Autumn 2012

AIMatters

Newsletter of the American Institute of Mathematics

The Mathematics of Planet Earth

MPE2013 Initiative Unites Global Academic Community

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Connecting Concepts
Organizing Data with New AIM Tools

From Berkeley to Budapest
Generous Gifts Benefit AIM Collections

Bringing Down the "Wall"
Workshop Helps Disprove 50-Year-Old Conjecture

Keyboards Meet Chalkboards
SQuaREs Program Facilitates Unlikely Collaboration

Letter from the Director

The Latest News from Palo Alto

Greetings from Palo Alto! It's been a while since we had a newsletter and much has happened! The biggest recent news item is that our new NSF grant has been awarded, effective August 1, 2012, through July 31, 2017, in the amount of $12.5 million. Over the course of this grant, AIM will run 100 workshops and 150 SQuaREs! The other biggest news item is that the Frys.com golf tournament, for which AIM is the main beneficiary, has moved to CordeValle golf course in San Martin, just a few miles away from AIM's permanent headquarters in Morgan Hill. In two short years, this tournament has become one of the Bay Area's premier sporting events, and AIM is delighted to be a part of it. This year's tournament will take place October 11-14. Friday, October 12, will be AIM day at the tournament and will feature fun math activities for the spectators. Can you estimate how far Tiger Woods' ball traveled on Day 4 of last year's tournament? If so, you will be in good shape for AIM's "Just Do the Math!" contest.

In this issue of AIMatters, you will read about some of the activities that have been going on at AIM, including some highlights from our recent workshops, SQuaREs, and special workshops. Our largest outreach programs – Math Teachers' Circles and Morgan Hill Math – continue to make great strides. In addition, our library also continues to grow.

AIM has also been very involved in an initiative called MPE2013. MPE is short for Mathematics of Planet Earth. It is a collective effort by the world's mathematical sciences organizations to highlight how mathematics can play a role in trying to solve some of our planet's problems. You can read on page 4 about some of the activities that will be taking place in 2013.

We are especially pleased with some of the mathematical developments this year. In particular, the disproof of Wall's conjecture about how many maximal subgroups a finite group can have was an unexpected breakthrough. And the mathematical modeling of the groundwater usage in the Pajaro Valley, where most of our local berries come from, has made an important contribution to the health of this industry. We are also very pleased to welcome two new members to AIM's Advisory Board, John Ewing and Julie Rehmeyer.

Finally, I'd like to announce that construction is underway for our beautiful new facility in Morgan Hill! An architect's drawing of the planned future building is shown at right, below the Table of Contents. It's too early to predict when it will be ready, but we are very excited about the recent progress. ■

Brian Conrey

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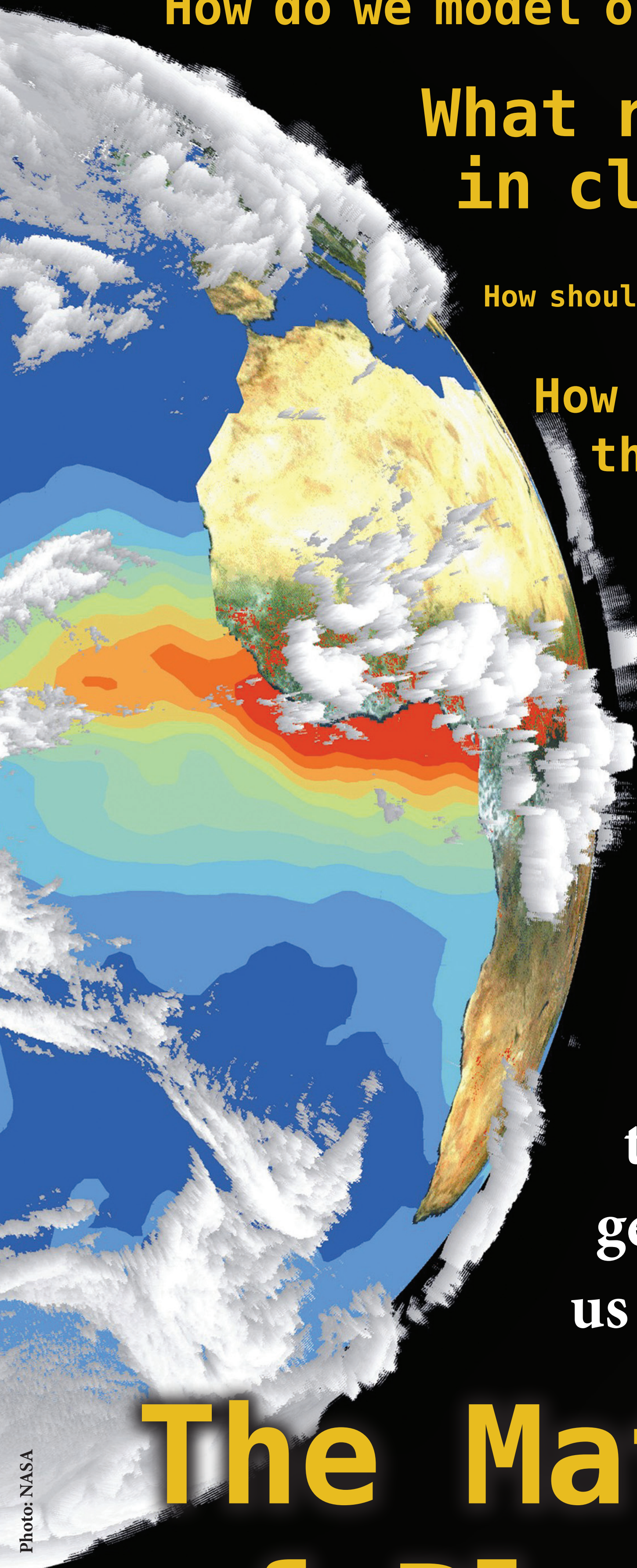


Photo: NASA

How do we model outbreaks of Dengue fever?

What role do oceans play in climate uncertainty?

How should we manage wildfires in populated forests?

How does climate change affect the way that species spread?

How can we use earthquake data to “see” the Earth’s interior?

All these questions have one thing in common: they are part of the worldwide MPE2013 initiative, in events open to mathematicians and the general public alike. Join us as we delve deeper into

The Mathematics of Planet Earth

Mathematical research institutes, scientific societies, universities, and foundations from all over the world have banded together to dedicate 2013 as a special year for the Mathematics of Planet Earth (MPE2013). The goal of MPE2013 is to highlight the role mathematics plays in understanding complex processes of the Earth and fundamental aspects of life and life-supporting systems. The year will be devoted to a wide variety of interdisciplinary research, including questions about ecology, epidemiology, meteorology, and management and sustainability of natural resources. The scope of this worldwide initiative is immense and unlike anything that the mathematics community at large has ever undertaken previously.

AIM is a partner organization of MPE2013 and has been instrumental in the planning phase of this initiative, notably by hosting two planning workshops for over 30 representatives of partner organizations in March 2011 and March 2012. The first AIM workshop was concerned with the planning of scientific activities, including long programs, workshops, summer schools, and public events, such as museum exhibits and lectures. At present, seven semester-long problems and nearly 50 workshops are scheduled for 2013 at over 27 societies and 40 mathematics institutes worldwide.

In addition, a series of international public lectures sponsored by the Simons Foundation will take place. The first three of these will take place in Australia, South Africa, and the Bay Area. In these talks, prominent mathematical experts will explain their efforts to solve the problems of Planet Earth through mathematics. These public lectures will also promote further public awareness of MPE2013. In addition, it is expected that the lectures will be recorded and later shared with a wider audience.

The second workshop at AIM this past March also resulted in a new AIM-hosted webpage at **http://mpe2013.org/** that highlights all the activities and includes a calendar with links to programs. The webpage will also showcase a daily blog for the year 2013. The page was created using a content management system so that all participating organizations can enter, edit, and update their activities.

Efforts at the March 2012 workshop also included planning for publicity and outreach, in addition to efforts to continue the work of MPE in the future. Plans were also made for proposals to make the activities of MPE2013 go beyond those currently planned – an MPE2013+ effort – in order to encourage the mathematical community to continue to help solve and understand the many challenges of Planet Earth. To fund this effort, a proposal to NSF was spearheaded by Fred Roberts from the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS) and has been awarded. The grant will fund workshops, small group meetings, and other educational activities. It also has the goal of bringing mathematical scientists not currently engaged in sustainability to these topics and to connect those who are already engaged with a broader multidisciplinary community.

Three MPE workshops have been scheduled at AIM. More information is available at **http://aimath.org/news/mpe/**. The first, in January 2013, is “Modeling problems related to our environment.” The second, in February 2013, is “Stochastics in geophysical fluid dynamics.” The third, in June 2013, is “Exponential random network models.” ■

– Estelle Basor

Dispatches from MORGAN HILL

Morgan Hill, California, is a small community of 38,000 people with a big heart for math, thanks in large part to AIM's outreach efforts. Nestled in the hills just south of Silicon Valley, the community is both AIM's future home and the current home of AIM's Morgan Hill Math program for fourth to twelfth graders, which was started in 2002 by AIM's executive director, Brian Conrey, and has been run by Lori Mains since 2004.

Hoping to cultivate the next generation of mathematicians, AIM Morgan Hill Math offers free academic programs each fall for students who enjoy math and show a propensity for it. Students complete an eight-week program with a curriculum developed by AIM coaches. Interested students then continue on to regional competitions in February. At the high school level, students have shown leadership by establishing Mu Alpha Theta chapters at each of the local high schools. These students continue to compete in national competitions at the high school level and often come back to MATHCOUNTS, the middle school program, to mentor their younger peers. As part of an effort to bring mathematics to the broader community, AIM Morgan Hill Math also puts on several community events, including its annual one-day event "AIM Math Mardi Gras" and monthly family-oriented Game Nights.

ELEMENTARY SCHOOL

The Golden Ticket for Latino Involvement

It was like a scene right out of "Charlie and the Chocolate Factory." Fourth through sixth grade students came clutching their golden tickets, eager to see what was in store for them. But rather than an invitation to a candy factory, the tickets read, "This is your golden ticket! If you have been in the AIM High program for kids who like math, you can come (and bring one friend) to today's Math Lunch Bunch!" The excitement was part of a new initiative that AIM Morgan Hill Math started this year, thanks to a $4,000 TensorSUMMA grant from the Tensor foundation, to increase the number of Latino students participating in our after-school programs. So far, as a result of this recruitment initiative, 23 new Latino families have joined the after-school program for the fall 2012 semester.

Two AIM Morgan Hill Math coaches spent six weeks meeting after school with Latino students from two local schools, working with them to understand basic math concepts at a deeper level. In one lesson, students explored the concept that in order to talk about fractional parts, the whole must be divided into equal-sized pieces (in this case, they used pattern blocks and broke trapezoids and hexagons into equilateral triangles). In another hands-on-lesson, students used tiles to make all the possible rectangular arrays for the numbers 1 through 25, and then examined the resulting geometric configurations for interesting patterns, discovering, for example, that 1, 4, 9, 16 and 25 each had an array which was a perfect square. Free time with Legos and estimating games with jelly beans in a jar kept students coming back for more.

MIDDLE SCHOOL

Morgan Hill Students Reach State Competition

This year, for the sixth consecutive year, Morgan Hill students have qualified to compete at the MATHCOUNTS State Championship by excelling at the regional competition. A total of 79 students, grades six to eight, representing 18 schools, competed in the regional competition, including 35 Morgan Hill students.

Marina Bireley, an eighth grader at Martin Murphy Middle School, received the top overall individual score and advanced to the state championship. Andrew Liu, an eighth grader at Britton Middle School, also qualified for the state championship. Jason Rhoads, a seventh grader at the Charter School of Morgan Hill, narrowly missed the opportunity to advance. In the team component, Britton Middle School's team placed third and also just missed qualifying for the state competition. The Britton team was composed of Andrew Liu, Alex Holmstrom, Kaden Foster, and Colin Kyle.

HIGH SCHOOL

Morgan Hill Team Storms Science Fair Circuit

Two long-time participants in Morgan Hill Math programs, Theresa "Tara" McLaughlin, 16, a sophomore at Ann Sobrato High School, and Mark Holmstrom, 17, a senior at Live Oak High School, are recipients of numerous science fair honors at the state and national levels for a joint project on math research.

Their project, entitled "Neighbors with Prescribed Prime Factors," won them Grand Prize – Best of Championship, the Mu Alpha Theta award for the "Most Challenging and Creative Project Involving Mathematics" and first prize in the Mathematics and Computers division at the Silicon Valley Science Fair hosted by Synopsys. Along with these honors, they received an all-expenses-paid trip to the Intel International Science and Engineering Fair in Pittsburgh, Pennsylvania, a prestigious worldwide competitive science fair, where they were awarded a Certificate of Honorable Mention from the American Mathematical Society. McLaughlin and Holmstrom also went on to win second place in the California State Science Fair.

Under the supervision of Dr. Brian Conrey, McLaughlin and Holmstrom invented a very quick way to find neighboring numbers with all small prime factors. For example, 80 = 2 x 2 x 2 x 2 x 5 and 81 = 3 x 3 x 3 x 3 are the largest neighboring integers that can be made using only the prime factors 2, 3, and 5. If you allow 7 into the mix, then 4374 and 4375 are the largest neighbor pair. They found 346,192 neighbor pairs with prime factors less than 200. Previous published work dealt with prime factors up to 100 and reported 13,325 solutions. For solutions with prime factors less than 100, their algorithm is 1,000 times faster than previous published methods and led to 49 new solutions. ■

– Lori Mains

Left, three elementary school students create and record tile arrays as a part of AIM's after-school program. Right, Morgan Hill Math has a strong showing of nearly 40 middle school students at the 2012 regional MATHCOUNTS competition held in Salinas, California.

Left, at Morgan Hill Math Mardi Gras, three finalists emerge victorious from a heated round of SET, a visual logic game. Right, Tara McLaughlin and Mark Holmstrom pose with their project board at the Intel International Science and Engineering Fair in Pittsburgh.

A Broader Perspective

Careers in Academia Workshop Aids Post-Docs

For many post-doctoral fellows, their next career step is one of the most challenging, both professionally and personally. It begins with the decision to remain in academia or not — a decision that cannot help but be influenced by the current economic climate. Having made the commitment to search for a tenure-track position, few post-docs are aware of the many different types of institutions, the expectations each one has of its faculty, and the ability to maintain scholarly activity at a place other than a research university.

One of the goals of AIM's "Careers in Academia" workshop is to introduce 26 to 30 post-docs to the breadth of possible academic careers. Another is to assist participants as they prepare to enter the job market. To accomplish these objectives, AIM invites a small team of senior faculty members from various universities to facilitate an intense three-day workshop. Collectively, the team of facilitators represents a cross-section of institutions with backgrounds in both pure and applied mathematics.

Prior to the workshop, each post-doc is assigned a facilitator and asked to submit a complete application packet for a tenure-track position at a school of his or her choice. The focus of the workshop is on revising these application materials, including the cover letter, C.V., and the research and teaching statements. Workshop days consist of a combination of individual consultations coupled with group sessions and panel discussions highlighting various aspects of the job search.

In addition to reviewing the application materials, significant time is spent preparing for the campus interview, particularly the all-important job talk.

"One of the greatest benefits is that post-docs leave with an insight into the job search from a department's perspective," says Loek Helminck, workshop facilitator and head of North Carolina State's math department.

Finally, the focus of the workshop turns to the negotiations following an offer and the challenges of the pre-tenure years.

Constanze Liaw, one of the 2010 workshop participants, reported, "I have just started a tenure-track position at Baylor University, which has the perfect balance of teaching and research, as well as an excellent salary. I have interviewed at many places and was in the lucky position to be able to choose from several good offers. The atmosphere in the math department here is wonderful. I love my job."

Overall, the workshop has been enthusiastically received by the mathematical post-doc community, with many participants attending based on recommendations from one year to the next. This response suggests that the workshop fulfills an important need. ■

– Sally Koutsoliotas

Participants and facilitators gather at the 2012 "Careers in Academia" workshop at AIM.

Where Are They Now?

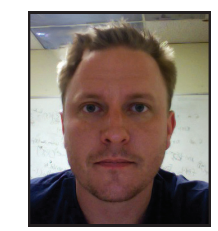
Keeping Up With Our AIM Post-Docs

In April of 2009, the NSF Mathematical Sciences Research Institutes announced the creation of 45 new post-doctoral positions for young, highly trained mathematical scientists across the country. The impact of the economic downturn was being felt everywhere, especially in academia, and the institutes responded by creating these new post-doctoral fellowships. In addition to furthering research in all areas of the mathematical sciences, these positions allowed recent Ph.D.s to teach at community colleges and other higher-education institutions or to participate in projects tied to business and industry. AIM hosted four of the post-docs and everyone on the staff enjoyed having them at AIM, learning about their specialities, and seeing their mathematical energy. Here is an update on their activities.

Ameya Pitale received his Ph.D. from The Ohio State University in 2006. He uses techniques from representation theory to study L-functions associated to Siegel modular forms. After just one year as an AIM post-doc, he became an Assistant Professor at University of Oklahoma in the fall of 2010. Pitale continues to have ties with AIM as a participant in one of the SQuaRE programs called "L-functions in explicit terms."

Anthony Bak received his Ph.D. from the University of Pennsylvania in 2007. Bak is interested in the interplay between geometry and physics. His fundamental view is that mathematics is more than an analytical tool for solving problems; it is a guide to the fundamental structures and principles of the natural world. In the past few years, he has become interested in the geometric properties of large data sets and is now in a visiting position at Stanford University studying persistent homology. While he was an AIM post-doc, he taught at San Francisco State University.

Jeremy Van Horn-Morris received his Ph.D. from the University of Texas in 2007. Van Horn-Morris studies open book decompositions and their applications to low-dimensional topology and contact and symplectic geometry. He also taught at De Anza College while he was an AIM post-doc. In the academic year 2011-2012, he was a lecturer at Stanford University and is starting this fall as an Assistant Professor at the University of Arkansas at Fayetteville.



Eddie Herman received his Ph.D. from UCLA in 2009. Herman's research is in the field of analytic number theory extracting information on L-functions by using something called the trace formula. The trace formula takes information that is difficult to work with and converts it to a form that is amenable to techniques of analytic number theory. While at AIM, Herman taught at De Anza College. In the fall of 2011, he became an L. E. Dickson Instructor at the University of Chicago. ■

– Estelle Basor

Opening Futures to Opportunity

Research Experiences for Undergraduate Faculty

Participating in a research experience in mathematics as an undergraduate can change a student's life, inspiring him or her to pursue a career in the mathematical sciences. Approximately 60 percent of bachelor's degrees in mathematics are awarded by primarily undergraduate institutions, or colleges and universities that do not have doctoral programs. Faculty at these institutions typically teach heavy courseloads and have limited time to invest in their own research pursuits, which means that engaging in research with students can be challenging. AIM's Research Experiences for Undergraduate Faculty (REUF) program encourages faculty to do research with undergraduates, while providing an avenue for research re-engagement for the faculty themselves and a network for professional support. Many of the faculty participants initiate research with undergraduates following the workshop; some have published papers with REUF collaborators.

The REUF program originated with a workshop proposal by three faculty members at historically black, primarily undergraduate institutions: Roselyn Williams of Florida A&M University, Yewande Olubummo of Spelman College, and Joe Omojola of Southern University at New Orleans. Since the first REUF workshop in 2008, AIM has organized three additional workshops and follow-up activities, all supported by the National Science Foundation. Williams, Ulrica Wilson of Morehouse College, and AIM's Associate Director for Diversity, Leslie Hogben, oversee the program, working closely with AIM's Director of Special Projects, Brianna Donaldson. Recruitment efforts focus on faculty at minority-serving institutions and underrepresented minority faculty at undergraduate colleges.

Each REUF workshop involves approximately 20 fully funded participants and four mathematical leaders, senior mathematicians who have experience doing research with undergraduate students. Most of the time is spent doing mathematics, but there are also whole group discussions about topics such as best practices in undergraduate research. The workshop also includes instruction in using the free open-source mathematics software Sage.

In addition to the workshop, each annual cycle of the REUF program includes follow-up activities for participants to support continuation of research engagement sparked by the workshop. One research group per year receives funding to return to AIM for a week to continue their collaboration.

Beginning this year, the Institute for Computational and Experimental Research in Mathematics (ICERM), in Providence, Rhode Island, has partnered with AIM on the REUF program. ICERM hosted the REUF 4 workshop in June 2012 in their beautiful new facility and will do so again in summer 2013. AIM looks forward to continuing this partnership. ■

– Brianna Donaldson and Leslie Hogben

Workshop participants and facilitators pose for a group picture at the ICERM facility in Providence, Rhode Island.

A Tale of Two Workshops

Two Workshops, Three Papers, New Ideas

In July 2009, together with my colleague and spouse Stephan Ramon Garcia (and our five-month old baby, Reyhan), I attended an AIM REUF workshop. The main motive of the workshop appealed to me, since I had been teaching at a liberal arts college since right after my post-doc. Because most of my research focused on quantum algebra, a topic not easily accessible to even the most well-prepared undergraduates, I had been struggling to find a way to initiate and sustain successful collaborations with my students.

On the first day of the workshop, the organizers introduced us to four possible topics, all intriguing. But Stephan's deep interest in number theory and my training in representation theory led us both to eventually select the project proposed by Phil Kutzko from the University of Iowa, a problem that combined classical character theory with number theory. When the workshop ended, most people went back to their regular routine, but Stephan and I, together with one of our team members, Patrick Fleming from the South Dakota School of Mines, kept at the problem. We were quite intrigued by how a simple finite group seemed to have embedded in its character theory some significant identities relating to a mathematical quantity called a Kloosterman sum. After additional focused work, we ended up with a lengthy preprint, which, when posted on the Internet arXiv of mathematics papers, generated several interesting follow-up e-mails from around the world. Our paper, "Classical Kloosterman sums: Representation theory, magic squares, and Ramanujan multigraphs," has already been published by the Journal of Number Theory.

We were pleased; none of us were experts in number theory, but this was a solid publication, and the conversations that opened up through the arXiv preprint itself were quite exciting. However, there was an element of redundancy in our work and we had a sneaking suspicion that there was something we were missing. We thought that somehow there had to be a way to clean things up so that we did not need to employ ad hoc methods to get rid of irrelevant material and reveal the desired information.

Meanwhile, back in December 2009, while we were still working on our Kloosterman sums paper, I received a most welcome invitation to attend another AIM workshop in May 2010 on supercharacters and combinatorial Hopf algebras. I had recently completed a project on combinatorial Hopf algebras and was looking to start a second one. I knew nothing about supercharacters at the time, but found the second topic of the workshop exciting. My main goal was to further connect with the active members of the combinatorial Hopf algebra research community and to possibly foster some new collaborations. However, the very first day of the workshop, when I actually understood what supercharacters were about, I had an epiphany. This was exactly what we needed!

The workshop itself brought forward some amazing results, which culminated in, with 28 authors, possibly the most co-authored paper in the history of pure mathematics. See **http://www.mathinstitutes.org/nuggets/secrete_identity.html** for more details. Later, we focused on how supercharacter theory could help us get rid of the redundancy in our previous work. We could see that the previous Kloosterman identities could be obtained through a particular supercharacter theory for the associated finite group, which then led us to wonder whether the theory could be applied in other situations. This led to fertile land for investigation. In particular, we were able to prove recently, together with Pomona undergraduate Christopher Fowler, that certain supercharacter theories for cyclic groups could be used to churn out several (known and unknown) identities related to other important quantities called Ramanujan sums. As we got more into this investigation, many new possible avenues opened up in front of us, and several undergraduate researchers joined our quest. Stephan directed a team project this summer to push this thread further with the result of a second paper already posted on the arXiv.

All in all, this has been a fantastic ride so far! And we could not have done it if it weren't for serendipity and, of course, the two distinct workshop opportunities, provided generously by the American Institute of Mathematics. ■

– Gizem Karaali

Math Teachers' Circles

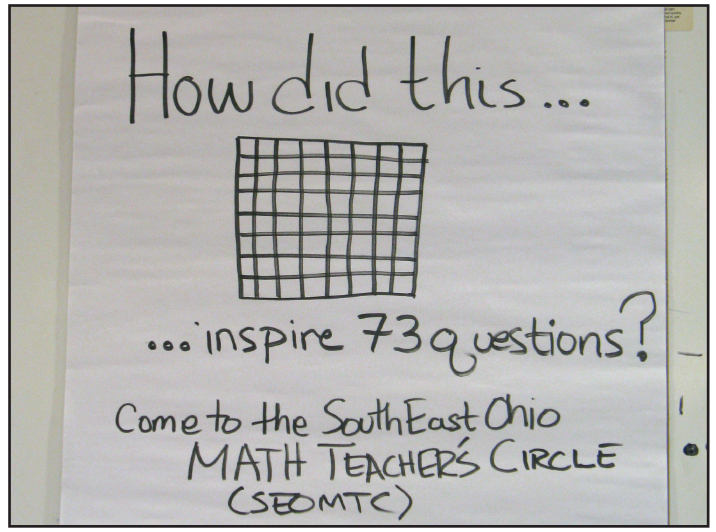
Supporting Teachers' Mathematical Lives

A Math Teachers' Circle (MTC) is a professional development community of middle school teachers and mathematicians who meet regularly to work on rich mathematical problems. The format is loosely based on the Eastern European model of math circles for K-12 students that has recently grown in popularity in the U.S. However, only teachers participate in MTCs. The highly interactive sessions are led by professional mathematicians, or co-led by a teacher and a mathematician. The emphasis is on engaging teachers in key features of mathematical practice, as described in the Common Core State Standards, while building long-term, meaningful partnerships among teachers and mathematicians.

Each summer, AIM holds two workshops on "How to Run a Math Teachers' Circle" for teams of middle school teachers and mathematicians from around the country. During the workshops, the teams experience MTC sessions firsthand and develop concrete plans for starting and sustaining their own local MTC. Since 2006, AIM has helped launch nearly 50 MTCs around the country through these workshops. Each of these MTCs includes approximately 15 to 20 teachers, who collectively reach 1,500 to 2,000 students in their communities per year. The MTC Network (**http://www.mathteacherscircle.org/**), administered by AIM, links together MTCs around the U.S. and provides ongoing support, including notes from successful math sessions, discussion groups, and a semi-annual newsletter.

In August 2011, AIM was awarded a competitive 3-year grant of $449,981 from NSF's Discovery Research K-12 program to study how MTCs affect teachers' mathematical knowledge and classroom teaching. AIM's Executive Director Brian Conrey and Director of Special Projects Brianna Donaldson are collaborating on the project with Michael Nakamaye and Kristin Umland of the University of New Mexico and Diana White of the University of Colorado Denver. According to Conrey, "This grant is an incredible opportunity to learn more about Math Teachers' Circles and how they affect teachers' mathematical lives." ■

– Brianna Donaldson



From top: The team from Southeast Ohio created this mock flyer as part of their plans for their newly formed MTC. The group from Thousand Oaks, California, consisting of, from left, Nate Carlson, Fawn Nguyen, Melissa Diaz, Erin Hanley, and Hala King, poses for a photo. Jeff Suzuki of Brooklyn College, New York, is pictured in front of a brainstorming board full of ideas from the session.

Bringing Down the "Wall"

Workshop Helps Disprove 50-Year-Old Conjecture

During the June 2012 AIM workshop, "Cohomology bounds and growth rates," a counterexample was found to a group theory conjecture known as the Wall conjecture, formulated by G. E. Wall in 1961. A mathematical group is a set along with an operation that combines two elements to form a third element of the set and satisfies certain other axioms. A familiar example is that of the integers with the operation of addition. The concept of a group first appeared in the middle of the 19th century, although not in the abstract form that is found in modern textbooks. The French mathematician Galois defined a group in 1832, and the notion first appeared in print in 1846. Groups appear (often in disguise) in many areas of mathematics and science, and understanding their basic structure is of fundamental importance in mathematics.

A subgroup is a group within a group, that is, a subset that with the same operation of the group also satisfies the group axioms. Some subgroups are contained in larger subgroups and the ones at the top of the chain, not contained in any other subgroup, are called maximal subgroups. Fifty years ago, Wall conjectured that the number of maximal subgroups of any finite group is less than the size of the group. Though mathematical progress is rarely made quickly, sometimes things come together in a serendipitous way. That is what happened at this workshop.

Wall himself had shown the conjecture to be true in some special cases in his 1961 paper. In 1986, Robert Guralnick, a workshop organizer, had also formulated a related relevant conjecture about a "cohomology bound." Recently, there was dramatic progress on the Guralnick conjecture, and as the workshop began, it was thought that the time was ripe to prove the Wall conjecture. The first two days were devoted to this task by reducing the question to some conditions that were slightly more tractable.

On day three of the workshop, Leonard Scott, also a workshop organizer, reported that one of his undergraduate students, Tim Sprowl, had run a computer program to check some examples. It succeeded in obtaining some new answers, but crashed when it was 80 percent complete. Fortunately, taking part in the workshop was Frank Luebeck, currently in charge of the computer algebra project GAP and an expert in computational algebra, and he knew that he had a program on his desktop computer in Aachen, Germany, that could complete the computation that had caused Sprowl's program to crash.

Overnight, he connected to his computer via the Internet and carried out an amazing array of calculations that he presented to the workshop the next day. Bob Guralnick immediately realized that the results gave counterexamples to the Wall conjecture, which came as such a surprise that some people in the audience took photos of Luebeck with their cell phones. Somewhat taken aback by all the attention, Luebeck spent the rest of the day thinking through the logic of his program to make sure it was right, and then Luebeck and Scott realized that Luebeck's computations could be checked independently by Scott and Sprowl.

This was carried out several weeks later, when Sprowl got his program to run without crashing, and handled the next larger cases for the groups it was designed to treat. This indeed produced counterexamples to the Wall conjecture and provided confirmation of a portion of Luebeck's calculations. Scott and Sprowl exchanged e-mails with Luebeck confirming that their computations gave identical answers. The effect of Luebeck's calculations at the conference had been, in Guralnick's later words, "revolutionary." Perhaps more importantly, it became clear from results presented at the conference that the Guralnick and Wall conjectures had helped lead the subject of finite group cohomology to a genuinely higher level. It showed how much modern methods in conjunction with improvements in computer technology had put questions like Wall's conjecture within reach, whereas before they were beyond either theoretical or computational methods alone. For a more complete account of the workshop, see **http://aimath.org/news/wallsconjecture/**. ■

– Estelle Basor

New Advisory Board Members

John Ewing: Three Math Careers Later

New AIM Advisory Board member John Ewing's interest in mathematics was sparked in a very likely place—his senior year calculus class. "The teacher was spectacular. The best I ever had. He inspired me to be interested in math." That inspiration propelled Ewing to study mathematics and physics in college. He received his Ph.D. from Brown University in 1971 and was a professor of mathematics at Indiana University for over two decades before becoming director of the American Mathematical Society (AMS) for 14 years, a position that, he says with a chuckle, was the result of sheer chance. "I actually owe it to an accidental meeting in an airport." While waiting for his flight he ran into a colleague, Bus Jaco, who suggested he should consider the position—advice that Ewing is grateful he took. "The job was fantastic. Challenging at times, but fun."

The AMS is the largest mathematics research society in the world. It has more than 30,000 members, over 200 employees, and it was also, right around the time the Internet started, at the forefront of electronic publishing. "It was right around 1995 and they were thinking of putting things online. The first year we put MathSciNet online. We made publishing programs electronic and formulated policies about electronic publishing. We set a lot of standards. The AMS is a really great organization. Great set of people, staff, and they stand for all the right things. Heading the organization was really a privilege."

Ewing is now the president of Math for America, a nonprofit organization whose mission is to improve math education in U.S. secondary schools. "It's all about teachers. There are lots of ways you can approach education, but Math for America is focused on getting great teachers into the classroom." The organization is committed to finding great teachers and bringing them together in the greater community. "The teachers themselves do a lot of the work. They run a semester on particular topics like algebra, or sometimes pedagogy and math mixed together. It gives them the opportunity to create the programs that they run for one another. Giving them the chance to do that makes a difference."

Math for America also runs an apprenticeship program for future teachers through City College of New York. The students in the program work with Math for America Master Teachers for one year. "We want to make sure the best teachers can be mentors for the next generation." He also sees the organization shifting gears in the future: "The president of the United States announced a plan for a national Master-Teacher Corps. If this happens, it would be natural for us to shift from what we do now to providing support for master teachers across the country in terms of conferences, travel grants, and travel to professional meetings." He also says that Math for America will add science to its curriculum in the coming year.

Although Ewing is in his third mathematical career, mathematics isn't his only interest. "I've always been involved in publishing. If I retire, I would write. I would have the time to sit down and write essays on education or mathematical exposition. I really enjoy that kind of writing." When he does have spare time, the Long Island native enjoys taking long walks in Central Park, going to museums, and reading.

JOINT MATHEMATICS MEETINGS
San Diego
January 9-13, 2013

Please join us at the
Mathematical Institutes' Open House Reception
Wednesday, January 9
5:30 p.m. - 8:00 p.m.

Also be sure to visit the AIM staff at our booth in the exhibit area.

Julie Rehmeyer: Telling the Story of Math

"What is that?" is a question that Julie Rehmeyer, a new member of AIM's Advisory Board, often hears when she tells people what she does for a living. A freelance math and science writer, she often finds herself having to take complex subjects and make them easy to understand and entertaining for a non-mathematical audience. Her strategy for doing this is simple. "A lot of it is following my own curiosity and making sure that it makes sense to me, and then I pull out what I think is exciting," says Rehmeyer. She can't pinpoint exactly where she gets her ideas from, but her general rule of thumb is that if it can capture her interest, it might be interesting to others as well.

She's written on topics that range from Portorlan maps of the Mediterranean to the only known live recording of Woody Guthrie. "Some guy found a live recording in his closet. On wire of all things!" After finding the wire the guy sent it off to the Woody Guthrie Museum. When they received a box full of wires a few days after the September 11th attacks, they were alarmed to say the least. But once they realized that the wires were actually a recording they wanted to play it but couldn't figure out how. The wire stretched, kinked, and broke over and over so they didn't know what to do. They eventually contacted some mathematicians to help them figure out a way to restore the recordings. "They won a Grammy for their work. The only known Grammy in mathematics!"

But Rehmeyer doesn't just want to write about math; she wants to change how people view it. "I'm really struck by how wounded so many people are with math. To a large extent, I think, that's because math is very often horribly taught – the teachers themselves are wounded, and so they perpetuate a garbled view of mathematics. The result is that people come away feeling that they're no good at mathematics. This is, in my view, a rather profound wound, one with repercussions far beyond a moment of anxiety when calculating a tip. Mathematics is, at its heart, our way of making sense of the world, of recognizing patterns, of seeing meaning. So when people feel that they're bad at mathematics, they really feel that they're bad at seeing meaning. That's ultimately a kind of spiritual wound, and it's horrible. My hope is that if someone reads one of my stories and comes away feeling like, 'Hey! I could understand that, and it was pretty fun!,' it will in a small way be a balm on that wound. It will leave them feeling a bit more comfortable with their mathematical selves, a bit more confident in their internal pattern- and meaning-finding machinery. And maybe that will affect more than the wallet of their restaurant server at the end of the night.'"

Rehmeyer, a Houston native, enjoys running, spending time with her dog, and gardening. She currently resides in New Mexico in a home made of straw bales that she built herself. ■

– Quanie Mitchell

CALL FOR PROPOSALS

Proposals are currently being sought for week-long workshops for up to 28 people and SQuaRE collaborations for 4-6 researchers to take place in 2013-2014 at AIM in Palo Alto, California. Proposals require:

- **a list of organizers**
- **a list of potential participants**
- **a description of goals**
- **an outline of how goals will be met**

For more details and online applications:
http://www.aimath.org/research

Application deadline: November 1, 2012.

Keyboards Meet Chalkboards

SQuaREs Program Facilitates Unlikely Collaboration

Jesús De Loera was on the verge of a new discovery. The UC Davis computational mathematician was knee-deep in a project regarding Ehrhart polynomials, devising ways to count the number of integer lattice points inside of polytopes that sit in higher dimensional space. He had just published a paper and was working on another with Davis colleague Matthias Köppe when he received an unusual email from French mathematician Michèle Vergne.

Vergne had written to tell him that she and her two European colleagues had also computed one of the 42-digit numbers that appeared in his paper and had arrived at a different answer. The answer from the European group proved to be correct. "We were working on the same topic on opposite ends of the world, using completely different approaches," De Loera said. "It was a little like meeting someone from Mars."

While De Loera and Köppe were delving into the mysteries of geometry from a computer science angle, using algorithms and designing software to help solve the problems, the three European mathematicians, Nicole Berline of France's Ecole Polytechnique, Michèle Vergne of the Ecole Polytechnique and the Institut de Mathématiques de Jussieu in France, and Velleda Baldoni of the University of Rome "Tor Vergata" in Italy, were using a theoretical approach to solve the same problem, using algebraic techniques on a good old-fashioned chalkboard.

An intrigued De Loera reached out to the European mathematicians with a proposal that they work together toward an answer, each using their own approach. But, while the European mathematicians expressed interest, the proposal faced unforeseen difficulties, including the lack of ways and places to work together. It soon became apparent that the group would have to meet in person in order to make any progress. But how do you get five mathematicians in three countries in the same room together?

"As a regular visitor to AIM, I was quite aware of the SQuaRE program and it seemed like a perfect fit for us," De Loera said. "In fact, I realize it would have been nearly impossible without AIM's help, and we are eternally grateful to them for making this possible."

The SQuaRE enjoys the California weather.

The purpose of a SQuaRE, or Structured Quartet Research Ensemble, is to allow a dedicated group of four to six mathematicians to spend a week at AIM with the possibility of returning for a week at a time in subsequent years. Collaborators stay in a local hotel and are given a workspace to hash out math problems and make discoveries without the distractions of the everyday office environment. The program facilitates associations between people who would not have the opportunity to work together otherwise, like De Loera, Köppe, Vergne, Berline and Baldoni. This group has written four papers together, an impressive number for what amounts to around three weeks of time spent together over a span of three years.

During one of the week-long research sessions, De Loera also brought along a few of his graduate students to offer practical help with creating software and writing algorithms, resulting in lively discussions involving three generations of mathematicians.

"We focus on what we have in common," De Loera said. "We start with a mystery that everyone wants to crack. It all comes down to our love for the math."

The group has overcome a variety of obstacles along the way – generational, linguistic, cultural, and mathematical – to become the cohesive problem-solving team that they are today. They plan to continue their collaboration in the future. ■

– Jessa Barniol

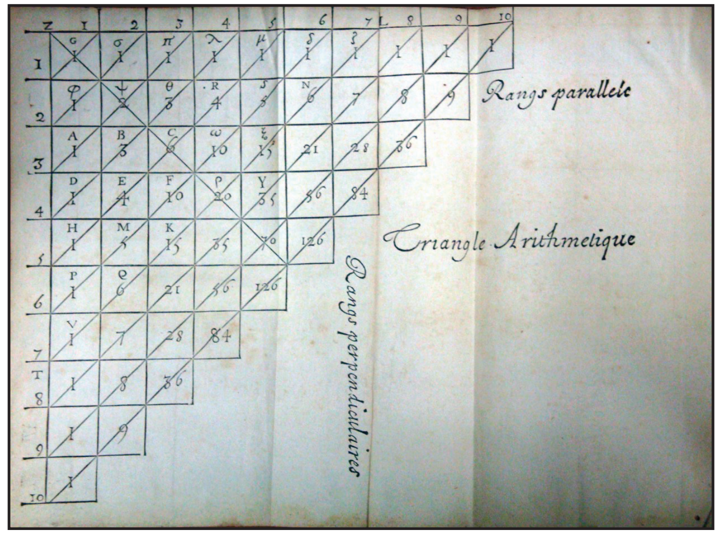
From Berkeley to Budapest

Generous Gifts Benefit AIM Library Collections

From Moss Beach to Minneapolis, Santa Barbara to Scituate, Berkeley to Budapest, books and reprints found new homes at the American Institute of Mathematics in 2010-2012. Since its inception, the AIM Library has enjoyed the support of local universities, math departments, and individuals. The Stanford math librarians alert us to duplicates and both the UC Berkeley and Santa Clara University math departments regularly round up material from emptied offices and send it our way. Individual donors have been equally generous in the last few years, which have seen a windfall of gifts from Californians. Among them, we note Virginia Halmos, who has not only donated items from Paul Halmos' library, but who has also generously donated his royalties to benefit AIM.

The most recent donation was also the most local, given by AIM's Kent Morrison and representing a first installment from his library. The earliest (and largest) donation came from the daughters of UC Santa Barbara mathematician Marvin Marcus. Further up the coast, UC Berkeley mathematicians Robin Hartshorne and Henry Helson and statistician Erich Lehmann made AIM the repository of their books and reprints. Both Helson and Lehmann were leading figures in their fields and spent virtually their entire careers at Berkeley, each serving as chair of his respective department. Helson's gift included a small trove of late 19th to early 20th century reprints, some bearing the signatures of or inscriptions to earlier Berkeley math department chairs. Taken together, these reprints describe a fascinating arc among Cal professors.

Although much of our library has been built on the donations of professional mathematicians, we also owe much to donors with degrees in mathematics who didn't pursue academic careers. A case in point is Joseph A. Zilber, who studied under Andrew Gleason (a prominent AIM donor and former Advisory Board member) at Harvard, taught briefly at Ohio State and retired to Moss Beach, California, where he kept and added to a choice library of some 400 books. Similarly, the heirs of Z. A. Typaldos, Sophie Squires and Bernard A. Asner, unaffiliated individuals all, contacted us with the goal of preserving their collections at AIM.



A folding plate depicting Pascal's triangle illustrates a first edition of Blaise Pascal's Traité du triangle arithmétique, *Paris: 1665. This fundamental work on probability theory arose from correspondence with Pierre de Fermat about various problems in calculating the odds in games of chance.*

As readers of AIM newsletters know, the Midwest is well represented in our library by donors such as Paul Bateman and Heine Halberstam. To their contributions, we now add 3,000 reprints from Walter Littman, formerly of the University of Minnesota. At the moment, we are also busy cataloguing the extensive collections of number theorists Marvin Knopp (who received his Ph.D. under Bateman and collaborated heavily with yet another AIM donor, Emil Grosswald), Barry Mazur, and Paul Turán. Turán's reprints remained in Budapest until last fall, when his wife, Dr. Vera Sós, donated them to AIM. They include the work of numerous fellow Hungarians, from the well known (e.g. Paul Erdős, Turán's close friend) to the less so. We are delighted to welcome them all.

On reviewing the acquisitions of the past two to three years, I am struck by the wealth of connections between authors and owners, collectors and colleagues, researchers and their advisors. Some of them are obvious, others more obscure. Discovering relationships among material donated from the West Coast to Eastern Europe, from professional mathematicians to enthusiastic amateurs, is immensely rewarding. ■

– Ellen Heffelfinger

Connecting Concepts

Organizing Mathematical Data with AIM Tools

LISTING MATH'S BIGGEST QUESTIONS

AIM Problem Lists

Unsolved problems are both the cause and the effect of mathematics research: you do research to answer a question, and, almost always, the answer leads to even more questions.

Most mathematicians are only aware of the problems in their own area. And even then it can be difficult to stay current on which problems have had recent progress, which are considered most important, and which are likely to see results in the near future.

At many AIM workshops, a moderated problem session leads to a discussion which helps clarify the latest developments in that specialized area. This is useful for the participants, particularly for the graduate students and post-docs who may be seeing the "big picture" for the first time. A write-up of the session provides a similar benefit to all mathematicians. Unfortunately, such a document becomes outdated rather quickly.

AIM is addressing this issue by developing an online tool specifically designed for creating and maintaining annotated lists of open problems. The "AIM Problem Lists" (AimPL) page supports a long-term view of mathematics research. Problems have a permanent identifier and URL, and, except to correct typographic errors, problem statements do not change. Remarks on the problems are curated by experts, reflecting the community's current understanding of the problem. Problems are grouped into specialized lists and are further organized into sections within the list.

Perhaps the most important feature is that the effort to maintain each list is distributed across the research community, yet still remains under the control of a handful of experts. This avoids placing the burden of maintenance on one individual, without compromising the scholarly integrity of the list.

AimPL provides a new approach to organizing the problems that drive research mathematics. It will continue developing to meet the needs of research mathematicians.

You can view the site at **http://AimPL.org/**.

LIKE FACEBOOK FOR FUNCTIONS

L-functions and Modular Forms Database

With the help of two grants from the National Science Foundation, AIM has begun developing a new way to organize mathematical data.

The "L-functions and Modular Forms Database" (LMFDB) organizes mathematical concepts like a social network: mathematical objects have a "home page" and "friends."

What is on your own home page? Probably your name, basic information about yourself, possibly your picture, information about what you like to do, and information about your friends.

What should be on the home page of the Riemann zeta function? Basic information like its name, and formulas such as its Dirichlet series and Euler product. And a picture, of course, which, in this case, is a graph of the function along the critical line.

What does the Riemann zeta function like to do? It has a functional equation, and (according to the Riemann Hypothesis) it likes to have zeros on the critical line. That information, and more, appears on its home page.

Who are the friends listed on the Riemann zeta function's page? The rational number field is a friend, because its Dedekind zeta function is the Riemann zeta function.

Other mathematical objects have a more intricate social network. An elliptic curve has its Hasse-Weil L-function as a friend. And, as proved by Wiles and his colleagues, there is a holomorphic modular form with the same L-function, so that modular form is a friend. The symmetric powers of the L-function are also friends, as is the isogeny class of the elliptic curve. Each of these friends has its own home page.

This project is still in its early stages. Currently there also are home pages, in various stages of development, for local and global number fields; Siegel, Hilbert, and Maass forms; Dirichlet characters; Galois groups; and Artin L-functions.

You can visit the site at **http://LMFDB.org/**. ■

– David Farmer

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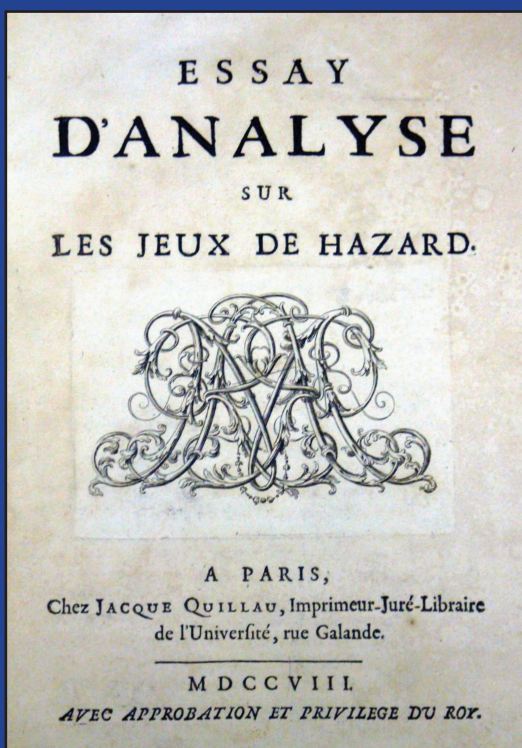
From Our Collections

On Probability and Games of Chance

Pierre Montmort, Essay d'analyse sur les jeux de hazard. Paris: 1708.



ESSAY
D'ANALYSE
SUR
LES JEUX DE HAZARD.

A PARIS,
Chez JACQUE QUILLAU, Imprimeur-Juré-Libraire
de l'Univerſité, rue Galande.

MDCCVIII.
AVEC APPROBATION ET PRIVILEGE DU ROY.

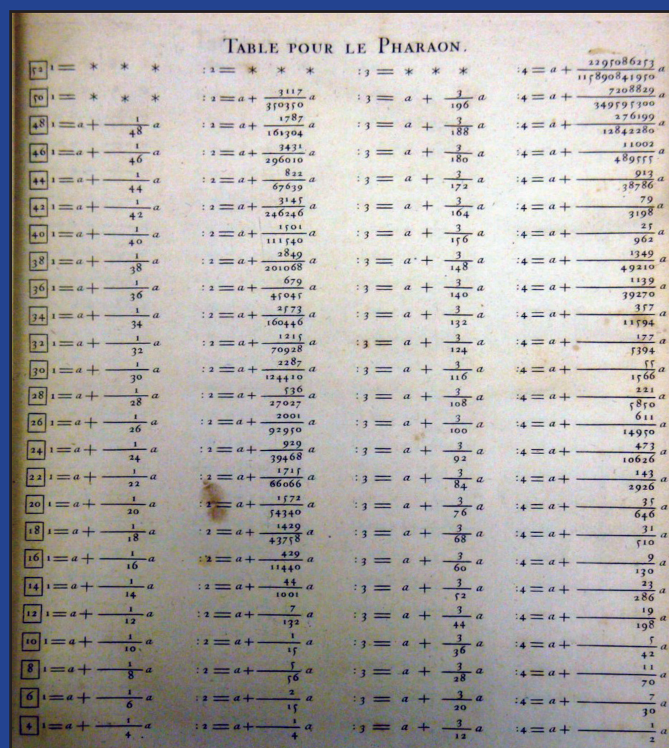


TABLE POUR LE PHARAON.

52	1 = * * *	: 2 = * * *	: 3 = * * *	: 4 = $a + \frac{2295086253}{115890841950} a$
50	1 = * * *	: 2 = $a + \frac{3117}{350350} a$	: 3 = $a + \frac{3}{196} a$	: 4 = $a + \frac{7208829}{349595300} a$
48	1 = $a + \frac{1}{48} a$	: 2 = $a + \frac{1787}{161304} a$	: 3 = $a + \frac{3}{188} a$	: 4 = $a + \frac{276199}{12842280} a$
46	1 = $a + \frac{1}{46} a$	: 2 = $a + \frac{3431}{296010} a$	: 3 = $a + \frac{3}{180} a$	: 4 = $a + \frac{11002}{489555} a$
44	1 = $a + \frac{1}{44} a$	: 2 = $a + \frac{822}{67639} a$	: 3 = $a + \frac{3}{172} a$	: 4 = $a + \frac{913}{38786} a$
42	1 = $a + \frac{1}{42} a$	: 2 = $a + \frac{3145}{246246} a$	: 3 = $a + \frac{3}{164} a$	: 4 = $a + \frac{79}{3198} a$
40	1 = $a + \frac{1}{40} a$	: 2 = $a + \frac{1501}{111540} a$	: 3 = $a + \frac{3}{156} a$	: 4 = $a + \frac{25}{962} a$
38	1 = $a + \frac{1}{38} a$	: 2 = $a + \frac{2849}{201068} a$	: 3 = $a + \frac{3}{148} a$	: 4 = $a + \frac{1349}{49210} a$
36	1 = $a + \frac{1}{36} a$	: 2 = $a + \frac{679}{45045} a$	: 3 = $a + \frac{3}{140} a$	: 4 = $a + \frac{1139}{39270} a$
34	1 = $a + \frac{1}{34} a$	: 2 = $a + \frac{2573}{160446} a$	: 3 = $a + \frac{3}{132} a$	: 4 = $a + \frac{357}{11594} a$
32	1 = $a + \frac{1}{32} a$	: 2 = $a + \frac{1215}{70928} a$	: 3 = $a + \frac{3}{124} a$	: 4 = $a + \frac{177}{5394} a$
30	1 = $a + \frac{1}{30} a$	: 2 = $a + \frac{2287}{124410} a$	: 3 = $a + \frac{3}{116} a$	: 4 = $a + \frac{55}{1566} a$
28	1 = $a + \frac{1}{28} a$	: 2 = $a + \frac{536}{27027} a$	: 3 = $a + \frac{3}{108} a$	: 4 = $a + \frac{221}{5850} a$
26	1 = $a + \frac{1}{26} a$	: 2 = $a + \frac{2001}{92950} a$	: 3 = $a + \frac{3}{100} a$	: 4 = $a + \frac{611}{14950} a$
24	1 = $a + \frac{1}{24} a$	: 2 = $a + \frac{929}{39468} a$	: 3 = $a + \frac{3}{92} a$	: 4 = $a + \frac{473}{10626} a$
22	1 = $a + \frac{1}{22} a$	: 2 = $a + \frac{1715}{66066} a$	: 3 = $a + \frac{3}{84} a$	: 4 = $a + \frac{143}{2926} a$
20	1 = $a + \frac{1}{20} a$	: 2 = $a + \frac{1572}{54340} a$	: 3 = $a + \frac{3}{76} a$	: 4 = $a + \frac{35}{646} a$
18	1 = $a + \frac{1}{18} a$	: 2 = $a + \frac{1429}{43758} a$	: 3 = $a + \frac{3}{68} a$	: 4 = $a + \frac{31}{510} a$
16	1 = $a + \frac{1}{16} a$	: 2 = $a + \frac{429}{11440} a$	: 3 = $a + \frac{3}{60} a$	: 4 = $a + \frac{9}{130} a$
14	1 = $a + \frac{1}{14} a$	: 2 = $a + \frac{44}{1001} a$	: 3 = $a + \frac{3}{52} a$	: 4 = $a + \frac{23}{286} a$
12	1 = $a + \frac{1}{12} a$	: 2 = $a + \frac{7}{132} a$	: 3 = $a + \frac{3}{44} a$	: 4 = $a + \frac{19}{198} a$
10	1 = $a + \frac{1}{10} a$	: 2 = $a + \frac{1}{15} a$	: 3 = $a + \frac{3}{36} a$	: 4 = $a + \frac{5}{42} a$
8	1 = $a + \frac{1}{8} a$	: 2 = $a + \frac{5}{56} a$	: 3 = $a + \frac{3}{28} a$	: 4 = $a + \frac{11}{70} a$
6	1 = $a + \frac{1}{6} a$	: 2 = $a + \frac{2}{15} a$	: 3 = $a + \frac{3}{20} a$	: 4 = $a + \frac{7}{30} a$
4	1 = $a + \frac{1}{4} a$	: 2 = $a + \frac{1}{4} a$	: 3 = $a + \frac{3}{12} a$	: 4 = $a + \frac{1}{2} a$

This landmark work in the history of probability is based on the problems set forth by Christiaan Huygens in his 1657 treatise, *De Ratiociniis in Ludo Aleae*. Clockwise from left, the title page features an engraved monogram, "P.M.," alluding to the author's name. A table presents numerical results involving the late 17th century French card game "Faro." A woodcut from the essay depicts gambling scenes.