Christian has done an extraordinary job working as a Beacon tutor. In fact, Christian had done so well working with students that other Beacon tutors are advised to attend his Beacon sessions to improve their technique. Christian's goal is to transfer to UC Berkeley and major in engineering, and he has done a remarkable job in pursuing his goal."

Second place and receiving $2,000:

Niels Schneider, Hartnell College

His faculty nominator writes, "Niels Schneider is a student at Hartnell College who is transferring to UC Santa Cruz this coming fall semester. Niels has been tutoring math at Hartnell since he started there in Fall 2013 and has worked closely with most of Hartnell's math faculty in either



tutoring and classroom preparation or further individual study in higher mathematics. He is the type of student who enjoys tackling a weekend take-home test on Friday night and then letting the math take him away into the early morning purely from the joy and entertainment he receives by doing the work involved. He believes that attention to detail and enjoying what you do are the most important fundamentals of life that will lead you in the right direction. He feels his academic success is due to all of his instructors' recognition of his abilities and belief in his potential."

Third place and receiving $1,000

Jordan Rayburn, Solano Community College

Faculty Nominator Darryl Allen writes, "Jordan is a second year student at Solano Community College. He will be transferring to university in the Fall of 2016, with aspirations of acceptance to UC Berkeley. Regardless of location, he plans to continue his undergraduate studies of mathematics and mechanical engineering. During his time at Solano, Jordan has become actively engaged with the Math Department, where he works as a tutor and is the president of the Math Club. When he is not studying, Jordan works as an Advanced Repair Agent for the Geek Squad."

Fundraising

The Tahoe conference provided a successful end to our 2014/2015 fundraising season. We continued our new tradition with our second annual Foundation Gala on the first night of the conference. I'd like to thank the following: Pearson Publishing, Cengage Publishing, the MontBleu Hotel, CMC^3, all those who helped with food and set up, and everyone who bought tickets for the Gala and the raffle. A very special thank you to Michael McGinnis from Santa Rosa Junior College for bringing his wonderful 3-dimensional labyrinth games to the Gala for us to play and for donating his speaker's honorarium to our scholarship fund! We raised over $1,200 for student scholarships.

We have started a new fundraising effort. Go to our Booster site at

http://www.booster.com/cmc3foundation

to order our new hoodie in your choice of size and color. Thanks to artist Scott Kim for the use of the "Mathematics" graphic. Check him out

on Wikipedia, http://en.wikipedia.org/wiki/Scott_Kim

Student Speaker Competition

The Foundation was once again delighted to facilitate the annual Student Speaker Competition, made possible by a generous gift from past CMC^3 president Debra Landre. This year's winner of a $500 scholarship was JoeAnna McDonald from Sacramento City College who gave a talk on Elliptic Curves. JoeAnna was mentored by

Sacramento City College professor Alex May. Thank you to Larry Green for running the competition.

AMATYC Scholarship

Mark Harbison, Sacramento City College

The American Mathematical Association of Two-Year Colleges (AMATYC) is holding a random drawing for a $ 1000 Presidential Student Scholarship. Nominees are eligible if

* the student is a mathematics major with at least a 3.0 GPA;
* the student was enrolled full-time in Spring, 2015; and
* the nominator is a current member of AMATYC who is employed at the student's college.

To entered the drawing, email nominations to Mark Harbison <harbism@scc.losrios.edu> before September 10.

The winner at the Sept. CMC^3 board meeting will advance to the drawing on Nov. 18 at the AMATYC board meeting (up to 1 entry is allowed from each of the 44 affiliates, including CMC^3). The winner will be announced on Nov. 20 and the money sent shortly after Nov. 22, 2015.

Through the History Glass

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

A growing number of people believe that it can be at least useful to include some history in the mathematics courses that we teach. Inserting some history can pique students' interest in a topic and engage them in what they may otherwise find boring. For example, talking about how John Napier (1550–1617), a Scottish baron, and Joost Bürgi (1552–1632), a Swiss craftsman, invented logarithms independently—or how when Henry Briggs (1561–1631), who introduced base 10 logarithms, and Napier first met, "almost one quarter of an hour was spent, each beholding other with admiration, before one word was spoke"[1]—can grab their attention.

Many textbooks are also getting into the game. In the calculus textbook that we use [7], for example, we find here and there some history mentioned in the margin or at the end of a section. For instance, on page 30 where Leibniz notation is introduced, there is in the margin an image of Leibniz along with a caption that reads,

> Gottfried Wilhelm von Leibniz (1646–1716), German philosopher and scientist. Newton and Leibniz (pronounced "Libenitz") are often regarded as the inventors of calculus (working independently). It is more accurate to credit them with developing calculus into a general and fundamental discipline, because many particular results of calculus had been discovered previously by other mathematicians.

In another instance, on page 155 at the end of the section on rates of change, there is a longer vignette on Galileo ("Historical Perspective") that spans a couple of paragraphs. Such historical tidbits are scattered throughout the textbook.

Unfortunately, flipping through the prealgebra textbook that we use [5], we did not see any history mentioned. (It may be there, but we did not see it.) We did not even notice a statement of who was Pythagoras when the theorem that bears his name is introduced on page 354. The same goes for the elementary and intermediate algebra textbook that we use [4].

Beyond injecting snippets from history into the mathematics courses that we teach, many colleges also offer history of mathematics courses—that is to say, many four-year colleges. These courses are typically upper-division courses that have at least a calculus prerequisite, and many of the standard textbooks on the history of mathematics are written for these. (Two examples of many are Burton [2] and Katz [3].) We are unaware of any two-year college that offers a course in the history of mathematics. (Please let us know if yours does, or if you know of one that does.)

We believe that a history of mathematics course would be a wonderful alternative to Intermediate Algebra to meet the associate's degree mathematics competency requirement. At Yuba College, we are currently developing such a course that we hope to offer for the first time in Fall 2016. Everything is a bit sketchy at the moment, but here is a draft catalog description:

> A history of mathematics from ancient times up to the 18th century. Introduction to a variety of number systems; the operations of addition, subtraction, multiplication, and division, and the finding of square roots; sets and logic; rational, irrational, real, and complex numbers; Greek number theory; linear, quadratic, and cubic equations; and applications (including proportions, variation, compound interest, exponential growth and decay). Ideas and methods from different parts of the world and at different times are mainly presented in their historical context.

[1] E. T. Bell, *Men of Mathematics*, Simon and Schuster, New York (1937).

The difficulty will be in selecting a textbook for the course. As we mentioned, many of the standard textbooks assume that the reader has at least a calculus background, although we could cherry-pick sections. There are books that are pitched at a more appropriate level, for example [1] and [6], but many lack exercise problems. One could also pull together material from many individual sources, but there would still be the task of creating exercises. Nevertheless, we believe that it will be worth the effort to offer a history of mathematics course for an associate's degree. I challenge you to develop a similar course at your college. Do it this summer! What better way is there to transmit the beauty and humanity of mathematics to another generation?

———————◇———————

Previous columns are on the Web at <http://ms.yccd.edu/history-glass.aspx>.

References

[1] William P. Berlinghoff and Fernando Q. Gouvêa, *Math through the Ages: A Gentle History for Teachers and Others*, Oxton House Publishers, Farmington (2002).

[2] David M. Burton, *The History of Mathematics: An Introduction*, 6th ed., McGraw-Hill Higher Education, Boston (2007).

[3] Victor J. Katz, *A History of Mathematics: An Introduction*, 3rd ed., Addison-Wesley, Boston (2009).

[4] Elayn Martin-Gay, *Beginning & Intermediate Algebra*, 5th ed., Pearson, Boston (2013).

[5] Charles P. McKeague and Kate Duffy Pawlik, *Prealgebra*, XYZ Textbooks, San Luis Obispo (2014).

[6] Dirk J. Struik, *A Concise History of Mathematics*, 4th revised ed., Dover Publications, Inc., New York (1987).

[7] Jon Rogawski, *Calculus: Early Transcendentals*, 2nd ed., W. H. Freeman and Company, New York (2012).

CMC^3 History Quiz, Part 3

Mark Harbison, Sacramento City College

1. Rearrange the letters "bare grin" to form the last name of the 2009 keynote speaker: Judith _____ .

2. In what year were two Monterey sessions dedicated to "Grants"?

3. These 5 people are all from CSU Fullerton. Arrange them in order of their first year speaking in Monterey for CMC^3: Marty Bonsangue, Frank Collea, James Friel, Bill Leonard, Harris Schultz.

4. How often has a talk on "Finite Mathematics" been given in CMC^3 history?

5. Multiple-choice: Where were Robert Fulkerth, Peg Partland, TJ Tabara, Cathi Colin, Jim Davis, Tatsuhiko Tabara & Faith Chao from?
a) Glendale College CA, b) Glendale College AZ, c) Golden Gate University, d) Golden West College, e) Gavilan College.

(Answers are on page 20)

Bull: Keynote at Monterey Revisited

Monterey redux

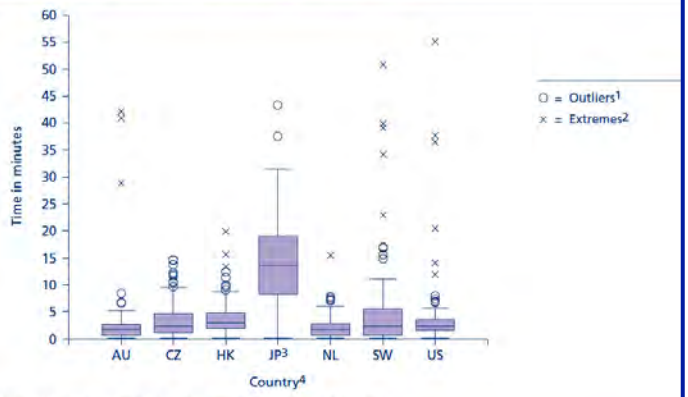
A colleague shared that, in response to Jim Stigler's keynote address at Monterey, he had introduced more group work with fairly challenging and unfamiliar problems in his Calculus I class. He added that the group work appeared to have worked out well. Having just returned from a conference on teaching statistics (USCOTS15) in which Stigler gave a very similar talk, the first question to the colleague was: "What was the link between what Stigler had to say and your decision to introduce group work?"

My colleague acknowledged that it was a big question (worth at least one beer). His initial answer was that almost all the teaching innovations with which he is familiar involve group work, so group work it was. That makes sense in a general way; after all, the Keynote addresses function somewhat like sermons: they are to encourage, to challenge and sometimes to inform. Hence, as a response, "doing the right thing" as best we know is perfectly reasonable. But the question remains: What is the link? Can we, as community college instructors, apply what Stigler and his group have found? So, prompted by this experience, Bull dug a bit deeper into the research Stigler and his colleagues have been doing, and attempt here to analyze what Stigler had to say with the application question: "As an instructor, how should I respond to what was said?"

Stigler one more time . . . with commentary

Monterey 2014 was over six months ago, so we had best begin with a brief review of the salient points of the talk. (The power point can be found at http://www.cmc3.org/conference/Monterey14/Monterey14.html on the CMC^3 website.) Recall that Stigler began his talk by reviewing research contrasting mathematics teaching in schools in Japan and in the US. Very briefly, teaching in America was characterized by "Quick and snappy", whereas in Japan it was "Slow and sticky." The impression given for teaching in the US was that mathematics problems should be solved quickly and efficiently, whereas in Japan, mathematics was expected to take time and the solution only expected to come after considerable struggle. Stigler did not dwell on these differences, but one quantitative measure (from the TIMSS 199 study) compared the amount of time on "independent" mathematics problem in the videos of eighth grade teaching (Hiebert et al 2003: 47). For more detail on the differences amongst teaching in America, Germany

FIGURE 3.6. Box and whisker plots showing the distribution of eighth-grade mathematics lessons based on average length of independent problems, by country: 1999



[1]Outliers are values from 1.5 to 3.0 box lengths from the upper or lower edge of the box.
[2]Extremes are values greater than 3.0 box lengths from the upper or lower edge of the box.
[3]Japanese mathematics data were collected in 1995.
[4]AU=Australia; CZ=Czech Republic; HK=Hong Kong SAR; JP=Japan; NL=Netherlands; SW=Switzerland; and US=United States.
NOTE: The shaded box represents the interquartile range, containing 50 percent of the lessons. The lines extending from the box indicate the highest and lowest values, excluding outliers and extremes. The horizontal line within the box indicates the median.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study (TIMSS), Video Study, 1999.

and Japan see especially Stigler and Hiebert 2009.

In Stigler's talk, many of his other characterizations of American teaching culture had a familiar ring, quite apart from the comparison between Japan and America. As an example, and as one who teaches statistics, Bull recognized the automatic assumption by students that the name of the game for a math course is the ability to manipulate symbols: so calculate!

The next step in the TIMSS research was to compare teaching practices in a larger group of countries to see whether there were commonalities amongst teaching practice in countries with high achievement, especially when compared with achievement amongst eighth grade students in the US; the figure above comes from that study. They found that there were greater differences in teaching practices *between* countries than there were *within* countries. That is, teaching practice was heavily conditioned by the educational culture of the country and that everything that is done in teaching is tied together. In Stigler and Hiebert's (2009) terms, "teaching is a cultural activity" that is deeply embedded in the expectations and assumptions and the structure of the educational system of which it is a part. There are corollaries to this finding. One is that unlike what might have been inferred from the comparison of Japan and America, there was not a single pattern (or culture) of teaching and learning that distinguished high-achieving countries from lower-achieving countries. A second is that teaching is rooted in the surrounding culture is potentially discouraging. The finding explains why innovations in teaching often meet opposition, and also alerts us to both the difficulty and the promise of "cultural change." In fact, one response is that cultural change in teaching is pretty much impossible, a response that comes easily for those who have been teaching for some time, and who have seen waves of innovative efforts.

Three types of good learning opportunities

If between culture (or country) variation in teaching practice is greater than within culture variation, the question then becomes whether within the teaching practices of high achieving countries there were commonalities, even though the commonalities would be variously expressed within the teaching culture of that place. Stigler identified three possible commonalities labeled: *productive struggle*, *explicit connections*, and *deliberate practice*.

Research Indicates Three Types of Learning Opportunities Required for Deep Understanding

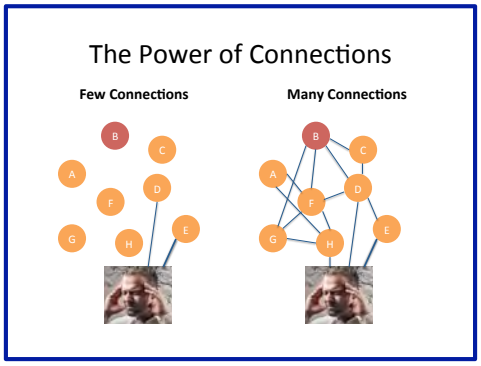
To achieve flexible expertise, students need recurring and sustained opportunities for:

- *Productive struggle* – with important mathematics
- *Explicit connections* – between concepts, procedures, problems, situations
- *Deliberate practice* – increasing variation and complexity over time

At the time (and especially on the second go) Bull was wishing there had been some examples of how these three aspects were expressed in the various teaching cultures. To take the first, productive struggle: it was clear even from the talk as well as from some of Stigler and Hiebert's publications how productive struggle worked out in Japan, and how it was not characteristic of American teaching. How productive struggle was expressed in Hong Kong, in the Czech Republic or especially in Australia, (whose overall culture is probably closest to ours) was not made clear.

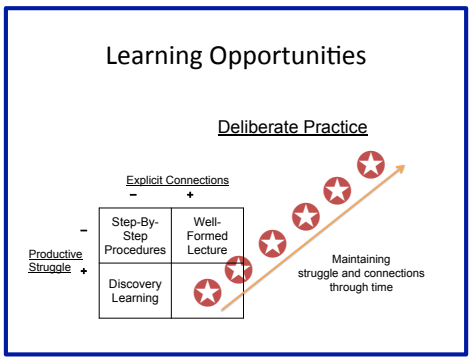
The second learning opportunity, explicit connections, appears to be a very attractive and useful idea. Part of its attraction stems from the fact that it is one that many of us will probably have come up with from our own experience in teaching. We

encourage students to make mental maps of the content of a course, and that practice come from wanting to see students make connections. Bull can recall making an illustration very similar to the slide shown (reproduced here) to make exactly the same point to students, and to counter the tendency for students to memorize long lists of facts ("factoids") without seeing the connections between them. It is also easy to see how parts of our teaching and learning culture work *against* the idea of making connections. Textbooks that encourage students to develop a repertoire of techniques to solve a limited set of "types of questions" that can be expected on tests are an example.



It was curious that Stigler's illustration of deliberate practice came from his music lessons rather than from any example from mathematics. In any case, it may have been the third slide shown here that prompted my colleague to "apply" the lessons learnt from the talk with group work involving discovery learning. It is easy to argue that providing challenging problems in a group setting will create a situation in which struggle is more expected by students than in "routine practice-this-because-it-will-come-on-a-test" material. The kinds of more challenging problems assigned afford the opportunity to emphasize connections.

So, in some ways the three types of learning opportunities were not surprising to many of us (perhaps even most of us) attending the Monterey conference. The three types are things that we can see make sense, and we may even have come to the same conclusions without being aware of the TIMSS research. It is natural for an instructor to respond to these principles by trying the best way to reach them "in my classes."



However, the first insight from the TIMSS research – that teaching is a cultural activity — is probably not as self-evident, or familiar in our everyday thinking. The corollary that teaching practice is very very difficult to change effectively is not something we wish to dwell upon. The insight that what we do in teaching, and the way we think of about learning and teaching are all part of our culture is something we may think about, but perhaps not deeply enough. When we do it may be in response to trying something that does not work. Try to change just one aspect, and one runs into opposition. So this insight of the cultural rootedness turns out to be not nearly so heartening. Taking this insight seriously may add to the cynicism of some who have seen innovations come and go – with no apparent difference in the way teaching is done.

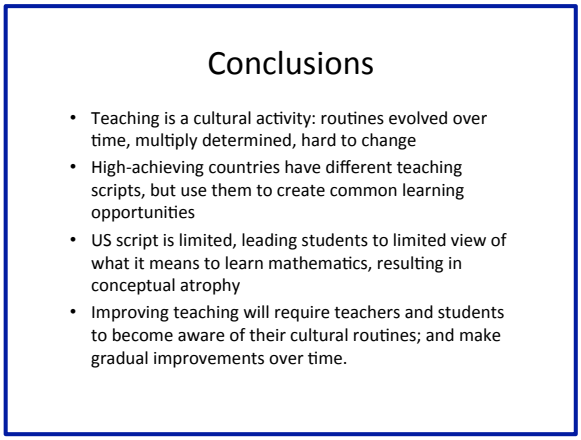
Moreover, that change is nearly impossible is not the kind of thing one will emphasize in a keynote talk to mathematics educators, but the cultural rootedness and the difficulty of change are emphasized in much greater detail in some of the publications from the group (See, for example, Stigler and Hiebert 2009).

So my colleague decided: "group work in calculus I next semester." The question still stands: is my colleague's response the only or best way to respond to the insights from the TIMSS research? Does his response do justice to what Stigler and his team have found? We will give both a positive and a negative answer.

Answers: Yes and No.

On the positive side, using challenging exercises or problems in a group setting gives a chance to support the idea of productive struggle, since the students probably expect the problems to be "harder than normal." Group work can affectively harness the variability in background of the students. If the problems assigned are "rich" enough, connections between various parts of the course can be made. The colleague implied that group work was used multiple times, and this may have afforded the opportunity for "deliberate practice" with connections between the problems assigned.

On the negative side, what was done did little to change the teaching culture of calculus I in our department, as far as we can tell. It is unclear that the other instructors teaching calculus knew about his efforts, although they would not be surprised, as he is known as an advocate of group work. Bull's verdict is that the colleague's response makes sense, but did little to even begin to change our teaching culture in our department. In his defense, we can point out that Stigler said almost nothing in the presentation about his ideas about how teaching cultures may be changed, except to say that cultural change is hard. In the publications that have come from the TIMSS study, much more is said about changing the culture of teaching and learning. The earlier reports (Stigler and Hiebert 2009, originally published in 1999 and largely a reflection on the 1995 study) go into some detail about cultural change in education in Japan. It is to these issues we turn.



Changing culture --- there's an app for that.

Well, actually . . . no. At least not that Bull could find, although there are websites full of hype that purport to be close to an "app for culture change." But there are books about changing culture, some of them focused on business ("How to change the culture of your organization!") but also some on healthcare and on education, and some books on culture change in general. Most of the literature on culture change emphasizes how hard it is, and how any endeavor is likely to be something that takes a long period of time. (The exception appears to be what is written for business people, but then they seem to have a culture of optimism that cannot be changed.) Also emphasized is the idea that culture is more likely to be changed locally rather than globally. Where do we, as community college instructors, fit into this picture?

That community colleges should play a role in educational cultural change seems highly unlikely in some ways. We are squashed (or squeezed) between the K – 12 system on the one side and the bachelor degree granting institutions on the other, and what happens on either side of us largely affects us – usually not the other way round.

Our ability to make changes in curricula is circumscribed by the transfer process, and lately by the C-ID system as well. We make do with lower levels of funding compared with other tertiary institutions.

On the other hand, we *do* have a clear interest in teaching and learning, being the central part of our mission, something we share with (often small) four-year liberal arts institutions. And we have a limited number of programs on which we can concentrate our efforts. We can effectively divide what we do into three programs: the STEM sequence, transfer level courses for non-STEM students, and "developmental education," a division to some degree reflected in the typical Monterey conference program.

The contrast in the last two paragraphs about culture change coming from colleges illustrates one of the ironies of culture change in general: it is generally impossible on a grand scale (the entire educational culture) but on a small scale, we "make culture" almost all the time. Think of how family traditions are shaped and molded: "on Sundays we have pancakes for breakfast . . ." At one point College of San Mateo had almost no afternoon mathematics classes; "the students work in the afternoon; they will not enroll" it was said. But then, why was it that other colleges in the Bay Area had afternoon classes? So afternoon classes were gradually introduced; these were often classes in blocks rather than daily meeting classes, and the first ones were with dedicated instructors who had a good reputation with students. But within the college, some aspect of culture was changed. Some who have taught at more than one college even in the same region remark at times on the differences in the student culture between colleges; the evidence is likely to be subjective and anecdotal, but may point to real differences. So, is there at least the possibility of changing how things are done in our colleges, and perhaps in our region?

Changing culture --- barriers in our system and the 3:12:120 principle.

The biggest barrier to changing culture in education in the USA and also in community colleges is the intensely individualized manner in which we teach; we are the monarchs of our classrooms. We speak of "my classes" and "my students" and the terminology reflects the structure and ultimately the way we think about what we do. Our intensely individualized culture has many consequences, including even a kind of self-centeredness on the teacher's part that can see change as a threat to one's being. However, more importantly, because of it, we do not have a well-established way of incorporating change into our practice as a community. Mostly changes come from seeing things at a conference or a workshop, and then trying things out – mostly individually. But typically, these changes do not spread.

Andy Crouch, writing about "making culture" in general suggests that a necessary condition (there being no sufficient conditions) for culture making is *community*. He goes further and says that what is nearly always needed are concentric circles of three, twelve and 120 (Crouch 2008: 239 ff.). That is, all culture change begins with an absolutely small number of trusted associates – one would even say "intimate": the three – surrounded by a somewhat larger group of about twelve supporters, and those surrounded by a larger group of 120. The exact numbers 3: 12: 120 are not important; the three could be two or five, and the next level somewhere around twelve, and the third about 120. (Some may be interested that one of Crouch's illustrations of this principle was the proof of the Poincaré Conjecture, where the three were Perelman, Hamilton and Thurston; it may not have been a good choice as an illustration.)

The social dynamics of 3: 12: 120 make some sense. The "three" serve as an important support group, both positively and negatively. These people should be close enough to help avert purely idiosyncratic moves – the three should be people who are able to tell us that something we want to do is crazy – and at the same time be an encouragement when doing something experimental is not going as well as we would like it. Besides, three heads are better than one, but they need to be thinking together constantly and not just once or twice a semester. The twelve operate in a similar fashion; very likely they are people who might hesitate to tell us that we are crazy, but they can be an encouragement as well. And the twelve serve to have contacts outside the three. Bull's experience is that there are few instances of 3: 12: 120 in our work. Very often we hardly even know what our colleagues are doing in their realms (i.e. "their" classes).

Stigler and Hiebert (2009:109 ff.) describe a practice in Japanese primary and middle schools that embodies the 3:12: 120 principle and which appears to result in ongoing teacher innovation and training. It is known as "lesson study" (in Japanese, *jugyou kenkyuu*) and has gained some small popularity in the USA. At the primary and middle school level, lesson study focuses on individual class lessons and involves an analysis by a group of peers (the "twelve"?) of how carefully designed lessons (by he "three") actually work out in practice. Since the focus is on a "class lesson" the peers actually observe the lessons and there is then much discussion of how things went, followed by much revising. The cycle is repeated with eventual dissemination to larger groups of teachers (the "120" or more?). In a paper on such methods, Catherine Lewis of Mills College (Lewis 2011) noted that US adaptations of the method have included "explicit processes to build collaboration skills" to counter the skepticism that the idea could be transported to our highly individualistic teaching culture.

Now, "lesson study" concentrating on individual lessons may not be appropriate for community college practice; we will probably not be patient enough to spend an entire semester or year analyzing just a single class lesson, which is the norm in Japan. However, the ideas surrounding the lesson study "movement" are worthwhile looking at, and specifically, the collaborative and revising aspects of the process.

One possible reaction to the paragraphs is to think of SLO discussions, either positively or perhaps negatively. One big difference is that SLO discussions often have an aura of a burden or an imposition from above. The idea of the 3: 12: 120 is that the process starts from below. That is not to say that changing culture from below is easy; besides the cultural resistance to collaboration ("my" classes, again), we also have the structural difficulty that a good proportion of community college instructors are adjuncts, whose participation must be measured on an hourly basis. However, the point is that local collaboration – with the three as a starting point, followed by review by the twelve, is something to shoot for.

Where does CMC^3 come in? Bull has been impressed with presentations at Monterey that come from practice within our own region; that kind of thing is in the spirit of the 3: 12: 120. Hence, perhaps the 120 can be provided by CMC^3 as a discussion group in one of the unused slots in the Monterrey program, even as a regular feature.

So the verdict is that the colleague probably did well to use the group work, but then he should have taken the group work to another level to respond properly. Start gathering your three.

Ken Bull

Crouch, Andy (2008), *Culture Making: Recovering Our Creative Calling,* Downers Grove, IL: IVP Books.

Hiebert, James et al. (2003) *Teaching mathematics in Seven Countries: Results From the TIMSS 1999 Video Study* NCES }(2003-013). Washington, D. C.: national Center for Education Statistics , U.S. Department of Education.

Lewis, Catherine C. (2011), "Schools Where Teachers Learn From Each Other" http://www.childresearch.net/papers/school/2011_01.html.

Stigler, James W. and James Hiebert, (2009), *The Teaching Gap,* New York: Free Press. (Originally published in 1999)

Answers to the CMC^3 History Quiz, Part 3

Mark Harbison, Sacramento City College

1. Judith Gabriner, from Pomona Pitzer College, gave a 2009 talk titled *Why Should Historical Truth Matter to Teachers of Mathematics? Dispelling Myths while Promoting Math.*

2. Either answer is acceptable: 1992 or 1998. In 1992, Denny Burzynski presented *How to Write a Successful NSF Grant* while David B. Johnson's talk was called *Securing a FIPSE Grant.* Then in 1998, Chris Avery and two high school teachers gave a talk on *A California Fill Grant Project* and Wei-Jen Harrison was a panel moderator for *Want Your Wish Grant - Ed?*.

3. Some CSU Fullerton faculty have spoken more than once in Monterey. In order of their first appearance: Bill Leonard (1978, 1982, 1995) tied with Harris Schultz (1978, 1979, 2007, 2008), Frank Collea (1980), Marty Bonsangue (1993), and James Friel (1995).

4. Only twice has a CMC^3 talk had "Finite Math" in its title: once in 1978 (*Finite Mathematics in Contemporary Culture* by Frederick Luttman from Sonoma State Univ.) and once in 1974 (*Using a Computer in Teaching Pre-Calculus, Calculus and Finite Mathematics* by Susan Shelley from Sacramento City College).

5. For six years (1993, 1996, 1997, 1998, 1999 and 2004), Robert Fulkerth, Peg Partland, TJ Tabara, Cathi Colin, Jim Davis, Tatsuhiko Tabara & Faith Chao were on the CMC^3 Monterey program representing (c) Golden Gate University, even though GGU is not one of the 112 Community Colleges of CA.

Math Nerd Musings

Jay Lehmann, College of San Mateo

Ever see the movie, "My Dinner with Andre," which captures the twists and turns of a two-hour conversation between two men? Well, my wife Keri and I had four two-hour conversations of our own last week when we went hiking in Napa Valley State Park as part of our five-day anniversary celebration in St. Helena. Actually, we had plenty of more conversations throughout our trip, but there's something about talking along winding paths that tends to encourage conversations to twist and turn as well.

As we forded a creek, which was amazingly strong considering the drought, I offhandedly said that if Keri were to dump her half-filled 16-ounce bottle of water into the creek and our 17-year-old son Dylan were to visit China 50 years from now, the probability that he would drink a molecule of Keri's water in an 8-ounce serving of water is extremely high.

Despite numerous other mind-bending mathematical conversations we've shared during our 21-year marriage, Keri said she didn't believe it. When I asked why, she answered with the question, "How could that be?" As I pressed harder, it became clear there were two issues. First, to what degree would the water molecules disperse? Second, what is the ratio of water molecules in a glass of water to the equivalent number of glasses of water in the hydrosphere?

For the first issue (dispersion), it seemed that the mechanics of sewage pipes, treatment plants, evaporation, and so on were making the discussion too complicated. By switching to the dispersion of air molecules from Keri exhaling once, she was quick to agree that those molecules would be scattered about the atmosphere with time.

For the second issue (ratio), we discussed just how many water molecules are in 8 ounces of water. But trying to wrap one's head around a quantity as large as 7×10^{24} is pretty tough. By the next bend in the path, our conversation had shifted to some other topic, to my wife's relief. She finds such mathematical discussions intriguing for a short while and exhausting once we dive into the details. The trials of marrying a math instructor!

Who can blame Keri's doubt? The whole point of the example is to state something that sounds unbelievable that can be shown using mathematics to be true.

In fact, even though I've done the calculations, there's a small part of me that says, "Really? Is it really true?" That small part, which I'll call my intuition, seems to be completely immune to computation.

My Apple dictionary defines *intuition* as the ability to understand something immediately, without the need for conscious reasoning. Thankfully, my intuition usually lines up with my conscious reasoning. But it's when they are at odds, like when I

reflect on the Monte Hall problem (Google it), that I find myself solving the problem over and over again, as if in the nth iteration, my logical side will convince my intuition. (It is with probability that my two sides come to blows most often.) But every time, the best I can achieve is a compromise between my two sides: my intuition will allow my logical side to see the solution through to the end, provided my intuition can once again be unaffected by the ordeal. Much like Keri puts up with our mathematical discourse.

While discussing the water problem with her, I muzzled my doubting intuition so as to be as convincing as possible. But it might have been more comforting to her—and honest—had I allowed my doubt to surface. That way, our intuitions could have coincided and it would have just been a matter of my logical side to persuade hers.

Although there are far too many times when I feel terminally unique, I suspect that I am not the only mathematics instructor whose intuition struggles with his or her logical side. Yet neither colleagues nor my past instructors have ever copped to this. I'm not talking about the battles of intuition and logic as one is in the midst of solving a problem. I'm talking about admitting to doubt even after one has completely proved a result.

From a pedagogical standpoint, it might not be helpful for an instructor to prove a result and then confess to students that he or she still has a lingering doubt about the result. Lack of confidence in instructors tends to spread to students. But from the standpoint of feeling terminally unique, it would have been reassuring to know that my professors had doubts, too.

But maybe they didn't have doubts. And maybe I needlessly have mine. Maybe my intuitive side remains unconvinced on certain topics because my logical side doesn't truly understand. I may have walked along the correct logical path, but perhaps there is some facet of a certain step that remains fuzzy and needs more attention.

It is that possibility that guarantees it will only be a matter of time until I revisit the Monte Hall problem one more time. And discuss unbelievable-yet-true math problems with Keri, in the hopes of convincing her intuition. But maybe next time, if my intuition's not convinced either, I'll let her know.

Calendar

September 26, 2015: **UMATYC Conference**, Weber State University, Davis Campus, Layton UT. Contact: Brenda Acor. Website: UMATYC.org

October 2-3, 2015: **MichMATYC 2015,** Macomb Community College - Cinton Township, MI. Contact: Mike Somyak. Website: www.macomb.edu/michmatyc15

October 2-3, 2015: **NDMATYC Fall Conference**, Chieftain Conference Center, Carrington, ND. Contact: Michael Kern

October 9, 2015: **IMATYC** at Northwest Iowa Community College; Sheldon, IA

October 16, 2015. **INMATYC Fall Conference**, Ivy Tech Community College—Kokomo. Contact: Becky Pohle. Website: http://irmc.matyc.org/

December 11-12, 2015: **43rd Annual CMC³ Fall Conference**, Hyatt Regency Monterey Hotel and Spa, Monterey, CA . Contact: Joe.Conrad (707) 864-7000 x4372, JosephConrad@solano.edu

February 26-27, 2016: **Joint Meetings of the MAA-Florida Section and FTYCMA**, Saint Leo University, Saint Leo, FL. Contact: Altay Ozgener. Website: http://sections.maa.org/florida/newsletter/callslu.htm

March 4-5, 2016: **CMC³-South Annual Conference**, Kellogg West Conference Center & Hotel near Cal Poly Pomona. Contact: Maribel Lopez

April 1, 2016. **INMATYC Spring Conference**. Indiana University/Purdue University at Indianapolis. Contact: Becky Pohle. Website: http://irmc.matyc.org/

April 8-10, 2016: **2016 NYSMATYC Annual Conference**, Kingston, NY. Contact: Josh Hammond. Website: www.nysmatyc.org

April 22-23, 2016: **20th Annual Recreational Mathematics Conference,** MontBleue Hotel. Contact Larry Green (530) 541-4660 ext. 341, drlarrygreen@gmail.com

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