The Mathematics Newsletter

Fall 2015 edition

Welcome to Fall 2015!

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Important Dates/Deadlines

- **Saturday, September 19th 2015** — Quarter Begins
- **Monday, September 21st 2015** — ISSS Mandatory Orientation at 9:30am - 12pm, Baskin SOE Auditorium
- **Tuesday, September 22nd 2015** — Campus Graduate GSA BBQ Orientation at 9am - 4pm, Various Locations Across Campus
- **Wednesday, September 23rd 2015**— Grad Division Campus TA Training 8:30am - 12pm Humanities 206/ All Math Grad Graduate Orientation 1pm - 3pm, McHenry Room 4130/ Incoming Math Grad TA Training 3pm - 5pm, McHenry Room 4130
- **Thursday, September 24th 2015**—Instruction Begins
- **Tuesday, September 29th 2015**—Mandatory All Math Grad TA Professional Development Workshop
- **Wednesday, September 30th 2015**—Sections Begin

Prelim Exam Dates

- **Friday, September 25th 2015**—Algebra Prelim Exam 10:00am - 3:00pm McHenry Room 4130
- **Friday, October 2nd 2015**—Geometry Prelim Exam 10:00am - 3:00pm McHenry Room 4130
- **Friday, October 9th 2015**—Analysis Prelim Exam 10:00am - 3:00pm McHenry Room 4130

*Order of exams subject to change

Seminar Schedule

- **Mondays**—Undergraduate Colloquium 5:00 – 6:00pm McHenry Room 4130
- **Tuesdays**—Math Tea Time 3:30 – 4:00pm Tea Room 4161
- **Tuesdays**—Math Colloquium 4:00pm – 5:00pm McHenry Room 4130
- **Wednesdays**—Graduate Colloquium 4:00pm – 5:00pm McHenry Room 4130
- **Thursdays**—Geometry & Analysis Seminars 4:00pm – 5:00pm McHenry Room 4130
- **Fridays**—Algebra & Number Theory Seminars 12:00pm – 1:00pm McHenry Room 1240

Newly arrived Visiting Assistant Professors:

Andrew Goetz: Andrew was raised in Trappe and Collegeville Pennsylvania and loved playing baseball. He attended The Hill School for high school, where he became hooked on squash (sport). In the fall of 2005, Andrew enrolled at Princeton University, where he majored in mathematics and played squash in his years as an undergraduate. Andrew received his A.B. degree in Mathematics at Princeton University in the spring of 2009 and in the fall, he began a Ph.D. program in mathematics at Duke University. Andrew graduated from Duke in the May of 2015 and soon after moved to Santa Cruz, California to take up a post as visiting assistant professor in the University of California Santa Cruz Mathematics Department. Welcome Andrew!

George (Ander) Steele: Ander grew up in the city of Atlanta, Georgia. Ander received his B.S. degree from Georgia Tech in 2007. Afterwards, Ander enrolled in the PhD Program at Boston University to study algebraic number theory. In 2013, Ander graduated from Boston University and moved to Alberta, Canada as a postdoctoral fellow at the University of Calgary. This past August, Ander moved to Santa Cruz. When he was living in Boston, Ander got hooked on cycling and hiking (great hobbies to enjoy in Calgary and the Canadian Rockies). Ander is enjoying cycling around Santa Cruz and is really looking forward to exploring the beautiful hiking trails that Santa Cruz has to offer. Welcome Ander!

Meet the new staff at the Mathematics Department!

Kathryn Baldwin: Kathryn attended The Ohio State University and majored in Sociology and Psychology. She also completed a graduate degree in Library Information Science at Kent State University. She worked for the Mathematics Department at Columbus State Community College in Ohio for 5 years. She moved to Santa Cruz from Ohio in July 2014. Stop by McHenry Room 4111 to meet Kathryn!

Kyle Blocker: Kyle is from the Central Valley of California, just outside of Fresno California. He is a Fresno State Bulldog at heart and has earned both his B.A. in Liberal Studies and M.S. in Counseling with a concentration in Student Affairs and College Counseling at California State University, Fresno. Feel free to stop by his office in the Mathematics Department to say hello!

Graduate Student Interviews

Interested in pursuing a Masters/PhD in Mathematics? Check out these interviews with Felicia, Alex, and Wei where they describe their experience and give advice/tips on their successful Mathematic Graduate Student careers!

Title of Thesis: *Shintani's method for computing Dedekind zeta functions*

Plans for future: Applying for jobs and being a TA over the summer

Insight/Advice on finding jobs as a Math Graduate Student:

"First off, you must choose if you want to work in academia or in industry—these two are completely different. If you choose to work in industry, you must make connections with company employees during your time in graduate school. Additionally, I recommend learning how to program in a language because computer programming is a skill many employers look for."

Advice on Graduate School/ How to make the most of your time.

"Finish the preliminary exams as early as possible to allow for more "breathing room" to focus on your studies and research. I also recommend getting to know the staff—they help you out a lot! Make sure to be friendly with the support staff and your fellow classmates and be aware that you are both a student and a co-worker as a graduate student."

Alex Beloi

Title of Thesis: *The Geometry of Vacuum Static Space & Deformations of Scalar Curvature*

Job Title/Employer: Postdoc Position in Sichuan University in China

Plans for future: Finish Postdoc job and keep researching his thesis

Insight/Advice on finding jobs as a Math Graduate Student:

"For academic jobs, you should show strength in research. The more research papers you do, the more credible you are. Also, get to know people in the research community."

Advice on Graduate School/ How to make most of your time.

"Timing is key. During the first year of graduate school, focus on passing the preliminary exams. That way, you will have more time to focus on your main research. Make sure you are genuinely interested in your research. Attend as many colloquium events as possible to learn about different areas of research you may be interested in!"

Wei Yuan

Title of Thesis: String Homology and Lie Algebra Structures

Job Title/Employer: Visiting Assistant Professor at the Rose-Hulman Institute of Technology

Plans for future: Become a Mathematics University Professor

Insight/Advice on finding jobs as a Math Graduate Student:

> "It is important to find out what YOU want to do after graduate school. Finding out early what you want to do with your studies is important because that way you can take classes that apply to your interests. Additionally, it helps to make connections with people within and outside of the Math Department."

Advice on Graduate School/ How to make most of your time.

> "Discipline/motivation is key for graduate school. I recommend taking as many preliminary exams as you can in order to finish them ahead of time. Additionally, I recommend going to as many conferences/events as you can in order to get the most out of your graduate school's resources and going to these events can also make you connections with people outside of the mathematics department. Lastly, working together with your fellow classmates can be helpful."

Felicia Tabing

Mathematics Awards 2015

- ❖ **Congratulations and kudos to Jackson Hsu and Ernesto Gallegos, recipients of Mathematics Awards this year!** Both received $500 awards in recognition of their accomplishments in the Mathematics major—Pure Mathematics concentration. We are honored to recognize their hard work and to be able to present them with an award.

  The Mathematics faculty selected Jackson Hsu and Ernesto Gallegos as recipients of this year's J.W.T. Youngs Memorial Undergraduate Award in Mathematics. The family and friends of Professor Youngs, a former professor at UCSC, established the award after he tragically passed away in 1970. Professor Youngs was a member of the Mathematics Department and a Fellow of Crown College. The endowment was established to honor his memory by supporting two annual prizes, one for an outstanding student of mathematics enrolled in Cowell College, and one for an outstanding student of mathematics enrolled anywhere on the Santa Cruz campus. The Youngs award is administered by the Mathematics Department.

- ❖ **Congratulations to Vinod Sastry for winning the 2015 Outstanding Teaching Assistant Award for Mathematics!** The Outstanding Teaching Assistant Awardees attest to the high regard faculty and students have for their work as Teaching Assistants. Awardees receive a gift certificate for the Bay Tree Bookstore as a token of recognition for their outstanding performance as Teaching Assistants across campus.

  In addition, Vinod also won a scholarship from the **ARCS Foundation**.
  - o ARCS Foundation, Inc. is a national organization dedicated to supporting the best and brightest U.S. graduate and undergraduate scholars by providing financial awards in science, engineering and medical research. It is ARCS Foundation's belief that support of STEM education is essential to US economic growth and technological competitiveness, and helps to ensure continued US leadership in global innovation, health and quality of life.

MDTP

UC/CSU Mathematics Diagnostic Testing Project (UC/CSU-MDTP), one of ten regional sites in California (sponsored by the California Academic Partnership Program [CAPP]), offers free mathematics achievement, diagnostic testing and analysis services to pre-collegiate schools and pre-collegiate outreach programs. The UC Santa Cruz site of the UC/CSU MDTP has served North Monterey, northern San Benito, Santa Clara and Santa Cruz counties for over 28 years.

The MDTP tests are designed to assist teachers in measuring student readiness for a broad range of mathematics courses. These tests are used as an integral part of a formative assessment process for middle school and high school mathematics teachers. A series of readiness tests for college preparatory mathematics courses are available at seven levels from Pre-algebra to Calculus. UC Santa Cruz scores the students' responses and provides summary and diagnostic information on student results. The diagnostic tests are used to assess students' mastery of key concepts that are requisite for success in mathematics classes. Individual diagnostic reports are provided for students as well as detailed item analyses and summary reports for teachers. The student reports indicate areas in which students did well and those areas in which the test results suggest a need for further study in order to be prepared for future coursework. The summary reports are used by teachers to help identify areas of the curriculum that seem to be working well and other areas or topics where changes may be needed. The diagnostic information provided enhances the teachers' ability to strengthen their curricula.

MBAMP

The Monterey Bay Area Mathematics Project (MBAMP) exists to increase the academic achievement of students in mathematics (grades K – 12), via professional development programs (PD) for teachers. These PD programs enhance the content knowledge and teaching skills of classroom teachers. As overall student achievement rises, MBAMP programs will reduce achievement gaps in the mathematics performance of student populations. Core to the improvement efforts sought by MBAMP programs are the partnerships developed between MBAMP and local school districts, the Santa Cruz, San Benito, Monterey and Santa Clara County Offices of Education (COEs), the mathematics faculty of UCSC and other organizations concerned about mathematics education.

MBAMP is dedicated to providing students a rich, rigorous, and coherent mathematics curriculum taught by competent and confident mathematics teachers who foster all students' proficiency in mathematics—achieving equity in quality. All teachers and students become competent mathematical thinkers as they investigate, conjecture and justify in their pursuit of mathematical knowledge.

Mathematics Placement - ALEKS-PPL

Beginning spring 2015, continuing and newly admitted students completed mathematics placement using ALEKS-PPL. Through this new placement process students assess, practice using customized learning modules, then reassess to improve their placement in Mathematics courses. As the assessment proceeds, ALEKS uses students' responses to construct a model of their "knowledge space", and adapts the questioning to refine and validate that model. After students take the initial assessment they have access to an ALEKS Prep and Learning Module. The learning modules are adaptive comprehensive tutorials, individually tailored to the students' needs, as they are based on students' assessment results. Students use the learning modules to prepare for reassessment and to review for Mathematics courses. The online assessment in ALEKS allows students to complete up to five assessments.

Putnam Exam Results

History of the Putnam Exam

The competition began in 1938 and is designed to stimulate a healthful rivalry in mathematical studies in the colleges and universities of the United States and Canada. It exists because Mr. William Lowell Putnam had a profound conviction in the value of organized team competition in regular college studies. Mr. Putnam, a member of the Harvard class of 1882, wrote an article for the December 1921 issue of the Harvard Graduates' Magazine in which he described the merits of an intellectual intercollegiate competition. To establish such a competition, his widow, Elizabeth Lowell Putnam, in 1927 created a trust fund known as the William Lowell Putnam Intercollegiate Memorial Fund. The first competition supported by this fund was in the field of English and a few years later a second experimental competition was held, this time in mathematics between two institutions. It was not until after Mrs. Putnam's death in 1935 that the examination assumed its present form and was placed under the administration of the Mathematical Association of America.

Description of the Exam

The examination will be constructed to test originality as well as technical competence. It is expected that the contestant will be familiar with the formal theories embodied in undergraduate mathematics. It is assumed that such training, designed for mathematics and physical science majors, will include somewhat more sophisticated mathematical concepts than is the case in minimal courses. Thus the differential equations course is presumed to include some references to qualitative existence theorems and subtleties beyond the routine solution devices. Questions will be included that cut across the bounds of various disciplines, and self-contained questions that do not fit into any of the usual categories may be included. It will be assumed that the contestant has acquired a familiarity with the body of mathematical lore commonly discussed in mathematics clubs or in courses with such titles as "survey of the foundations of mathematics." It is also expected that the self-contained questions involving elementary concepts from group theory, set theory, graph theory, lattice theory, number theory, and cardinal arithmetic will not be entirely foreign to the contestant's experience.

This past competition 6 students participated and four had positive scores:

- ❖ Zachary Parazette-Tillar
- ❖ Zach Drumbar
- ❖ Jackson Hsu
- ❖ Molly Baird

Exchange Scholar Program

Here are the visitors this year from the Exchange Scholar Program:

Tongzhu Li:
Mar. 2014 - Mar. 2015

Visiting Associate Professor from Beijing University of Technology

Fang Yi:
Jan. 2013 - Jan. 2015

Visiting PhD student from University of Science and Technology of China
July 2015, Assistant Professor, Anhui University of Technology

Jingyong Zhu:
Feb. 2015 - Feb 2017

Visiting PhD student from University of Science and Technology of China

Nandini Bhattacharya on Math 193

Math 193: Senior Pedagogy and Teaching (W-S 2 quarter sequence, 6 units total)

Math 193 is a seminar course designed especially for the Education track Mathematics majors. This course will satisfy the senior seminar requirement for majors. The purpose of the course is twofold: to learn effective Mathematics teaching methods grounded in educational theory; and to apply that knowledge in teaching alongside a TA in Precalculus (Math 3) discussion sections. Students will develop worksheets for the Math 3 curriculum, present mathematical concepts, and write a final paper consisting of their reflections and learning outcomes of both theory and practice. Prerequisite(s): satisfaction of the Entry Level Writing and Composition requirements; course 103 or 103A or 105A or 111A. Enrollment priority will be given to seniors.

-Professor Nandini Bhattacharya

Colloquium

Summary
The Department of Mathematics offers several seminars and colloquia each quarter, including colloquia geared toward graduate students and undergraduate students. The new special colloquium is a portion of the regular weekly department colloquium and began in the fall of 2014. Each quarter two special colloquia are offered. The special colloquium speakers are nationally recognized experts with expertise that fits the interests of the faculty, one from outside the university and the other from another department at UCSC. This helps promote the intellectual interactions with others on campus and our visibility at the national level.
Here is a link to view all of the Seminars and Colloquia: http://www.math.ucsc.edu/seminars-colloquia/index.html

Sue Carter
In the fall of 2014 we had presenter Professor Sue Carter, who is the Associate Dean of Graduate Studies and Professor of Physics at UCSC. In her lecture, she provided an overview of the approaches that they are pursuing to make solar energy costs competitive with energy generated from fossil fuels. The idea is to increase power efficiency and reduce balance of systems costs. By utilizing quantum confinement effects, more than one electron can be collected for each incident photon, which enables people to exceed the long-standing Shockley-Queisser limit. By taking advantage of energy efficiencies across the solar spectrum, wavelength-selective modules can be directly installed into building windows or over agriculture crops or greenhouses to simultaneously grow food, generate electricity, and harness thermal energy. Professor Carter emphasized the importance of developing models that accurately include thermal modeling alongside electrical and optical modeling in order to develop technologies that can efficiently utilize the entire solar energy spectrum.

Kenneth Ribet
On November 4, 2014, the department hosted Professor Kenneth Ribet from UC Berkeley for a special colloquium. Professor Ribet spoke on the discrete logarithm problem in cryptography. The lecture began with a quick and elegant introduction to public key cryptography, including an explanation of the Diffie-Helman key exchange protocol, the associated Diffie-Helman problem, the discrete logarithm problem, and the relationships between them. Next, Professor Ribet explained the index calculus attack on the discrete logarithm problem in finite fields, motivating the use of elliptic curves in cryptography. Professor Ribet concluded with open questions in the field, including those studied by one of his Ph.D. students, on the use of Jacobians of curves of higher genus in cryptography. The lecture beautifully drew the audience from the beginnings of the theory to the cutting edge of modern research in the field.

Ken Ono
In late February 2015, the department hosted Professor Ken Ono from Emory University for a week of research collaboration (with Professor Samit Dasgupta) and presentations. Professor Ono delivered a lecture in the "Bay Area Algebraic Number Theory and Arithmetic Geometry Day", a one-day conference organized jointly between UCSC, Stanford, and UC Berkeley. He also delivered a special colloquium at UCSC on February 24, 2015, on his recent work relating the representations of finite groups to modular forms in number theory. This blossoming theory has its roots in mathematical identities of Ramanujan, who expressed certain infinite product modular forms as number theoretic q-series. Professor Ono then described the "Moonshine Theorem" which relates the coefficients of the modular j-function to the dimensions of the irreducible representations of the monster group. Next, Professor Ono described his recent theorem with Griffin and Duncan, in which the frequencies of these representations in Moonshine was calculated. The talk concluded with a discussion of the Umbral Moonshine Conjecture, a generalization of the original Moonshine Theorem. Professor Ono also delighted the audience with an inside look at the upcoming movie "The Man Who Knew Infinity" based on the life of Ramanjuan; Ono served as a mathematical consultant and associate producer for the film.

Colloquium (continued)

Stephan Smale

In the spring of 2015 on April 28th, the Mathematics Department welcomed Professor Steve Smale (Professor Emeritus of Mathematics at UC Berkeley and Distinguished University Professor at the City University of Hong Kong) as its Distinguished Colloquium Speaker. His research concerns topology, dynamical systems and mathematical economics. In 1966, Professor Smale won the Fields Medal for his seminal work in differential topology and in particular for his solution of the Poincare Conjecture in dimension greater than four. In 2007, Professor Smale was awarded the Wolf Prize in mathematics. Since that time, Professor Smale has made influential contributions to a diverse area of Mathematics, including non-linear functional analysis, dynamical systems theory, numerical analysis, economics and mathematical biology. In his UCSC colloquium talk he laid out a new theory for Mathematics of The Genome with a special emphasis in understanding Circadian Rhythm.

Stephan Smale, UCSC Colloquium Speaker

Greg Laughlin

Professor Greg Laughlin (Professor and Chair of Astronomy and Astrophysics at UCSC) gave an amazing talk concerning two apparently unrelated problems of prediction: the long-term dynamical stability of the Solar System, and price movements and volatility in financial markets. A key idea is that of the Liaponov exponent λ associated to a dynamical system, a numerical invariant which estimates the rate of divergence of nearby trajectories and is a basic measure of unpredictability for a system. It has units of 1/(time), and $1/\lambda$ is roughly the time beyond which no predictions can be made. For the solar system this characteristic time is about 10 million years. For the stock market it is milliseconds. One of the most interesting parts of the talk concerned arbitrage - taking advantage of getting knowledge more quickly than other players to game a market. The speed of light is faster in air than in glass. Fiber optics (glass) cables were built connecting Chicago to New York to carry a key piece of financial data. A group of physicists realized this basic fact of light could be used for arbitrage and began building high volume microwave repeaters to connect Chicago to New York -essentially cell phone towers. The highest density of such towers in the US now is a thick line of such repeaters connecting Chicago to New York. It was a beautiful talk. We are sad to say Greg has left his post as chair of astronomy at UCSC to take a job at Yale running their exoplanet search missions.

Quentin Williams

Professor Quentin Williams (Professor and Chair of Earth & Planetary Sciences, Associate Vice Chancellor for Research at UCSC) gave a talk on the Silicon Valley Campus of UCSC and funding opportunities there. Quentin is the Director of the UARC's [University Affiliated Research Center] Aligned Research Program. Quentin gave interesting insights into the politics of the development, the various historical quirks and different cultures of the players involved, particularly the NASA culture, and of the opportunities possible. He also decoded a number of acronyms for us.

2015 Graduation Photos

Yusuf Goren and Wei Yuan

Mitchell Owen and Wei Yuan

Court 1

EXIT

Wei Yuan and Jie Qing

Yusuf Goren

Samit Dasgupta and Mitchell Owen

Jie Qing, Mitchell Owen, Samit Dasgupta, Wei Yuan

Congratulations Class of 2015!!!

(From left to right)
Top Row: Hadrian Quan, Andrew Edwards, Zach Drumbor, Carl Eadler, Nathan Sievers, Nathan Wilson, Tai Huynh, Juan Saludes.
Middle Row: Jackson Hsu, Adrian Thompson, Pamela Schliesser, Amadeus Martin, Alex Martin, Michael Silva, Becky McKee, Michael Kraut, Katie Mrgudic, John Hayes.
Bottom Row: Mona Zibahalat, Angel Calero, Gabriel Rhodes, Peter Mercado, Taryn Radamaker, Sageanne Senneff, Molly Baird, Alix Feinsod, **??.**