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California Mathematics Council Community Colleges

President's Report

James Sullivan, CMC^3 president, Sierra College

To no pomp and circumstance whatsoever, the newly elected members of the 2022-2023 CMC^3 board got straight to work on carrying out the business of CMC^{3}at their first board meeting of the term in January. In my first newsletter article as President, I would like to recognize the dedicated and hardworking members of the CMC^3 board.

Jen Carlin-Goldberg transitioned from CMC^3 President to Past-President. I thank Jen for steadfastly leading CMC^3 through the unprecedented challenges faced during a global pandemic. As President, Jen managed the massive transition from in person to virtual conferences, modernized the CMC^3 constitution and by-laws, and championed the ideals and practices of inclusivity, diversity, equity, and antiracism in mathematics education. The irreplaceable Katia Fuchs completed her presidential cycle last term and could have easily rode off into the sunset leaving a legacy of amazing accomplishments and significant contributions to CMC^3 to be admired, but fortunately for us all, Katia will continue to serve on the board and remain the CMC^3 Foundation President and spring conference speaker chair.

Tracey Jackson is the CMC^3 Secretary. She has admirably served in this roll for several years. Tracey helps CMC^3 in a variety of meaningful ways and received the President's Award in 2020 in recognition of her valuable contributions to CMC^3.

Leslie Banta is the CMC^3 Treasurer. She provides a great deal of organization and accountability to our board. The board can always count on Leslie to offer sound advice, wise recommendations, and a clear vision for our organization to follow. Leslie and CMC^3 at-large board member and adjunct advocate Chantal Cimmiyotti have done a tremendous job improving our CMC^3 representative network. Their efforts have strengthened our ability and effectiveness to disseminate information to faculty in mathematics departments at our members' colleges.

Contents

Longtime CMC^3 board members Wade Ellis, Larry Green, Steve Blasberg, Kevin Brewer, Darryl Allen, and Manjit (Manny) Kang continue to make valuable contributions to CMC^3. Wade and Larry are both former presidents and provide us with helpful insights and historical perspectives. Kevin is the CMC^3 membership chair. He maintains our membership database and is quick to respond to and resolve inquiries made by our members and requests made by the board. Steve and Manny apply their special knowledge and technical background to support and assist our conferences. Steve maintains our presentation equipment and provides technical assistance to our conference presenters. Manny is working to bring live-streaming options for our return to in person conferences. Darryl Allen is the CMC^3 webmaster. Darryl created the current version of the CMC^3 website. He works to maintain and support our website and ensures that our information is secure, accessible, and up-to-date.

We welcome two new members to the CMC^3 board, Joshua Rhodes from the College of San Mateo and Sonny Mohammadzadeh from the City College of San Francisco. I look forward to collaborating with Sonny and Joshua and learning from them what things CMC^3 can do to service our members better. Joshua is the new CMC^3 newsletter editor (by the way, this is his first edition of our newsletter). He is taking on the newsletter responsibilities after Jay Lehmann, our newsletter editor for the past 20 years, retired from the board. Jay is an incredible educator and colleague. His presence on the board will be greatly missed. Another dear and valued colleague, Dean Gooch, ended his long term of service to the CMC^3 board last year as well. We thank Dean and Jay for their tremendous service to CMC^3. We appreciate and are grateful for all that they have done on behalf of our organization.

Last, but definitely not least, I want to congratulate Cortney Schultz for becoming the newly elected CMC^3 President-Elect. Cortney quickly distinguished herself as an outstanding member of the CMC^3 board. She served on the CMC^3 foundation board, acted as our awards coordinator, and managed our social media presence. Cortney is now the fall conference chair, and she is planning our 50th annual fall mathematics conference which will take place in Monterey. Cortney has several wonderful ideas for making our 50th anniversary a special celebration. You definitely don't want to miss what Cortney has in store for us this year as we return to Monterey for an in person conference.

Each of these dedicated CMC^3 board members deserves our utmost respect and admiration. They volunteer their valuable time and talents to support the mission of CMC^3 on behalf of all its members. I am extremely proud and grateful for their contributions to our organization, and I truly appreciate their collective efforts and support.

CMC^3 Virtual Spring 25th Annual Rectrational Mathematics Conference

Larry Green, Lake Tahoe Community College

This spring, we will have our 25th recreational mathematics conference. The original plan was to have it in Tahoe, but with omicron raging, we have decided to have it virtual. In particular, the CMC^3 Recreational Mathematics conference will take place via Zoom on April 23. We will still be able to enjoy recreational mathematics talks and see each other, at least on the screen. In addition to being able to watch excellent speakers, we will have breakout room in between times where we can chat with other California Community College math instructors.

The virtual conference will close with a mathematics presentation by this year's Tahoe Student Speaker. If you have a student who may be interested in being this year's Tahoe Student Speaker, please encourage them to apply. The committee will begin reviewing the applications on March 15. Students can apply online at: http://www.cmc.org/students/speaker/. There is an associated scholarship that comes with it. Also, students can also receive a half unit of college credit if they register for the associated applications of mathematics course, MAT 119, at LTCC which is basically a course that just involves virtually attending the conference. For more information about this class, please contact me at DrLarryGreen@gmail.com.

This conference will be free to all CMC^3 members and students. If you are not a current member of CMC^3, it is easy to become a member by going to the site: https://cmc.org/about/join/ and following the instructions. We are still working out the details of registration, but all the information about how to register for the conference will soon be found on the CMC^3 webpage at http://www.cmc3.org/. Although there will be no charge to members for attending the conference, we strongly encourage everyone to donate to the CMC^3 foundation whatever we all can in place of the normal registration fee. I look forward to virtually seeing you all on April 23 as we experience recreational mathematics.

Mentality, Mindset, and Math

Joshua Rhodes, College of San Mateo

I am excited to start my journey as Editor of this newsletter! I have a lot to learn when it comes to editing, especially when reviewing Jay's excellent work for so many years, but I could not be more proud to be a part of this organization. CMC^3 is an important space for educators to come together, share ideas, and open up about what defines and drives our day, so being able to contribute to this community is an exciting new role for me. In an effort to first chew what I bit off, I think it would be best for me to outline what is coming for our newsletter and keep my first submission brief.

First, CMC^3, as an organization, is always looking to expand the platform that helps enable educators to promote their best practices – as well as what hasn't worked – to other faculty. The issues our profession face, alongside those in the classroom, can vary across many topics and situations. Because of this, We believe it would be pertinent to make sure that as many professors as possible have their experience heard. In Fall 2021 67.7% of faculty were adjunct faculty. With such a huge pool of experiences out there, we will be dedicating a portion of our future newsletters towards information, events, and opinions for and from adjuncts. The goal, as always, is to promote our beloved math community, so, if you would like to share any events, ideas, or opinions (especially those from adjuncts), please contact our Adjunct Advocate at adjunct-advocate@cmc3.org – Chantal Cimmiyotti and I are looking forward to your correspondence.

Secondly, teaching math at a community college the last few years has been... more than expected, to say the least, for many, if not most, of us. We are continuing to teach mathematics while being in the line of an absolute torrent of new methods, rules, regulations, and policies that impact every part of what we do – good on us! Even before the lock downs, we have had legislation that impacted and redefined what a typical student entering college is going to see for many campuses. I had the pleasure of being in many productive and proactive communities while these changes were implemented, but I also saw how much stress and frustration my colleagues felt as they tackled these issues. In an effort to try and inform, as well as give voice to, our community, we will be also adding a periodic column that tailors towards the legislative impact on our job. We will be expanding on what legislation may be proposed, what impacts it might have, and possibly some ideas and discussions about it from people who may be closer to the capital. This will be an opportunity for our community to organize and express our expertise on future topics that impact our classrooms.

Lastly, I am looking forward to the opportunity to contribute my own thoughts and ideas about mathematics and education in this newsletter. While subject to change, my columns will focus more on teaching methods, ideas, and philosophies we can employ to try and help our students engage with difficult problems in math but also the problem of math being difficult. Since this is such a dynamic issue, I will also be actively seeking feedback and methods from instructors in regards to articles, so I look forward to beginning that discussion in our summer newsletter!

I had mentioned at the start that this was to be a brief submission so I suppose it is best to leave you with a brief conclusion.

The Pleasures of Problems

Kevin Olwell, San Joaquin Delta

Spring 2022:
Every positive integer ending in 133 has a prime factor > 7.

Fall 2021: Suppose

$$-1 \leq f(x) \leq 1 \text{ and}$$

$$\int_1^3 f(x) = 0.$$

f need not be continuous. Find the maximum value of

$$\int_1^3 \frac{f(x)}{x}.$$

Thanks to Joel Siegel for submitting a solution.

One might guess that a function whose positive values are concentrated where $1/x$ is biggest will give the integral its maximum value. The following step function maximizes the integral:

$$s(x) = \begin{cases} 1 & 1 \leq x \leq 2, \\ -1 & 2 \leq x \leq 3 \end{cases}$$

For $1 \leq x \leq 2$ we have $1/x > 1/2$. Since $f(x) \leq 1 = s(x)$, multiplying this inequality by $f(x) - s(x) \leq 0$ reverses the inequality:

$$\frac{f(x) - s(x)}{x} \leq \frac{f(x) - s(x)}{2}. \tag{1}$$

On the other hand, $f(x) \geq -1 = s(x)$ for $2 \leq x \leq 3$. Multiplying $1/x \leq 1/2$ by $f(x) - s(x) \geq 0$ preserves this inequality. Consequently inequality (1) is true for all x.

Integrating inequality (1) yields

$$\int_1^3 \frac{f(x) - s(x)}{x} \leq \frac{1}{2}\int_1^3 f(x) + \frac{1}{2}\int_1^3 s(x).$$

Notice that both integrals on the right vanish. Hence

$$\int_1^3 \frac{f(x)}{x} \leq \int_1^3 \frac{s(x)}{x} = \ln\left(\frac{4}{3}\right).$$

Submit a solution to the current problem to: kevin.olwell@icloud.com

Upcoming

April 1-2, 2022: ArizMATYC & Southwestern Section of MAA Joint Conference, ASU (Polytechnic Campus) Website: http://arizmatyc.org/wp/

April 8–10, 2022: NYSMATYC Annual Conference, 1000 Islands Harbor Hotel, Clayton, NY Contact: Erin Newton Website: www.nysmatyc.org

April 23, 2022: CMC3 24th Annual Recreational Mathematics Conference, Lake Tahoe Community College. https://www.cmc3.org/conferences/spring/ Contact: Larry Green, Lake Tahoe Community College, (530) 541-4660 ext. 341, drlarrygreen@gmail.com

Assessment Adjustments

California Assembly member Jacqui Irwin has, on January 26, introduced Bill AB-1705 (Link provided) to the California Assembly. According the to the legislation's Legislative Council Digest, "This bill would make findings and declarations of the Legislature's intent to continue to increase California community college student placement and enrollment in transfer-level English and mathematics". The bill is planned to be heard in committee on February 26. If you are interested in sharing your opinion on the legislation with us at CMC^3, please contact Cortney Shultz (cshultz@santarosa.edu), Katia Fuchs (efuchs@ccsf.edu), or Jennifer Goldberg (jcarlingoldberg@santarosa.edu). Contact us.

The History Corner

Joe Conrad, Solano Community College

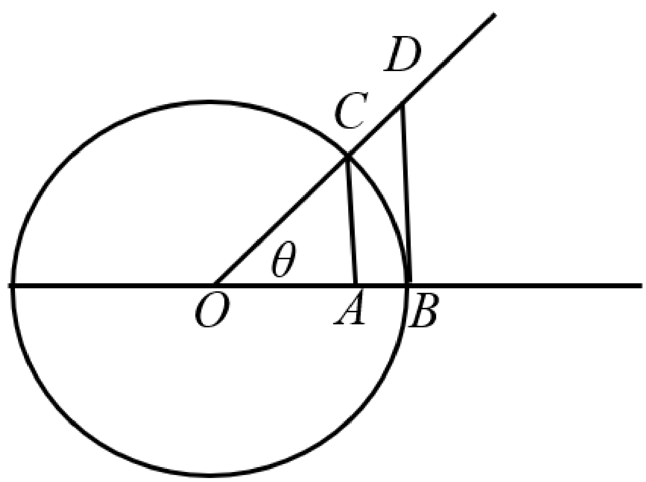
In the last column, I discussed the development of the sine function. If you recall, the sine was the first of the six standard trigonometric functions to be developed. It came out of Greek and, later, Hindu astronomy and was viewed as a line segment related to the chord of the associated angle. As I mentioned last time, the cosine, in principle, was developed along with the sine, not as a concept of its own, but as the sine of the complementary angle. The goal of this column is to discuss the other the trig functions. It was not until the sixteenth century until all six trig functions where thought of as ratios of the sides of right triangles. The unit circle approach came even later.

The oldest other trig function is the tangent, but it was not considered a part of trigonometry for many centuries. We are all familiar with a sundial. It is essentially a stick (the gnomon) placed in the ground that casts as shadow. For a stick of fixed height, the angle of the sun to the ground determines the length of the shadow. A moment's thought (for us) will reveal that the ratio of the length of the shadow to the height of the gnomon is the cotangent of the angle the sun makes with the ground. The length at noon can be used to determine latitude and the longest length in a year will indicate the winter solstice. A gnomon imbedded in a vertical wall can also function in a similar way with the ratio now being the tangent of the angle of the sun. These two shadow lengths were referred to as the direct shadow (umbra recta) and the inverse shadow (umbra versa).

The shadows were not considered part of trigonometry. In his Almagest, Ptolemy around 150 AD used only the chord function (discussed last column) which is essentially our sine. The Hindu and Islamic astronomers replaced the chord function with the sine. They made tables of values for the sine that depended on the value of a radius that they varied to produce more accurate results. They also generated tables of shadows in terms of the position of the sun. They did not include shadow tables among their trig tables and did not use the same length for the gnomon that they did for the radius in their trig tables.

Given a sine table, it was easy to compute a shadow if the angle of the sun was known. It was done by observing that the ratio of the length of the gnomon to the length of the shadow is equal to the ratio of the sine of the angle and the sine of the complementary angle. The hard part, was doing the reverse. Namely, if the lengths are known, finding the angle was not possible to do directly from their tables. What was done (and this appears regularly in ancient works) was to use the lengths of the gnomon and shadow together with the Pythagorean Theorem to find the hypotenuse of the relevant triangle and then use that with one of the sides get the angle by reading the sine tables in reverse (much as the older among us had to do in the pre-calculator days.)

Despite the fact that the early Greek, Hindu and Islamic scholars were quite adept at their mathematics, it appears that (just like us sometimes) they had issues with academic silos. Shadows were part of time keeping and geography while sines were part of astronomy and trigonometry. It was not until the latter part of the tenth century when Abū-l'Wafā (940 – 998) working in Baghdad wrote his Almagest where he considered all six standard trig functions: sine and cosine, shadow (cotangent), inverse shadow (tangent), hypotenuse of the shadow (cosecant), and the hypotenuse of the inverse shadow (secant). He was able to illustrate them all in a single diagram which should look familiar to us.



Of course, if the radius of the circle is 1 (again only used much later), then we have the familiar $\sin(\theta) = AC,\ \tan(\theta) = BD$ and $\sec(\theta) = OD$. He illustrated the other functions by drawing the corresponding segments on the complementary angle drawn with the vertical line through O.

Unfortunately, not all Islamic scholars adopted this new way of doing things and preferred the standard method of computing shadows. It was this older version that came to Europe. In the last column, I mentioned Regiomantus's epic De Triangulis Omnimodis (On All Sorts of Triangles) written around 1450. He basically reviewed all that was known about trigonometry but did not use the tangent function at all restricting himself to sines and cosines. About 15 years later, he published a table of trig values and included a separate table that he called the Tabula Fecunda (Fertile or Fruitful Table) that was a table of tangent values. Of course, he did not call these tangent values but "fruitful numbers."

As mentioned last time, it was Georg Joachim Rheticus (1514 – 1574) who first talked about the six trig functions in terms of triangles rather than circles. He did not use a single triangle as we do, but had three separate right triangles where the radius alternated positions in the triangle. One of the triangles is the same as what we would use with the radius (which remember was not fixed) on the hypotenuse and the sine (times the radius, likewise with the others) becoming the opposite and the cosine the adjacent. The second triangle had the radius on the adjacent side which made the opposite the tangent and the hypotenuse the secant. The third triangle had the radius opposite the angle which yielded the cosecant and cotangent. This was an interesting idea, but led to confusion about which triangle was being referred to at any given time since saying "the adjacent side", for instance, could refer to three different functions.

Besides the sine which appeared in Latin in the twelfth century, the names we have for the trig functions are due to Thomas Finke (1561 – 1656). Fincke was a Danish mathematician and physicist. At that time, the tangent had no fixed name and was still called the fruitful number or the shadow. Fincke published Geometriae Rotundi (On Round Things) in 1583. He used essentially the same figure as Abū-l'Wafā. He noticed that the line segment BD (in my figure) was tangent to the circle and that OD cut the circle, so he thought that the names "tangent" and "secant" made sense. (Secant means "cutting.") He said, "The words, if not the things, are new, nevertheless they are, we hope, appropriate." He specifically called out "fertile number" and wondered how people could defend that name. He said, "Geometry herself has supplied an apt name." Of course, the other functions come from the complementary angle and would be co-functions.

Not surprisingly, Fincke's names were not immediately accepted, but it did not take long. Bartholomew Pitiscus (1561 – 1613) was born in what is now Poland and did most of his work in Heidelberg where he also was a theologian. He published Trigonometria in 1595 which covered plane and spherical trigonometry and became a standard reference for many years. By using this title, he coined the word that came to describe the subject. It was the 1614 translation that introduced the term "trigonometry" to English. Pitiscus used Fincke's names which led them to become accepted by the general mathematical audience. In later publications, he produced tables that expanded upon and improved Rheticus's tables including computations of the sine function to 22 decimal places for many small angles. It always amazes me what determined individuals were able compute by hand!

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