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Cal Poly Pomona Mathematics and Statistics

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Chair's Message

Berit Givens

Hello to the math faculty, students, and staff! I'm happy to be back for my second year as Department Chair. This year promises to be especially eventful as we all prepare for semester conversion. We are making some big changes to our curriculum that I think will improve the students' experiences. For example, MAT 310 is going to be 4 units for a full semester, allowing students more time to master proofs and fundamentals of mathematics at the upper-division level. I'm also very excited about the redesigned complex analysis course (MAT 428), which will cover some really fun topics, like residues, that haven't usually fit into the quarter schedule. We are still working on putting together more videos and handouts, plus a soon-to-be-unveiled webpage to explain all the changes. Keep your eyes open for announcements.

For those new to the department, my best advice is to get involved in departmental activities. For students, we have two clubs: Kappa Mu Epsilon and SIAM. For students and faculty, we have colloquia every other week, usually on Wednesdays at 1:00 or Thursdays at noon. Attending colloquia is a great way for students to learn a little bit about different types of math, without the pressure of exams or homework. For me, attending colloquia is a chance to learn something new, relax for an hour, and get ideas about different topics I might like to research more in the future.

There are two things I like most about mathematics. First, I've always enjoyed solving puzzles. I love crosswords, I love sudoku, I love logic puzzles. Every new math problem is like another puzzle for me. Second, I like seeing how all the pieces fall into place and everything is logical and makes sense. Recently I was working on some math with a colleague. We weren't sure if we had any mistakes. "But," I said, "there can't be a mistake. This is too beautiful to be wrong." For me, it is always satisfying when the mathematics works out so perfectly. I hope that your mathematical endeavors are equally as satisfying for you right now.

Finally, I'll end with a question about integrals: The graph of the function $y = \sqrt{4 - x^2}$ is the upper half of a circle. When you integrate it from -2 to 2 , you should get the area of half of a circle. If you multiply by x , you get the function $y = x\sqrt{4 - x^2}$, which is odd, so when you integrate it from -2 to 2 , you should get zero by symmetry. In general, what is the formula for the integral $\int_{-2}^2 x^k \sqrt{4 - x^2} dx$ for different values of k ? Can you find any patterns?

Dr. Fernando Lopez-Garcia

Fernando Lopez-Garcia was born in Buenos Aires, Argentina. He obtained his PhD in Mathematics from Universidad de Buenos Aires in 2010. In 2009, he moved to Boston, Massachusetts with his then girlfriend, now wife and mother of his daughter Milana. After a six month visit at Massachusetts Institute of Technology as a Research Affiliate, he had two Visiting Assistant Professor positions at Worcester Polytechnic Institute and University of California Riverside from 2011 to 2017. His research interest lies in Analysis, specifically in spaces of functions on irregular domains.

He was raised in a family where discussions about education were usual and he started teaching mathematics early during his Licentiate in Mathematics. When he is not doing math, Fernando loves spending time playing with Milana. He also enjoys watching sports, hiking, cooking, and hunting for jazz records in flea markets. Fernando is excited about this position and is looking forward to collaborating with the faculty and students at Cal Poly Pomona.



Dr. Jimmy Risk

Jimmy Risk grew up in Michigan, receiving his Bachelors in Mathematics with an actuarial specialization at Michigan State University in 2010. He continued there to receive his Masters in Statistics in 2013, afterward making the trek to California, where he obtained his PhD in Statistics, with an emphasis on financial math, in 2017. His research areas are computational statistics with applications in financial math and actuarial science. So far, his research has centered around use of Gaussian Process regression, a tool recently popularized in machine learning applications. He is honored to serve as a faculty member at Cal Poly Pomona, especially as someone who can introduce students to financial math and actuarial science.

In his spare time he spends a lot of time playing card games and video games. Semiannually, he even makes trips across the US to attend gaming charity events. More recently, his focus has been on rhythm games, and you might even run into him at the local Round 1 or the Cal Poly arcade!



Déjà Vu and Many Things New

Mits Kobayashi

sab·bat·i·cal (n)

a period of paid leave granted to a university teacher or other worker for study or travel, traditionally one year for every seven years worked.

Walking around my graduate campus, seeing the professors who taught my graduate courses, and discussing research with my graduate advisor, all felt like déjà vu. The only difference was that I didn't know any of the graduate students. I had been away for six years, but I quickly got used to life back at Dartmouth College.

The purpose of my sabbatical was to expand my range of research for both personal and student work. The original plan was to work with my former advisor, Carl Pomerance, on a new research project, improving bounds on the count of primitive nondeficient numbers. But I quickly found other projects to work on as well. I learned that my interests overlapped with two other Dartmouth faculty, Naomi Tanabe and Edgar Costa, and started collaborations with them on discovering telescoping series expressions for zeta function values and attacking the Erdős-Moser conjecture. An undergraduate student, Jared Lichtman, worked with me to determine the sum of reciprocals of the primitive nondeficient numbers. The most far-flung collaboration I started was with Tim Trudjian at the Australian National University to determine bounds on the density of a set of numbers closely related to abundant numbers.

I sat in on one class per quarter: Lie algebras and Lie groups in the fall, Modular forms in the winter, and Hilbert's tenth problem in the spring. Lie (pronounced "lee") algebras are outside my specialization of number theory, so this was my way of "taking in some culture." Modular forms are an exciting area of number theory popularized by the solution of Fermat's Last Theorem by Andrew Wiles in 1994. Hilbert's tenth problem (the

tenth of 23 problems that Hilbert proposed in 1900) deals with Diophantine equations, and was solved by Matiyasevich in 1970. It was satisfying to see the complete proof of this major theorem within the span of a few weeks.

Besides my studies, some highlights of my time away include the long drive across the country from California to New Hampshire. I took a circuitous route through Colorado, Arkansas, Tennessee, and Mississippi, which left only seven states that I have not yet visited. I viewed the Colorado River from Colorado, the Mississippi River from Mississippi, Lake Michigan from Michigan, and the Connecticut River from Connecticut. My family

dug for trilobites in Utah and explored a salt mine in Kansas. On the appropriate day, we drove from New Hampshire to Kentucky, 17 hours away, to view the total solar eclipse. In rural New Hampshire, I enjoyed mountain hiking, sometimes with snowshoes, and kayaking.

Once, I even tried my hand at lumberjacking!

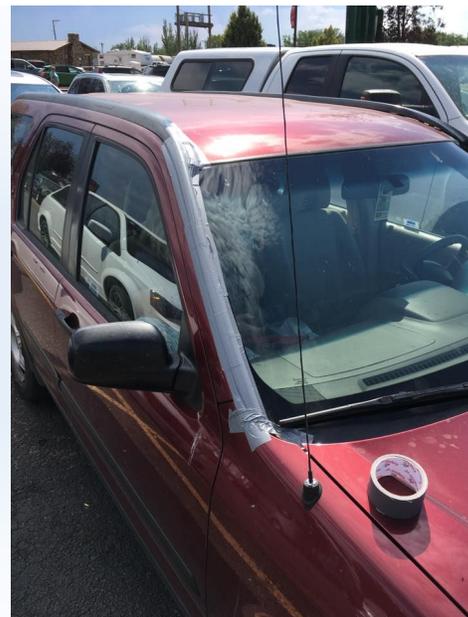
On my last day at Dartmouth, I visited the Rauner Special Collections Library which housed a copy of Leonhard Euler's two-volume *Introductio in analysin infinitorum* (Introduction to analysis of the infinite). I was surprised to learn that I would be allowed to touch it and carefully leaf through the book. It was a thrill to see the year MDCCXLVIII on the cover page, and to admire the beautifully drawn figures. I was even treated to some number theory in the form of continued fractions.

After such a refreshing change of pace, I am well-prepared to return to my teaching duties back at Cal Poly Pomona. If something in my whirlwind description of my sabbatical interests you, let me know. I'd be happy to chat about details of my research and my time back at my alma mater.

"I was surprised to learn that I would be allowed to touch it and carefully leaf through the book."

Always Pack Duct Tape

Arlo Caine



I'll bet that's not a title you were expecting to see in the Math and Stats department newsletter. But it's good advice and a lesson learned during my sabbatical over the 2016-2017 academic year. I spent the year away from Cal Poly Pomona on a half-time visiting professorship at

the University of Notre Dame (ND). To journey there and back, I drove my family 2900 miles across the country one way and then 2900 miles back, learning the lesson of the title on the way home.

While at ND I spent a great deal of time focused on mathematics, proving new theorems in Poisson geometry and developing a paper on text recognition via computational topology and geometry, and teaching a proof based Honors Calculus course. The Poisson geometry project, joint with Prof. Berit Givens of CPP and Melinda Lanius, a graduate student at the University of Illinois Urbana Champaign, aims to compute the Poisson cohomology of quadratic Poisson structures on affine space.

Cohomology theories compute invariants about mathematical objects which can be used to answer

hard questions about what is possible or impossible to do with them. A Poisson structure on a space is a certain kind of tensor which solves a semi-linear partial differential equation. There are many such structures on a given space, but on affine space it is possible to consider those which are quadratic in the sense that the components of the tensor are quadratic functions of the coordinates on the space. For quadratic Poisson structures there are three cohomology theories that one can consider: algebraic cohomology, smooth cohomology, and formal cohomology (think formal power series). An important question about such structures that cohomology theories can help answer is: given one quadratic Poisson structure,

does there exist a change of coordinates which puts the tensor into a standard (more simplified) form? If so, then one could use this abstract existence to prove theorems classifying Poisson manifolds which are locally of this type. If not, then mathematicians would know that a finer analysis is needed.

If two quadratic Poisson structures have different cohomology, then such a transformation would not be possible. If the algebraic cohomology is different, then no algebraic transformation is possible. If the formal cohomology is different, then no formal transformation is possible. We used representation theory to find another way to compute the algebraic case

"...enjoy the intellectual challenge of abstract mathematics when you can, but when planning a trip don't forget to be practical, and always pack duct tape."



and observed that it gave the same answer as the formal case computed by another mathematician. The smooth case is an open (and hard) problem, but we suspect it will give the same answer as well and we continue to work in this direction. Given the examples of Poisson structures we've found with different cohomologies, this shows that a finer analysis is needed to classify such structures.

What does this have to do with duct tape? Nothing. The importance of that was revealed on the long drive home from Indiana this summer. In the tradition of the great American road trip, we sought to see the sights driving by car and camping along the way. We visited the Ingalls Homestead (as in Laura Ingalls Wilder of Little House on Prairie fame) in De Smet, South Dakota, Badlands National Park, Mt. Rushmore, Custer state park (home to a wild buffalo heard), then Devil's Tower National Monument, Yellowstone National Park, and Grand Teton National Park in Wyoming, followed by Zion Canyon National Park in Utah, and Las Vegas, NV. Cruising west on the interstate in South Dakota on a Sunday, about 100 miles from the nearest town, a plastic body rail on my 11-year-old car popped loose and started banging violently against the windshield. On the side of the road under a broiling sun (103F) I figured out how to lash the panel to the car using some string I scrounged out of the back seat of the car. For the next few hundred miles, I would have to pull over often and re-lash when the string broke under the stress of the slipstream put on the errant part. If you ever drive across the center of the US, you will see thousands of

billboards everywhere for the famous Wall Drug Store in Wall, SD, a tourist trap designed to draw interstate travelers into the tiny town of Wall, SD (pop. 766). They claim to sell just about everything and, thankfully, they had duct tape. I gave up on the diminishing string solution and secured the body panel in place with that wonderful sticky substance that I wish I had packed for the trip. We were able to continue on in a timely manner, seeing the great sights after that. So, my advice to you is to enjoy the intellectual challenge of abstract mathematics when you can, but when planning a trip don't forget to be practical, and always pack duct tape.

Interested in Relaxing but Don't Get a Sabbatical?

Our very own Lecturer Neal Golub helped get a free Weekly Meditation class started at CPP!

Hosted by: Venerable Andrew and Dr. Alane Daugherty

When: Tuesdays, 12:05 pm—12:45 pm

Where: Mind and Heart Research Lab (in the Darlene May Gym behind the BRIC)

Activities: Guided meditation for mindfulness and stress reduction



Commencement 2017

Congratulations to the 103 undergraduate math majors who earned bachelors degrees and 19 graduate students who earned mathematics masters degrees!

2017-2018 Scholarship Awards

On Thursday, November 16, 2017, the mathematics community convened for a Scholarship Reception to celebrate the accomplishments of the 2017-18 scholarship recipients.

Mr. and Mrs. Keith Soon Kim Mathematics and Science Scholarship

Giao (Selena) Bui
Ruben Hurtado
Huyen Le

John and Rosetrina Flaig Mathematics Scholarship

Ashley De Luna
David Perez

Dr. Emil R. Herzog Department Scholarship

Anthony Simon

Samuel Gendelman Memorial Scholarship

Gabriela Florido



Figure: Scholarship recipients. Back row (left to right): David Perez, Anthony Simon, Ruben Hurtado; Front row (left to right): Giao (Selena) Bui, Huyen Le, Gabriela Florido, Ashley De Luna. Photo by Melissa Martinez, Associate of Leadership Annual Giving.

MathByFives

Lecturer Frank Ives' YouTube channel MathByFives now has over 7 million views and over 45,000 subscribers! You can check it out at www.youtube.com/MathByFives.

Popcorn and Sea Slugs

What do popped corn and sea slugs have in common? Lecturer Karen Vaughn discussed this question and more in her talk *Having Fun with Hyperbolic Paraboloids* for the CSU East Bay Math Club on March 10, 2017.



Gift of Numbers

Greisy Winicki-Landman

In keeping with our tradition over the last nine years, MAT 495 students participated at a Gift of Numbers event. This time we were at Simons Middle School, located in Pomona. Cal Poly students ran math games for about 150 local students and their families. It was a hot day in that gym, but we had a great time helping the middle schoolers discover that mathematics is fun. Stay tuned for the Gift of Numbers



In the Classroom and Beyond

Doing something cool within or beyond the confines of CPP classrooms? Let us know so we can include it in the Spring 2018 Newsletter. Email Dr. Stacy Musgrave at smmusgrave@cpp.edu with your submission.



CPP Students and Alumni Present

At MAA Section Meeting

On October 21st, students Jeffrey Yeh and Chon In (Dave) Luk went to Chapman University to present a talk *Transition Probabilities, Exponential Matrices of Small Birth-death Chains and Processes* at the Fall 2017 Meeting of the Southern California-Nevada Section of the MAA. Yeh and Luk are part of a team of seven Cal Poly Pomona students and alumni who have been collaborating on a research project on birth-death chains:

Jeffrey Yeh	alumnus and graduate student
Chon In (Dave) Luk	undergraduate student
Uyen Nguyen	alumna and lecturer
Lyheng Phey	undergraduate student
Samuel Lyche	graduate student
Tanner Thomas	undergraduate student
Luis Cervantes	alumnus

At AMS Section Meeting

On November 4th, master's student Diego G. A. Avalos Galvez went to UC Riverside to present a talk *Calculating exponentials of real skew-symmetric matrices in terms of their eigenvalues* at the AMS Fall Western Section Meeting. The talk was based on his master's thesis work with Dr. Von Bremen.

AMS/MAA Joint Math Meetings 2018

John Rock

If you're not sure which talks and sessions to go to at the upcoming 2018 Joint Mathematics Meetings in San Diego, why not attend some of the talks and sessions put on by fellow Broncos? To make them easy to find, I've compiled a list (on the next page) of the speakers and sessions where a CPP student or faculty member is presenting something or running things. Go support your friends and colleagues!

A probability problem: Given the huge number talks at the joint meetings, what's the probability that *two pairs of talks* given by Broncos would be scheduled at the same time?

Note that on Friday the talks by Dr. Stacy Musgrave and Jeffrey Yeh will both run at 1:00 pm, and on Saturday the talks by Dr. Fernando Lopez-Garcia and Dr. John Rock will both run at 2:00 pm.

I hope to see you there!

CPP Broncos at the 2018 Joint Mathematics Meetings

Calendar compiled by John Rock

Thursday, January 11

Ivan Ventura (1135-35-2493) – talk

8:30 a.m. --- 8:30 in the morning?!? Ugh, sorry, Ivan.
Existence of solutions to a semilinear elliptic boundary value problem with augmented Morse index bigger than two.

AMS Special Session on Research by Postdocs of the Alliance for Diversity in Mathematics, II
Room 33C, Upper Level, San Diego Convention Center

Jennifer Switkes – organizer of a special session

1:00 p.m.-4:15 p.m. MAA Session on Innovative Mathematical Outreach in Alternative Settings
Room 31C, Upper Level, San Diego Convention Center

Jeffrey Yeh, student (1135-C1-2898) – talk

1:00 p.m.
Powers of Matrices and Exponential Matrices.
MAA Session on Innovative and Effective Ways to Teach Linear Algebra, II
Room 14A, Mezzanine Level, San Diego Convention Center

Stacy Musgrave (1135-G1-2887) – talk

1:00 p.m.
Teachers' Structural Reasoning with Algebraic Expressions and Equations.
MAA Session on Mathematical Knowledge for Teaching Grades 6-12 Mathematics, II
Room 32A, Upper Level, San Diego Convention Center

Stacy Musgrave, again – poster

2:00 p.m.-4:00 p.m.
MPWR-ing Women in RUME: Continuing Support.
MAA Poster Session: Projects Supported by the NSF Division of Undergraduate Education
Exhibit Hall B2, Ground Level, San Diego Convention Center

Friday, January 12

Alan Krinik (1135-60-1551) – talk

2:00 p.m.
Matrix Properties of a Class of Birth-Death Chains and Processes.
AMS Special Session on Markov Chains, Markov Processes and Applications, I
Room 29D, Upper Level, San Diego Convention Center

Ioana Mihaila (1135-VV-1621) – talk

2:45 p.m.
Beautiful Problems.
MAA General Contributed Paper Session on Other Topics, I
Room 28D, Upper Level, San Diego Convention Center

Diana Curtis, former student (1135-60-84) – talk

5:00 p.m.
Dynamics of a Predator-Prey Model through Stochastic Methods.
AMS Special Session on Markov Chains, Markov Processes and Applications, I
Room 29D, Upper Level, San Diego Convention Center

Saturday, January 13

Stacy Brown – organizer of an invited paper session

8:30 a.m.-10:50 a.m.
MAA Invited Paper Session on Research in Undergraduate Mathematics Education: Highlights from the Annual SIG-MAA on RUME Conference
Room 3, Upper Level, San Diego Convention Center

Fernando Lopez-Garcia (1135-26-3081) – talk

2:00 p.m.
Orthogonal decomposition of functions and applications.
AMS Contributed Paper Session on Operator Algebras
Room 18, Mezzanine Level, San Diego Convention Center

John A. Rock (1135-VJ-824) – talk

2:00 p.m.
It's Just Parts: A User's Guide for the Tabular Method of Integration by Parts.
MAA General Contributed Paper Session on Teaching and Learning Calculus, II
Room 28D, Upper Level, San Diego Convention Center

Summer Vacation Flight with Nicolette

Karen Vaughn

A few years ago, when I told my grader Nicolette Mitchell that I was a pilot, her response was, “Oh, I’ve always wanted to learn to fly an airplane!” I enthusiastically offered to take her for a ride, but well, she was busy getting through her studies as a CPP Applied Math major. And for me, during the school year I had little time to fly and in the summer there was always a scheduling problem...until this summer.

By the time Tuesday, July 25th came around, a summer storm had just passed in the Inland Empire. It would be a nice day to take Nicolette on her first general aviation flight. We met at Riverside Flight Academy where I had trained and rented Cessna 172s. After some introductions with the flight school staff, we sat down and talked about the flight plan, the FAA Passenger Safety Briefing, and some basic physics/math related things about flight. We went through the pre-flight procedure, and I was pleased that Nicolette stayed on my heels, mimicking, and asking questions. Hubby Jeff, also a pilot, brought his video sunglasses for Nicolette to use. Cool!

Piloting a site-seeing flight was newer to me, but the general area was familiar. I planned to make a counter clockwise path around Ontario Airport’s Class Charlie airspace, basically following Highway 91, I-215, Highway 210, Highway 57, then Highway 91 back home to KRAL. Since everything looked different from the air, Jeff helped point out to Nicolette way points and freeway interchanges. The highlight was of course flying over Cal Poly Pomona.

During the last third of our flight the haze got heavy and though I could still see the ground, I asked SoCal Approach (Air Traffic Control) permission to fly at a lower altitude to remain VFR (visual flight reference).

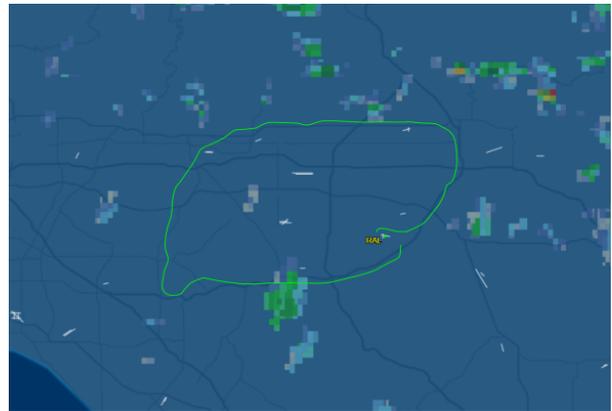


Figure: Tracking map (courtesy of Flight Aware)

That apparently put a kink into their sequencing Heavies (large jets) into John Wayne Airport, and I was diverted for a short while, instructed to fly an s-pattern in Placentia/Yorba Linda.

Once back on the ground in Riverside I asked Nicolette how she liked the experience. She replied, “So cool!” That was my response as well. So cool! Flying. Got to love it!

Note: The video glasses ran out of power before we got to Cal Poly. Here is the [embedded link to the shortened video on YouTube](#). My channel is MrsKarenVaughn.