



California Mathematics Council Community Colleges

President’s Report

Jen Carlin-Goldberg, Santa Rosa Junior College



Greetings my fellow Mathematics Enthusiasts! I am excited to announce that CMC³ will hold our 48th Annual Fall 2020 *Virtual* Conference this December 11 and 12! The CMC³ Board spent the summer researching conference formats,

prices, and possible sessions. Our Conference Chair, James Sullivan of Sierra College, has put in an incredible amount of work into getting a plan laid out and recruiting exciting keynotes and session speakers. He reached out to the California Community College Chancellor’s office to request permission to use Zoom under their license, which the Chancellor’s Office was generously able to give. At our last Board Meeting, on September 26, we decided that the conference will be free to everyone who registers AND as an added bonus, registrants will receive one year’s membership for free! We

honor all the hard work that you have had to put in since March, whether you are teaching or not, and we want to be able to support you. You will still be able to donate money to support the organization and our scholarship efforts if you wish.

This conference will be fun and worthwhile. We will still recognize our outstanding teachers as well as members who have made significant contributions to our organization, and there will be several entertaining activities like our pre-Friday Keynote cocktail which our Past President, Katia Fuchs, is putting together. Our two keynotes this year, Jessica Bernards and Dr. Brittany Mosby, will further our quest to hear from new and interesting voices in the realm of mathematics education.

Our communities, our country, still grapple with a devastating pandemic while we also face another, more destructive, fire season. Our political climate makes it hard for many people to discern fact from fiction. Our jobs as educators, mentors, champions of reason are more important now than ever. The tools we teach are needed to tackle this world and to allow our students to feel the triumph of fearlessly facing a factoring problem, dealing with a difficult derivative, annihilating annuities, and perfecting probabilities. And you, magnificent mathematics educators, stay safe and take care of yourself. I hope to see you all this December!

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Update Your Calendar:

**48th Annual CMC³
Conference Will Be Online**

**December 11th and
12th, 2020**

Volume 49, Number 3 Fall 2020

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.

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48th Annual CMC³ Fall Mathematics Conference



*James Sullivan,
President-Elect/Fall
Conference Chair,
Sierra College*

You are cordially
invited to attend the

48th annual CMC³ Fall Mathematics conference. Our conference will take place virtually via Zoom on Friday, December 11, 2020 from 4:45 pm to 7:30 pm and Saturday, December 12, 2020 from 9:30 am to 2:15 pm (all times are Pacific Standard Time). You can register for the conference on the [CMC3 website](#). Registration is free and includes one year of membership in CMC³. I highly recommend you register today to take advantage of this tremendous value and professional development learning opportunity.

If attending a free online teaching mathematics conference and receiving a free year of membership in CMC³ is not enough to inspire you to register for the conference today, once you learn about our lineup of dynamic speakers and their intriguing presentation topics, you probably will. We have three breakout sessions with three presentations each to choose from over the course of two days and two keynote presentations (one to conclude each day) scheduled.

The Friday breakout session includes a presentation on “Why do we call it Algebra?” by Pat McKeague (an AMATYC Presidential Award recipient), a demonstration of a free co-requisite college-ready math system to support student success by Barbara Illowsky (of De Anza College) and Richard Rasiej (of Santa Monica College), and a talk titled “Introducing Inferential Statistics Early in the Course” by

George Woodbury (from College of the Sequoias).

Our Friday keynote speaker is Jessica Bernards (from Portland Community College). She received the Leila and Simon Peskoff AMATYC Award for her work with Project ACCESS. Her keynote will discuss what growth mindset looks like in a math class, the importance of it, and how you can foster this trait in your students.

The first Saturday breakout session includes a presentation titled “Engaging Students Online Through a Variety of Interactive, Asynchronous Activities” by Mike Greenberg (from City College of San Francisco), a review of research results examining the effect of replacing performance grades with self-reflection exercises in a Calculus course by Kevin Shryock (of Northern Illinois University), and a talk by Michael Sullivan (from Joliet Junior College) on “Using Real Data to Illustrate Statistical Concepts”.

The second Saturday breakout session includes a presentation by Donna Smith (of Sierra College) demonstrating how she leveraged the dynamic Top Hat platform to engage her trigonometry, college algebra, and statistics students in her online learning environment, a lecture by Guillermo Alvarez (of Cuesta College) introducing a pedagogy for distance education and a collection of materials (www.standardstatistics.com) which are free to use for the teaching and learning of statistics, and a talk titled “Mathematical Modeling for Community College Curriculum: Examples from the COVID-19 Pandemic” by Ying Lin (from Santa Rosa Junior College).

Our Saturday keynote speaker is Dr. Brittany Mosby (the Director of HBCU Success at the Tennessee Higher Education Commission). Her presentation “Teaching to Transgress: Mathematics as a Tool for Social Justice” will encourage faculty to view the mathematics classroom as a launchpad for the success of underrepresented and minoritized

students, rather than the barrier/gatekeeper it has traditionally been. In particular, she will discuss the importance of connecting mathematics to not just “real world” applications, but also meaningful, interdisciplinary problems that more accurately reflect the reality of 21st century citizens, and problems that value and celebrate, rather than minimize and silence, individual students’ identities and community connections.

In addition to our impressive slate of conference speakers, we are planning fun activities during the breaks between presentations. At the break before the Friday keynote presentation, you can participate in a social distancing conference cocktail happy (half) hour. Between the Saturday breakout sessions, you can solve a proposed math problem and share your solution. During the lunch break before the Saturday keynote presentation, you can participate in a special wine and cheese pairing opportunity offered by Foursight Wines. Visit the [CMC3 website](#) for more information and details about these activities and our 2020 virtual fall conference.



Happy Hour Anyone?

Leslie Banta, Mendocino College

Are you ready for the CMC³ conference on Dec. 11 and 12? I'm really excited to hear from our keynote speakers and fellow community college math educators! A free conference, great speakers, and a one-year membership... does it get much better? Yes, it does! We may be meeting remotely but that doesn't mean that we can't have a little fun and socializing. We have planned a keynote cocktail for Friday and a special wine-pairing at lunch on Saturday with featured wines and easy to prepare recipes from Foursight Wines.

Foursight Wines has offered a 2-bottle wine sampler with special pricing for conference attendees (a \$76 value for \$60, shipping included), a [dedicated order link](#) to make things easy, and they will be donating \$5 from each box purchased to the CMC³ Foundation to help support our scholarship program. Each wine-pairing box includes one bottle each of their estate grown Sauvignon Blanc and flagship Pinot Noir, along with 2 easy to prepare pairing recipes that are perfect for a mid-day treat.

Details for ordering the special CMC³ conference wine sampler box and keynote cocktail ingredients can be found at [CMC3 website](#) with other conference information. Order early so that you're fully stocked in December. Cheers!



Math Nerd Musings: Gratitude and Happiness



*Jay Lehmann, Editor,
College of San Mateo*

I'd like to express my gratitude to all the columnists in this paper. In the past 20 years of editing the newsletter, the number and breadth of columns has increased greatly! Somehow Kevin Olwell

has managed to continue to find interesting, engaging problems for us to solve. In addition to greatly enjoying Joe Conrad's conference presentations on the history of math, we get to read his colorful descriptions of famous mathematicians. Hal Huntsman challenges us to reflect about important equity issues and use cutting-edge pedagogy. And our newest columnist, Jeff Anderson, has written his first of many articles on using technology to effectively teach remote math courses.

Shifting wildly to another area of gratitude, my wife, Keri, and I had a lovely dinner outside (bordered by plexiglass) at a neighborhood French restaurant. After sheltering for the past six months, it was incredible to have a leisurely dinner, talk, and take in the San Francisco skyline, backlit by smears of purple and red as the sun set. Assuming a COVID-19 vaccine is produced that is effective, we will all be able to reclaim many pleasurable activities, and when we do, it will be an excellent opportunity to not

only experience gratitude the first time but every subsequent time. This is a gift because when we look for opportunities to experience gratitude, we open the door for happiness.

The good news is that we don't have to go out fine dining or wait for a COVID-19 vaccine to experience gratitude. It really is a glass half-empty versus half-full type of thing. I'm amazed how often I will persevere on the negative aspects of a situation when there are many positive aspects as well. For example, I'll tend to focus on students who are not applying themselves and don't respond to my efforts to motivate them, rather than focus on students who are working hard. But if I catch myself and shift my perspective, it's striking how much less stressed and happier I feel. That's not to say I give up on students who need a nudge!

Circling back to food, Keri and I have been doing a simple thing that we've greatly enjoyed. On Friday and Saturday nights, we get takeout, set the table including a tablecloth and lit candles, and pretend we're at a nice restaurant. Basically, this means we don't rush through dinner, taking time to have in-depth conversations. A couple of times, we randomly selected questions provided by the *New York Times* that were

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meant to spark interesting conversations, which they did! Since then, we've made up questions along the same lines, but custom-fit to us. We jokingly say we are eating at the restaurant "Chez Lehmann."

What things are you grateful for? Really sink into the reasons why you're appreciative. The key is to then notice an uplifting to your spirit. It might feel so good that searching for gratitude becomes a habit.

What's Happening at Hartnell College

Brian Palmer

Course Sequence Redesign

In response to AB705, we informally grouped students into several different groups, based on their mathematical needs. As we all now acknowledge, the basic algebra sequence has always been a pathway to Calculus, and very few students have needed such a demanding course sequence to be successful in lower-level terminal classes like statistics, or liberal arts mathematics. With this idea as a starting point, we have redesigned our course sequences to better serve student needs based on their academic goals. Our basic algebra offering is *intermediate algebra*, and we also offer an intermediate algebra course with a lab, for students with weaker math backgrounds. Intermediate algebra courses are intended for Associate's degree requirements for "STEM-adjacent" fields, and for students in STEM pathways who wish to take additional algebra before beginning the pre/



calculus sequence. STEM students mostly enroll in college algebra, fewer in intermediate algebra, and most non-STEM students take statistics. This, however, left a gap for students who do not intend to transfer to a four-year university, and are enrolled in a non-

STEM program. To fill this gap, we created a new course, *algebraic and quantitative reasoning*, which satisfies the Associate's degree requirements for students who do not intend to transfer to a four-year university. This is a survey course, with topics that may commonly appear in an applied setting, such as mathematical modeling (polynomial,



exponential, logarithmic); the theory of interest, investments, and debt; basic statistics and probability, etc. This course launched this fall, and recruitment for the course will continue for several semesters to promote better uptake by students and more familiarity among counselors.

Acceleration Support Courses

We have handled the new accelerated math pathways by providing lab classes to support students who need (or want) additional support. We currently offer labs for *intermediate algebra*, *statistics*, and *college algebra*. There is a mix of about 2/3 classes without supporting labs, and 1/3 with supporting labs. The labs are 1 unit of lab credit (3hrs a week) and are tied to a particular section of the course they support. For sections with a lab, participation in the lab is required of all students in the course. Over the spring and summer of 2019, several math faculty members developed course content for the support courses, and have since continued

to expand and refine the materials. Content ranges from prerequisite skills, to core course content, to study skills, to the meta-cognitive/affective domain. Each instructor’s treatment of this content varies considerably at this point, and the lab courses will no doubt continue to evolve over time. We have supported this ongoing development through regular community of practice meetings, where we share what has worked, what we’ve struggled with, disseminate helpful materials, and otherwise reflect on our successes and challenges.

Extracurriculars

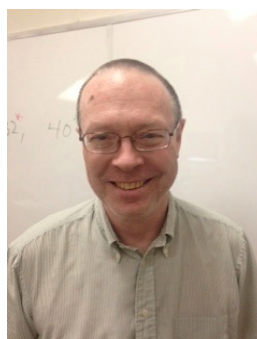
Hartnell College recently completed its 14th year of STEM internships, and the graduates from this program list a long line of accomplishments during and after their time at Hartnell. Student participants from this program have gone on to transfer to competitive STEM programs, complete many remarkable internships and REUs, and have begun careers in a wide variety of STEM-related companies and organizations. To expand this program beyond the traditional 40-hour-a-week model into a more equitable and accessible experience, we have recently begun offering *MicroInternships*, where the entire experience is a total of 25 hours. To date, we have had hundreds of students complete a MicroInternship, and these experiences serve as valuable resume-building activities, as well as stepping stones to longer-format internships.

The Pleasures of Problems

Kevin Olwell, San Joaquin Delta

Fall 2020: Let a, b, c and d be positive real numbers. Then

$$a + b + c + d \leq \frac{a^2 + b^2 + c^2}{a + b + c} + \frac{b^2 + c^2 + d^2}{b + c + d} + \frac{c^2 + d^2 + a^2}{c + d + a} + \frac{d^2 + a^2 + b^2}{d + a + b}.$$



Summer 2020: The floor function, $[x]$, is the largest integer $\leq x$. For example $[\pi] = 3$. Let m and n be positive integers with no common factor. Find a formula for the

following expression:

$$\left[\frac{m}{n} \right] + \left[\frac{2m}{n} \right] + \dots + \left[\frac{(n-1)m}{n} \right].$$

Thanks to Carlos Valencia, Fred Teti, Joel Siegel and Chuck Barnett for submitting answers.

Long division with remainder gives

$$\begin{aligned} \frac{km}{n} &= q_k + \frac{r_k}{n} \\ \left[\frac{km}{n} \right] &= q_k = \frac{km}{n} - \frac{r_k}{n} \\ \sum_{k=1}^{n-1} q_k &= \left(\frac{m}{n} \right) \sum_{k=1}^{n-1} k - \left(\frac{1}{n} \right) \sum_{k=1}^{n-1} r_k \\ &= \frac{m}{n} \cdot \frac{(n-1)n}{2} - \left(\frac{1}{n} \right) \sum_{k=1}^{n-1} r_k. \end{aligned}$$

It turns out that the sequence of remainders (r_1, \dots, r_{n-1}) is just a permutation of $1, \dots, (n - 1)$. To see why we make a couple of preliminary observations.

- All the r_k 's are nonzero.

Suppose one of the remainders is zero. Then

$$\frac{km}{n} = q_k.$$

Each prime factor of n must cancel some prime factor in the numerator. Since m and n have no factors in common, this means that n must divide k . But $k < n$.

- All the r_k 's are distinct.

If not, then for some $k > j$ we get

$$\begin{aligned} \frac{(k - j)m}{n} &= \left(q_k + \frac{r_k}{n} \right) - \left(q_j + \frac{r_j}{n} \right) \\ &= q_k - q_j. \end{aligned}$$

This contradicts the previous observation.

Since there are exactly $(n - 1)$ nonzero integers between 0 and n , and there are $(n - 1)$ distinct nonzero remainders, r_1, \dots, r_{n-1} must be a permutation of $1, \dots, (n - 1)$. Hence

$$\begin{aligned} r_1 + \dots + r_{n-1} &= 1 + \dots + (n - 1) \\ &= \frac{(n - 1)n}{2}. \end{aligned}$$

A very elegant solution by Carlos Valencia uses the technique to sum an arithmetic series. Write the series twice, the second time with the terms in the opposite order, and then add column by column. A typical sum is

$$\begin{aligned} \left\lfloor \frac{km}{n} \right\rfloor + \left\lfloor \frac{(n - k)m}{n} \right\rfloor &= \left\lfloor q_k + \frac{r_k}{n} \right\rfloor + \left\lfloor m - q_k - \frac{r_k}{n} \right\rfloor \\ &= q_k + m - q_k - 1 \\ &= m - 1. \end{aligned}$$

Since there are $(n - 1)$ columns, we obtain $2S = (n - 1)(m - 1)$.

Although the original sum does not seem to be symmetric in m and n , the obvious symmetry of the solution invites an explanation. In the (x, y) -plane let R denote the rectangle $[1, n - 1] \times [1, m - 1]$ and let L denote the line $y = (m/n)x$. The sum in the problem counts the integer lattice points in R below L . Interchanging $m \leftrightarrow n$ in the sum counts the points to the left of L .

Geometrically the symmetry in m and n says that L divides the lattice points in half. To see why rewrite the formula established in the 2nd proof:

$$\left\lfloor \frac{km}{n} \right\rfloor = (m - 1) - \left\lfloor \frac{(n - k)m}{n} \right\rfloor.$$

This equation says that the number of lattice points below L when $x = k$ (the left side) is equal to the number of lattice points above L when $x = n - k$ (the right side). Summing both sides over k says that the total number of lattice points below L is the same as the total number above.

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

kevin.olwell@icloud.com

The Story of Knowledge



Hal Huntsman, Antelope Valley College

Knowledge came to my office hours in November 2019. On those pre-COVID-19 days when a student could just appear at your door, she came to interview me about my

Pre-Calculus class for the spring 2020 semester. She wanted to know how I ran class and how I graded and other things that students are concerned about.

Knowledge is real student, and though that's not her legal name, it's what she prefers to be called. She is around 20, African-American, and wants to be an engineer. She didn't complain, but it was clear to me that she was used to being stereotyped and doubted as a woman of color in a STEM field. She wanted to know if I was going to judge her by who she was rather than the quality of her work.

On the first day of precalculus in January 2020, Knowledge sat in the front row. She asked a lot of questions, engaged fully during class, and did all her homework on time and completely. However, when she took the first exam—a traditional in-class exam, she struggled. By March, when we went into remote learning mode, despite her working hard, she was barely passing the class.

For the rest of the semester, this first-generation college student, who would be considered “at risk” by many, almost never came to synchronous Zoom class sessions. Her family life had been turned upside down and she had to play some new support roles at home. Since the school was closed, she had no consistent quiet place where she could study.

That's when she started missing assignments. I reached out to her by email and

text app, and she always responded, but sometimes not for a couple days. She would catch up and then get behind, again. As we neared the first exam in remote mode, I was pretty worried about her.

When the quarantine started, I changed the way I tested my students. I was not interested in trying to police my students during tests, so I eschewed the use of cameras or other methods of seeing what they are doing during their tests. Instead, I treated the exams as take-home exams and made it clear to students what resources they were allowed to use. More importantly, I asked different questions and stressed explanations and thinking rather than a relatively schematic series of steps. I also stopped penalizing students for turning in late homework. As long as they completed the work by the end of the semester and demonstrated learning on the exams, they would meet the learning outcomes for the course.

I made these changes in response to the extraordinary circumstances of a global pandemic, but I intend to continue these practices, because I've come to see that “answers” and turning in homework on time are not very important. Moreover, I've also realized that traditional tests and homework deadlines are often barriers to student success, especially for first-generation and underrepresented students. I have the power to remove that barrier, so I have done so.

On that first remote exam in precalculus, I gave students 16 hours to complete the test. Knowledge asked for a few extra hours. When she turned it in, she wrote to me that she had worked on the exam almost non-stop for the entire time. And, boy, did it show. Her work and explanations were beautiful and complete – not all correct, but all thoughtful and full of critical, mathematical thinking.

After that, as she continued to be an integral part of her family's support system,

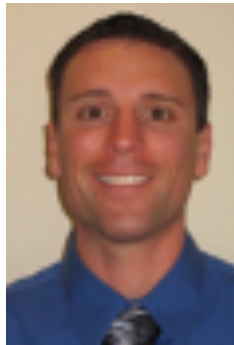
she also continued to be spotty about getting work in on time, but she completed almost all assignments by the end of the semester and turned in an excellent final exam. Again, she didn't solve every problem correctly, but she demonstrated excellent thinking and process.

Knowledge earned a B in the course. In her final exam she wrote that having more time on the tests allowed her to feel less pressure and to really learn from the test questions. She also wrote that my repeated checking in with her, and allowing her to turn in late work, had helped keep her in the class despite feeling desperate and uncertain of how she would survive everything that was happening for her at home and at school.

I don't know how she would have done if we had not gone to remote learning. I'd like to think that she would have passed, but I'll never know. What I do know is that she did better than surviving in my class. She thrived. By shifting the way I assessed my students, I removed a barrier to her success, increased her confidence, and promoted her learning. As a teacher, I can think of nothing more important.

Questions? Comments? Want to connect? Reach Hal at: shuntsman1@avc.edu.

We Can Do It: Capture Video Content



Jeff Anderson, Foothill College

The COVID-19 pandemic has forced us to reimagine how we do our work and to develop new skills to support our students. One powerful tool we can use to enhance student learning is to provide custom content using online videos. But learning how to produce videos is nontrivial. In

this article, we explore ideas and resources to help you get started on the journey of producing videos that empower your students and energize the classroom.

Build a Studio: One of the first steps in learning to produce videos is to build an educational recording studio. This requires a lot of thinking, planning, and energy. I built my first home recording studio in 2010 and have been recording instructional videos ever since. In light of this pandemic, many of my colleagues at Foothill College have asked for my help in creating their own recording systems.

After numerous one-on-one meetings spanning tens of hours, I decided that I needed a more efficient strategy to share my knowledge and support fellow college instructors who want to learn how to produce their own videos. With these goals in mind, I created a blog at <https://jeffandersonmath.wordpress.com/>. My first posts highlight ideas about how to set up a home recording studio. These include a list of criteria I use to purchase equipment and an example list of gear I might buy today if I were setting up a studio from scratch.

Choose a platform: After you set up your studio, you'll probably film your first video and be ready to share. At this point, you'll need to decide which platform to use to host your content. A very natural choice is to embed your videos directly into Canvas. Through [Canvas Studio](#), you can upload,

record, view, and share videos. There is also a [built-in feature to add captions](#) and make your content accessible.

Another option is to use [3Cmedia Solutions](#), which is part of the California Community College's [TechConnect project](#). As stated on their website, 3C Media Solutions focuses on supporting our system's distance learning initiatives by "providing services to acquire, store, share, and distribute educational media and professional development programming." There is also a [built-in captioning feature](#) on this platform.

[YouTube](#) is also an option. In my case, I host my videos on YouTube. But, I have made a commitment to myself that my videos are available free of advertising. I also intend NOT to monetize any of my content on this platform. My goal is to make content that is easy to access, publicly available, and free from distracting advertisements. For a more famous example of a math educator who uses YouTube without monetization, you can YouTube search "Eddie Woo Math." This high school teacher recently reached one million subscribers and does not host advertising on his YouTube channel.

Get Funded: Video equipment and production time are expensive. However, there are many ways to find money to build your systems. I have purchased most of the equipment I use out of my own pocket by teaching overloads or using [grant money](#). Generally, I dedicate any income beyond my normal paycheck to this type of work.

If you do not feel strongly about owning your own equipment, try speaking with your department chair or division dean about using school money to purchase production tools. For example, the [Foothill College PSME Division](#) pays for a [Camtasia license](#) that is freely available to faculty and staff in our division. Foothill College also has a system for requesting equipment purchases

for instructional use. I discuss many more ideas about how to fund these types of projects on my blog.

One challenging aspect of video production is to ensure all video content is [ADA compliant](#). The state of California provides money for this purpose. Specifically, the [Distance Education Captioning and Transcript \(DECT\) Grant](#) is designed to help community college instructors get videos captioned. If you want to learn more about using this money, reach out to the talented staff at your school's Disability Resource Center about the application process. Chances are that your school already uses DECT Grant money to caption videos. You might also [contact Justin Manalang](#), the friendly and responsive DECT Grant Program specialist and ask more about how the application process works at your school.

Next Steps: Like all great things in life, learning to make videos is a challenging process that requires lots of time. If you have an interest in this subject, I encourage you to create mechanisms to develop these skills as part of your daily work life. For example, you might read the book [How to Shoot Videos that Don't Suck](#) to learn more about the technical aspects of filming. Or, you might read [Flipped Learning: A Guide for Higher Education Faculty](#) to help redesign your classes and leverage the content you produce.

In addition to professional development, I recommend building a community of practice with other educators who share this interest. On a weekly basis, I interact with at least four other professional friends who actively produce content. We share ideas, ask each other questions, celebrate small successes, and encourage each other to stay positive when the going gets tough. Video production is a labor of love that is not currently remunerated as part of our normal work responsibilities. Thus, it can be

(See "Video Content" on page 17)

Math Girls 4: The Fourth Book in The Math Girls Series

Dean Gooch, Santa Rosa Junior College

All of the “Math Girls” series of books were originally written in Japanese by Hiroshi Yuki and deftly translated by Tony Gonzalez. I first noticed these books at a JMM conference and met Tony Gonzalez at his table for Bento Books, Inc. He told me of these wonderful teenage novels where the heroes were mostly young women exploring mathematics and making mathematics and the trials of learning more and more mathematical concepts the center of their social life.

These books have become very popular in Japan Tony tells me. As Tony lives a little outside Tokyo and makes his living as a technical translator of Japanese mathematical papers into English, I assume he understands these aspects of popular Japanese culture quite well.

It seems that no mathematical topic is left untouched in the “Math Girls” series. Sequences and Series, Fermat’s Last Theorem and Gödel’s Incompleteness Theorems are the focus of the first three volumes with little digressions that get the reader to learn and review other mathematics topics.

Hiroshi Yuki roughly bases his stories on the mathematical adventures and misadventures during his years in high school.

Not including the narrator, there are four main characters. Miruka is the really brilliant mathematician who teaches everybody mathematics at a higher level than one would expect from a young person in high school. Tetra is a year below the narrator and Miruka and is likewise brilliant but is always questioning the validity of hers and everyone else’s mathematical thinking.

Yuri is the cousin of the narrator and is only in middle school, but always seems to be in the narrator’s house whenever he has

important studying to do with her own mathematical questions. She worships the narrator’s friends Miruka and Tetra.

New to the fourth novel is the blue-hair computer genius, Lisa, who has just entered into their high school. While the characters respectfully argue about algorithms, Lisa is usually coding their thoughts to demonstrate using her bright red laptop.

I always find these novels great inspiration for examples in my teaching. The author uses simple examples that are very thoroughly explained. After all, his target audience is a young adult one. Even though I have taken a course in complexity theory, I feel I now understand it so much better after reading “Math Girls 4.”

The most recent volume’s full title is *Math Girls 4, Randomized Algorithms*. This book explains complexity theory using randomized algorithms and the importance of considering randomized algorithms in computer algorithm analysis. Other topics that are included in the story are The Monty Hall Problem, probabilities and expected values, the binomial probability distribution and expansion, matrix diagonalization and random walks.

The book is written with a lot of love and humor using LaTeX 2 and AMSTEX, with some of the whimsical fonts that were thought up by Donald Knuth such as die faces. Daniel Defoe’s *Robinson Crusoe* is quoted often along with mathematicians including Donald Knuth and Ron Graham. For example, *The Art of Computer Programming* by Donald Knuth and *Concrete Mathematics* by Graham, Knuth and Patashnik are referred to often.

Tony Gonzalez tells me that there is at least one more “Math Girls” book to be translated. I can’t wait. The most recent one came out in March of this year, but I had other things on my mind at that time and did not order my copy until recently. I highly recommend this book for mathematicians of all ages.

The History Corner



*Joe Conrad, Solano
Community College*

My favorite course to teach is Calculus 2 not because of integration techniques or applications of the integral but because of series. I find that this is where students can have their minds stretched considering some of the beautiful results that often do not match their intuitions. One of those results is the divergence of the harmonic series. Most calculus texts that I have seen prove this using a comparison by grouping the terms so that each group has sum greater than one half and since there are infinitely many groups, the series must diverge. What has always amazed me about this proof is that it was first given in the 14th century by Nicole Oresme. The amazing part to me is that there are few theorems outside geometry or number theory where modern authors use such an old proof. I thought I would address this column to learning more about Oresme and his contributions.

Nicole (or Nicholas) Oresme was born around 1323 somewhere in Normandy, France. He studied at the University of Paris. He earned a Masters in Theology in 1355 and was named a Master at the College of Navarre the following year. Around this time, he became friends with the Dauphin of France who became King Charles V in 1364. Charles was known as the Wise and part of the reason was because he surrounded himself with good advisors including Oresme. Oresme translated

several classical works from Latin to French for Charles as well as advising him on economic issues. Charles rewarded him by appointing Oresme bishop of Lisieux in 1377. He held this position until his death on July 11, 1382.

Oresme was one of the premier philosophers of the era. Not only did he write about mathematics, he also discussed theology, economics, philosophy, music and physics. He was among the first who were willing to suggest that the Aristotelian view of the world was not correct. Oresme questioned Aristotle's views on such things as place, time and motion. He dared to suggest that the earth was not stationary but did affirm that he believed it was. He also strongly opposed astrology on religious and scientific grounds.

In the area of mathematics, Oresme also had some revolutionary ideas. He developed the concept of rational exponents and used them in physical applications. He suggested that some exponents could be irrational, but his lack of good notation hindered his ability to develop the idea. Despite some suggestions, he did not develop a coordinate system before Descartes and Fermat, but he did link quantities in a way that presaged graphing functions. He used geometric ideas, where the height of a figure corresponded to the velocity of an object at the time corresponding to the position on the base of the figure. He used this idea to prove the so-called Merton Rule developed a couple decades earlier by Thomas Bradwardine (ca. 1290 – 1349), which says that the distance traveled by a uniformly accelerating object with a given initial velocity is equal to the distance traveled by an object with velocity that is equal to the average of the initial and final velocities. Oresme's argument foreshadowed Galileo's nearly three centuries

later concerning the velocity of a falling body, but Oresme never applied his work to this situation.

It is time to talk about Oresme's work on series. As I mentioned, he was the first to prove that the harmonic series diverges. Beyond the harmonic series, he also discussed convergence and divergence of geometric series and presented the correct conditions on the common ratio so that the series converges. He did not find the general formula for the sum of a convergent geometric series but did find the sum for several particular series using geometric methods. For example, to find the sum of $\sum(1/2^n)$ he cut a unit square into vertical strips of width $1/2, 1/4, 1/8, \dots$, which would exhaust the area of the square. Adding that to another unit square, he got the sum to be 2. He also found the exact sum of the series $\sum(n/2^n)$ to be 2 using another geometric argument that was probably the first time that someone used a figure of finite area but infinite extent in a proof. Much of Oresme's work, including the proof of the divergence of the harmonic series, became hidden to future mathematicians due to the dark times of the 14th century. Fortunately for us, his work, both mathematical and in other areas, came to light in later centuries.

The next person to prove the divergence of the harmonic series was Pietro Mengoli (1626 – 1686). Mengoli was an early master of infinite series and had many new results including that the sum of the alternating harmonic series is $\ln 2$. His proof that the harmonic series diverges was not the same as Oresme's, and since I have not done any math so far, I will include it here. He used a proof by contradiction. Assuming the series converges, let S be the sum. Now group

the terms as follows:

$$S = 1 + \left(\frac{1}{2} + \frac{1}{3} + \frac{1}{4}\right) + \left(\frac{1}{5} + \frac{1}{6} + \frac{1}{7}\right) + \left(\frac{1}{8} + \frac{1}{9} + \frac{1}{10}\right) + \dots$$

Using a bit of algebra, it is easy to show that

$$\frac{1}{x-1} + \frac{1}{x} + \frac{1}{x+1} > \frac{3}{x}.$$

Consequently,

$$\begin{aligned} S &= 1 + \left(\frac{1}{2} + \frac{1}{3} + \frac{1}{4}\right) + \left(\frac{1}{5} + \frac{1}{6} + \frac{1}{7}\right) + \left(\frac{1}{8} + \frac{1}{9} + \frac{1}{10}\right) + \dots \\ &< 1 + \frac{3}{3} + \frac{3}{6} + \frac{3}{9} + \dots \\ &= 1 + 1 + \frac{1}{2} + \frac{1}{3} + \dots \\ &= 1 + S \end{aligned}$$

This is a contradiction, so the series must diverge. Unfortunately, this proof was also lost for a time which is why Jacques Bernoulli has been credited with proving this result in 1689.

Nicole Oresme was ahead of his time mathematically and was an innovative thinker in other areas as well. Had he lived three hundred years later he may have been listed among the great 17th century mathematicians. He is definitely at the top of the list of 14th century mathematicians!

What's Happening at Columbia College

Lahna VonEpps

Hello CMC³ community! There have been a lot of things going on at Columbia College Mathematics department in this last year. In addition to the common experience of the COVID-19 transition to all-online-all-the-time in the midst of spring 2019 semester, we also experienced huge changes in staffing.

We said a fond farewell to our long-time math department lead Maryl Landess who retired after over 30 years at Columbia College. Maryl is enjoying her retirement by walking every day and rubbing it in that she isn't spending hours on Zoom calls every day.

We said another fond farewell to Anne Cavagnaro in her retirement from the college after serving for more than a decade. Anne is enjoying her retirement by planning her move to the big island in Hawaii, where she looks forward to beautiful runs without having to grade for hours on end.

We said yet another fond farewell to Casey Bonavia in her retirement from running our Math Achievement Center for

over 30 years. Casey is enjoying her retirement by working on her tiny home and continuing to help students as a private online tutor.

On a personal note, Casey was my boss when I was a student working in the math lab back in the late 90s and Maryl was my statistics and calculus teacher. Both of these incredible educators have been my mentors and friends for my entire career and were instrumental in setting me on my path to become a math teacher. I am forever grateful to them both.

New in our math department are Katryn Weston, Gurprett Deol, and Blanca Lopez. Katryn is a long-time part-time instructor and holds the distinction of also teaching Columbia College's first online math class years ago. Gurprett and Blanca both join our part-time pool. As a note, if your college has not already transitioned to calling instructors "part-time" instead of "adjunct" please consider the definition of "adjunct:" a thing added to something else as a supplementary rather than an essential part." Our part-time faculty are absolutely essential and colleges would not function without them.

The continuing department members are myself, Lahna VonEpps (current



department lead and senior full-time member with 12 years), Jim Retemeyer (6 years FT and lead member for the sierra conservation center math program), Joe Manlove (5 years FT and our current SLO coordinator, faculty advisor to the Columbia College outdoor club, and computer programming instructor), Meg Rosacco (part-time and essential faculty member who leads the department in statistics).

Raelene Juarez, our Dean of Arts, Science, and Health and human performance often joins our meetings and gives insight. (You should be jealous, she's wonderful). Joey Partridge is filling a bit of the gap left by Casey Bonavia in her role of instructor support.

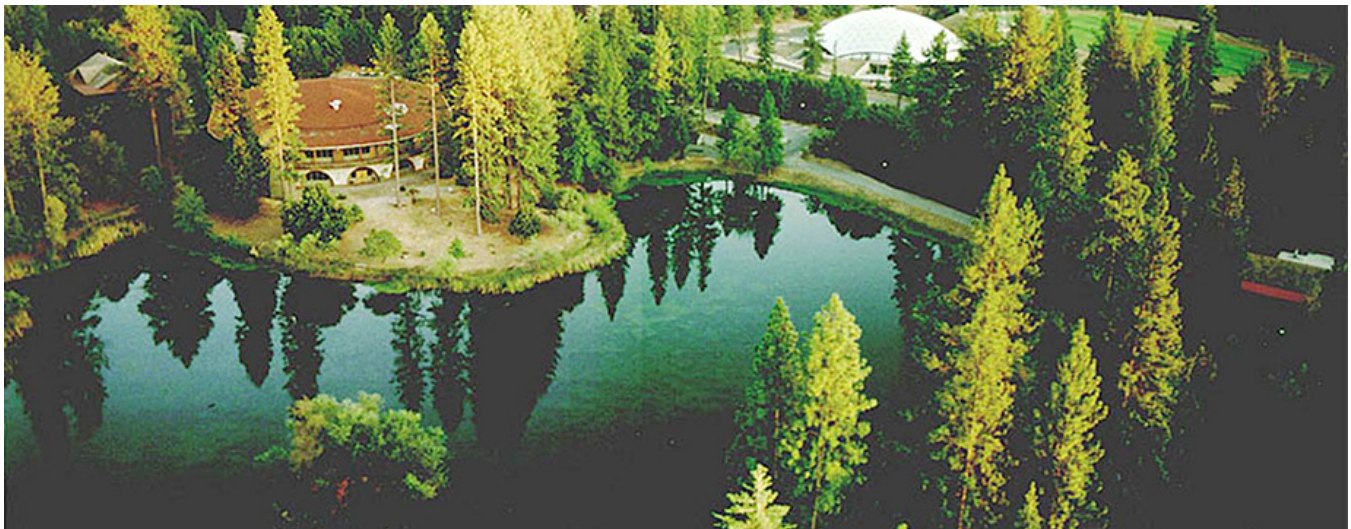
I hope you are all staying sane and finding moments of joy in the midst of all the turmoil brought by a pandemic, an election year, and online teaching. Weren't there supposed to be murder hornets too?

Video Content

(continued from page 12)

very helpful to have a team of people on your side as you struggle through the learning process.

One of the last benefits of this practice of making videos is the ability to share content with fellow educators. I invite you to use any of my content in any class you'd like. On my YouTube channel, www.youtube.com/c/JeffAndersonMath/, I share over 540 videos on topics including multivariable differential calculus, linear algebra, intermediate algebra, and introduction to MATLAB. Over the next few years, I plan to build out my library. I am working to make sure all these videos are closed-captioned and fully accessible for in-class use. As you build your own online libraries, I encourage you to share your content with others. Such sharing is a great way to leverage your school's resources, support your full- and part-time colleagues, and save students money.



Ronald Lewis Graham

October 31, 1935 to July 6, 2020

By Dean Gooch, Santa Rosa Junior College

I was very saddened to learn that Ron Graham has passed away. He was very active in the mathematics community until his death. His contributions to mathematics and the art of juggling are denumerable. Two of my favorite books that he participated in writing are *Concrete Mathematics* by Graham, Knuth and Patashnik and *Ramsey Theory* by Rothschild, Spencer and Graham. Both of these books have become huge time-wasters in my life and I have learned much from them.

I first met Ron Graham when he spoke for CMC³ many years ago. He was warned that many in the crowd did not have a very thorough understanding of combinatorics and that his talk should be simple. At the time, Graham worked for Bell Labs, and he gave a talk about the complexities of having a telephone grid that reached all small towns in the United States as well as metropolitan areas. He drew simple graphs of power lines that showed how difficult it was to do this without making the grid extremely expensive to operate. He was essentially showing a shortened example of the “Traveling Salesman Problem” on a graph with weighted edges. He did not address the greater problem, nor did he try to show how to algorithmically solve this problem. I remember loving his talk and being surprised that many participants at that conference complained that he had gone completely over their heads. I am not sure why with the lack of substance in this talk how anyone would have had difficulties understanding the talk. Perhaps, it was the fact that Ron Graham was speaking.

Several years later, Ron Graham was asked to speak again at the Tahoe conference. He was warned that his talk had to be simple. He gave the same talk, but even more

simplified. There were the same complaints as before.

By that time Ron Graham was working at UC San Diego and became a fan of the Tahoe conference. He appreciated the mountain air and the ability to practice discrete probabilities. He may have spoken for CMC³ a couple of times more at Tahoe. The last time he spoke for us, his talk was on juggling with demonstrations and a private break-out session to teach juggling for those who were so inclined.

I brought my copy of *Concrete Mathematics* in the hopes of getting a signature but he chided, “You know we have a new edition of that book and it’s much better.” I withdrew my request.

Ron Graham was one of the head researchers in mathematics at Bell Labs. While there, he was working with students through Rutgers University. When I thought my life might have time for a PhD, I considered applying to Rutgers in order to try and work with him. It did not work out. I ended up getting a full-time position at Diablo Valley College.

In the later years of the life of the famous itinerant mathematician Paul Erdős, Ron Graham had an extra apartment built on his New Jersey home so that Erdős could come and go as he pleased and have a more permanent place to stay. Ron Graham and Paul Erdős had collaborated often on papers. It is said that Graham was not happy that Erdős would beat him at table tennis.

It is rare that we have talks given by one of the true mathematical geniuses of our time at our conferences at CMC³. We were very lucky that Ron Graham was kind enough to speak at CMC³ conferences and entertain our organization on a number of occasions. If there is a mathematical heaven, then I think having an Erdős number of one would be sufficient for Ron Graham to gain entrance. I hope that his spirit, if it exists, will enjoy solving problems in that space.

Calendar

Visit the CMC website (<https://www.cmc-math.org/conference-overview>) for current information and details about their upcoming conferences.

November: AMATYC, Online (more info to come at <https://amatyc.site-ym.com/>)

December 11–12, 2020: CMC³ 48th Annual Conference, ONLINE. Contact James Sullivan, Sierra College, (916) 660-7973, jsullivan@sierracollege.edu

April 23—24, 2020: CMC³ 24th Annual Recreational Mathematics Conference (may be online or cancelled; more info to come via next issue of newsletter, website, and possibly e-mail). Contact: Larry Green, Lake Tahoe Community College, (530) 541-4660 ext. 341, drlarrygreen@gmail.com

Jay Lehmann

Editor

CMC³ Newsletter

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