

# NEWSLETTER

## RESEARCHERS ACROSS DISCIPLINES SEEK TO SOLVE FUNDAMENTAL EVOLUTIONARY QUESTIONS

In an academic world largely divided by disciplinary boundaries, Tandy Warnow is a leader in bridging the gaps. Warnow connects mathematicians, computer scientists, and biologists in an effort to solve complex problems in genomics – questions as fundamental as how life on Earth evolved, and how organisms change as a result of their interactions with other organisms and with their environment.

“Genomics involves data generation and the technology for doing the sequencing – the analysis of which involves a lot of computer science and statistics,” says Warnow, the Founder Professor of Engineering in the departments of computer science and bioengineering at the University of Illinois, Urbana-Champaign. “But it’s what you do with the data that can transform the sciences. My goal is to bring together the understanding of mathematics, probability theory, and

statistics with the computer science for developing efficient algorithms, then take that to the biologists as part of an iterative process of making progress on problems.”

Warnow’s interest in collaborating across disciplines is what drew her to IPAM. “IPAM is the most exciting institute for connecting applied and pure mathematicians with people outside of mathematics,” she says. “People who are at the forefront of biology but need new methods and ideas are paired with top mathematical scientists who appreciate the importance of interacting with other disciplines to study the most important problems and move closer to solutions.”

Although she is housed in a computer science department, Warnow’s PhD is in pure mathematics from UC Berkeley, and math continues to inform all of her scholarly work. Warnow’s focus is on methods for

estimating evolutionary histories – from how humans and other biological species evolved to more complicated questions such as the evolution of gene sequences, as well as the evolution of languages.

“Over the last several decades, the research community has formulated evolution as a random process generating DNA sequences, and has used properties of the random process in an effort to determine



**Tandy Warnow**  
Univ. of Illinois

(continued on page 3)

## IPAM HOSTS FIRST LATINA/OS IN MATH CONFERENCE



Latina/os in  
Math Conference

On April 9-11, 2015, IPAM was honored to host the first ever Latina/os in the Mathematical Sciences Conference. The conference celebrated the contributions of Latina/os to mathematics and encouraged students to pursue advanced degrees and careers in math. The event was a major step in building a community of Latina/o mathematicians that supports and promotes the advancement of its members.

Over 150 students, postdocs, faculty and professionals attended the conference which included research talks, panel discussions, mentoring activities, and a celebratory banquet. Highlights included presentations and a discussion on Latina/os in STEM

fields and higher education led by Ana Mari Cauce, Interim President of the University of Washington, and Cristina Villalobos, Professor and Director of the Center of Excellence in STEM Education, University of Texas-Pan American; a hands-on math activity for local high school students; and a banquet with special guest Edward James Olmos, who portrayed legendary math teacher Jaime Escalante in the film *Stand and Deliver*. Special thanks to the organizing committee, speakers, panelists, session chairs, and conference sponsors NSA and Raytheon. To read about the conference and view videos of selected research talks, go to [www.ipam.ucla.edu/lat2015](http://www.ipam.ucla.edu/lat2015). ■

### INSIDE FEATURES

Financial Mathematics	2
Materials Science Open Problems	3
Culture Analytics	8

### REGULARS

Director’s Note	2
News and Recognition	4
Frontiers Society	5

### OTHER

Corporate Giving	5
Upcoming Programs	6
Call for Proposals	6

## NOTE FROM DIRECTOR RUSSEL CAFLISCH

It's been a good year for IPAM! After a successful site visit, the National Science Foundation renewed IPAM's funding for another five years, through 2020. In a time of tighter federal budgets, this was a nontrivial feat. Though we were pleased by the outcome, our NSF funding will stay flat, at the level of the last 5 years. Consequently, external fundraising is more important than ever. We are grateful for recent generous contributions from IPAM Trustee David Balaban and from AMD facilitated by IPAM Trustee Alan Lee, as well as from many other individuals and corporations.



**Russel Caflisch**  
IPAM Director

The year was marked by two strong long programs. Mathematics of Turbulence brought together physicists, engineers, and mathematicians for a new look at an old subject. The program highlighted exciting progress on topics such as spontaneous stochasticity and lean models for turbulence. The second long program was New Directions in Financial Mathematics, with participants from academia, industry and regulatory agencies. This program focused on data analysis and systemic risk, in response to the financial crisis of 2007-08, as well as recent developments in high-frequency trading and financialization of commodity markets.

The workshop topics from last year - genomics, computational photography, Zariski-dense subgroups, machine learning for materials, and quantum physics - demonstrate the breadth of IPAM's interests. Our sponsorship of the Blackwell-Tapia Conference, the Latina/os in Mathematics Conference, and the Women in Financial Mathematics workshop demonstrate our commitment to diversity.

This was also a year of transition. We will miss Mike Raugh, who stepped down as director of RIPS (IPAM's summer undergraduate research program), after 15 years. Also Skip Garibaldi, IPAM's Associate Director for the last two years, moved to the Center for Communications Research West. He was replaced by Jorge Balbás from California State University Northridge, who has been involved in several IPAM programs.

IPAM will be 15 years old this fall! A special event on October 6th will celebrate our anniversary, with presentations by Roja Bandari (Twitter), Maryam Fazel (University of Washington) and Ranaan Schul (SUNY Stony Brook), each of whom was strongly influenced by IPAM at an early stage in their career. A 15th anniversary fundraising campaign will feature an opportunity to "name a seat" in our recently renovated seminar room. I urge you to get involved with IPAM by attending the 15th Anniversary Event (and other programs) and by contributing to this campaign. ■

## LONG PROGRAM EXPLORES NEW DIRECTIONS FOR FINANCIAL MATHEMATICS IN AFTERMATH OF CRISIS

In the years since the financial crisis of 2007-08, leaders in the field of financial mathematics have been concerned that their research has become less relevant. Although traditional areas of focus such as derivative pricing, hedging, and portfolio theory remain important, new issues have become more pressing. "Directly addressing the quantitative challenges of the industry by providing practical solutions and implementations was one of the earliest successes of the field," explains René Carmona, the Paul M. Wythes '55 Professor of Engineering and Finance at Princeton University. "In the early development and explosion of the derivative markets, a mathematician could talk directly to a trader, understand what was needed, and develop new mathematical tools to help address the trader's problems. But the financial crisis

and growth of high-frequency markets dramatically changed the industry, resulting in new demands that need to be better reflected in academic research."

To address these demands, Carmona joined with George Papanicolaou of Stanford University and Thaleia Zariphopoulou of the University of Texas at Austin in organizing Broad Perspectives and New Directions in Financial Mathematics, a long program held at IPAM this spring. The program, which addressed the stability of the network of financial institutions, the impact of high-frequency and algorithmic trading, the financialization of the commodity markets, and the huge challenges raised by the size and speed of trade data, was distinctive for its mix of researchers from academia, industry, and regulatory agencies.

"We thought it was time to expose entrants to the field to the new realities of the financial industry," says Carmona. "Yes, derivative pricing is still active, and the credit market hasn't completely disappeared, but the challenges are now in large part motivated by systemic risk and the growing importance of high-frequency trading."



**René Carmona**  
Princeton Univ.

*(continued on page 7)*

# OPEN PROBLEMS IN MATERIALS SCIENCE CHALLENGE MATH PHD STUDENT

UC Santa Barbara PhD student Silvia Comelli expects to receive her degree in 2016.

I first heard about IPAM from my PhD advisor at UCSB, Carlos Garcia-Cervera, who invited me to join him at IPAM for Materials for a Sustainable Energy Future, in the fall of 2013.

At that point, my background was mainly in analysis, but I found myself intrigued by the idea of employing my math skills towards the solution of concrete, real-life problems. As I explored this new possibility, Prof. Garcia-Cervera introduced me to the world of density functional theory and the mathematical foundation for some of the electronic structure models found in quantum chemistry and materials science. I spent the year acquiring the necessary background knowledge of the field.

The emphasis of the IPAM long program was the design of new materials capable of replacing today's fossil fuel-based infrastructure. I was really impressed by how the program itself was introduced: we have an open problem that needs a solution as soon as possible, so let's gather all the experts from all possible related disciplines and see if together we can discover a solution. This was exactly the type of problem and approach I sought for my own research!

I have to admit that I struggled to follow the first few talks. People

from different disciplines often speak about the same things using different terms; to remedy this problem, IPAM constantly encouraged the speakers to make their talks accessible to people of other research communities. By the end of the program, I was really impressed by how my ability to enter into discussions with people from other backgrounds had improved. The focus groups in particular helped make this possible. These small, informal groups met weekly to discuss additional, often more specific topics related to the workshops and facilitated further discussion.

Finally, during the program, I had the chance to meet with scholars whose work I had been studying over the past year. This was a great opportunity to clarify in person all the details of their research, which truly helped me progress with my own work.



**Silvia Comelli**  
UC Santa Barbara

(continued on page 4)

## Evolutionary Questions

(continued from page 1)

how species evolved," she explains. "My group uses mathematics, as well as software simulations, to develop methods that will help to bring greater accuracy in describing the evolutionary process. We prove theorems, but we try to go beyond that to come up with methods that biologists can use."

For the last several years, Warnow has been involved in a multinational collaboration focusing on how birds evolved. "There is a major effort to accurately reconstruct the genome-scale evolution of a species when different parts of the genome have different evolutionary histories, which is a highly challenging statistical inference problem," Warnow explains. Her work played an integral role in two papers in a special issue of *Science*: one describing the evolutionary history of birds, and another describing the method her group developed to conduct the evolutionary reconstruction.

Revolutionary advances in high-throughput technologies, which have transformed the field of genomic studies, have also created a tremendous need for the development of new mathematical and computational infrastructures to meet the challenges of analyzing the data, which is both voluminous and more prone to errors and statistical noise. That's where Warnow comes in, and it's what led her to become involved in 2011 as a speaker and core participant in IPAM's long program, Mathematical and Computational Approaches in High-Throughput Genomics. The program proved fruitful, Warnow believes, because it brought

together talented participants from a wide variety of disciplines within mathematics, computer science, statistics, and probability over an extended period of time.

Following that experience, Warnow agreed to serve as a main organizer and speaker in the 2015 IPAM workshop Multiple Sequence Alignment, aimed at the emerging biological questions on the function of proteins. "What was fantastic was that we had as many biologists as mathematicians and computer scientists at that workshop," Warnow says. "It was a great opportunity to engage in a dialogue about the problems that are essential to address, how our approaches differ, and how we might be able to bring them together to create breakthroughs."

The crosstalk that occurs at IPAM meetings is essential when attempting to marshal the efforts of multiple disciplines to solve complex problems, Warnow says. "A lot of people think you just need to learn the language of the other disciplines," she notes. "That's part of it, but more important is to gain an understanding of what the people in that discipline care about. To do that, you need people who are strong in their discipline, as well as people who either sit in the middle or have spent a lot of time on the other side. And you need the right people – those who are going to take the time to learn and understand other fields. When you have all of those elements, and a venue like IPAM where there can be an extended dialogue, you have the potential to transform the science." ■

## NEWS AND RECOGNITION

### ANDREW LO GIVES 2015 GREEN FAMILY LECTURES

Andrew W. Lo, professor at the MIT Sloan School of Management and the director of MIT's Laboratory for Financial Engineering, visited IPAM in May to give the 2015 Green Family Lectures. He gave two talks to the UCLA community: "Can Financial Engineering Cure Cancer? A New Approach to Funding Biomedical Innovation" and "Evolutionary Foundations of Economic Behavior, Bounded Rationality, and Intelligence". Videos of both talks are available on IPAM's website and YouTube channel. Andrew Lo is the author of *The Econometrics of Financial Markets*, *A Non-Random Walk Down Wall Street*, and *Hedge Funds: An Analytic Perspective*.



Mark Green, Andrew Lo, & Russ Cafilich  
2015 Green Family Lectures

### IPAM CELEBRATES RENEWAL, 15TH ANNIVERSARY

Last winter, IPAM was recommended for renewal by the Division of Mathematical Sciences, National Science Foundation. The five-year grant, which starts on September 1, 2015, marks the fifteenth

anniversary of IPAM's first year of programming. To celebrate, IPAM will host a 15th Anniversary Event on Tuesday, October 6, 2015. The afternoon event will consist of three talks by former participants of IPAM programs whose research was greatly influenced by their participation at IPAM, followed by a reception. For more information and to register, go to [www.ipam.ucla.edu/ann2015](http://www.ipam.ucla.edu/ann2015).

### "WOMEN IN FINANCIAL MATH" MEETING HELD AT IPAM

On May 14, 2015, IPAM hosted the inaugural conference of Women in Financial Mathematics, organized by IPAM Trustee Tanya Beder (SBCC Group), Xin Guo (UC Berkeley) and Thaleia Zariphopoulou (Univ. of Texas). Sixty-five participants, mostly graduate students and women working in the financial sector, engaged in panel discussions on topics such as quantitative trading and portfolio allocation, and networking. A second meeting is tentatively scheduled for October 6, 2016, also at IPAM.



Women in Financial Mathematics

### JORGE BALBÁS JOINS IPAM AS ASSOCIATE DIRECTOR

Jorge Balbás recently joined IPAM as Associate Director. Balbás is well-known to IPAM: as a UCLA graduate student and then as a professor of mathematics at California State University Northridge, he attended many IPAM workshops and three long programs, and twice served as an academic mentor in RIPS. His research is in scientific computing and numerical analysis. In particular, he is interested in the design and implementation of efficient numerical algorithms for solving hyperbolic conservation laws and related time dependent problems. Balbás replaces outgoing Associate Director Skip Garibaldi, who has taken a position at the Center for Communications Research West.



Jorge Balbás  
IPAM Associate Director

### IPAM WELCOMES NEW BOARD MEMBERS

IPAM is happy to announce three new board members who were recruited in the past year. Iain Couzin, Director of the Department of Collective Behavior,

## Open Problems in Materials Science

(continued from page 3)

The overall experience was so positive that a year later when Prof. Garcia-Cervera proposed that I participate in IPAM's 2014 summer school Electronic Structure Theory for Materials and (Bio)-Molecules, I immediately accepted, even though I was nine months pregnant! My research fit perfectly within the topic of the program. Once again, internationally renowned experts as well as junior researchers from different disciplines gathered at IPAM. I reconnected with people I had met the previous year and discussed with them all the progress made in those seven months. Furthermore, I benefited from the summer school's special attention towards the junior researchers: after the talks held in the morning, we participated in computer-based exercises which gave us a more intimate understanding of what had been presented. Three days before the program ended, I gave birth to my son!

I am grateful to IPAM for organizing these types of programs and giving me the chance to participate. The programs offered me a unique opportunity to acquire a greater understanding of my research by sharing and discussing it with a worldwide community of experts. ■

## CONTINUED

Max Planck Institute for Ornithology, and Professor, Department of Biology, University of Konstanz, joined IPAM's Science Advisory Board. Leland Wilkinson, Vice President of Statistics at Tableau Software, and Nancy Potok, Deputy Director and Chief Operating Officer of the U.S. Census Bureau, joined the Board of Trustees. IPAM is grateful for their service and looks forward to their participation.

### IPAM PARTICIPANTS, ORGANIZERS, AND BOARD MEMBERS RECEIVE AWARDS

IPAM wishes to acknowledge the following awards and honors bestowed upon IPAM participants, organizers, and board members in the past year. Emmanuel Candès (Stanford) was presented the AMS-SIAM George David Birkhoff Prize in Applied Mathematics. Alexander Eskin (University of Chicago) and Donald Geman (Johns Hopkins University) were elected to the National Academy of Sciences. IPAM Trustee Tatiana Toro (University of Washington) was awarded a Guggenheim Fellowship. The



**Tatiana Toro**  
Univ. of Washington

2015 Simons Fellows in Mathematics included Liliana Borcea (University of Michigan), Ted Chinburg (University of Pennsylvania), and Mitch Luskin (University of Minnesota). Finally, Kristen Altenburger (Stanford), who participated in RIPS-Hong Kong as an undergraduate, was a finalist in the LinkedIn Economic Graph Challenge.

### IPAM THANKS MICHAEL RAUGH FOR 15 YEARS OF RIPS

The Research in Industrial Projects for Students (RIPS) Program began in 2001 with Michael Raugh as Director. For the next fifteen years, he spent his summers as "guest conductor" (as he likes to say) of RIPS, providing essential structure to the program, advising the teams on difficult problems, and helping them prepare sophisticated presentations of their results at Projects Day. On August 18, 2015, Dr. Raugh directed his last Projects Day. IPAM and the 429 students and 120 academic mentors who participated in RIPS are grateful for his leadership and devotion to the program.



**Mike Raugh**  
RIPS Director

## FRONTIERS SOCIETY



**IPAM turns 15!** IPAM will commemorate its 15th anniversary on Tuesday, October 6 with a half-day event of talks, networking and celebration. We are also introducing a special giving opportunity for our

supporters for the anniversary year. **For a donation of \$1,500, you can name a seat in our newly renovated lecture hall.** Make this gift soon to be recognized at the anniversary event!

Of course, gifts at all levels are welcome and support IPAM's innovative programs, including RIPS, diversity conferences, and scientific programs that apply mathematics to real-world problems. To read more about the Frontiers Society including benefits and fundraising priorities, and to make a contribution to IPAM, go to [www.ipam.ucla.edu/donate](http://www.ipam.ucla.edu/donate).

### 2014-15 MEMBERS

IPAM wishes to thank the following individuals who joined or renewed their membership in the Frontiers Society in the past year:

#### CHAMPIONS (\$1000+)

Dr. David Balaban  
Ms. Tanya Beder and Mr. Joseph H. Bretton  
Dr. Russel E. Caflisch  
Dr. Tony F. and Mrs. Monica K. Chan  
Dr. James C. and Mrs. Diana K. Fraser  
Mr. James E. Gidney, Jr.  
Mark L. Green and Kathryn Kert Green  
Dr. Alfred W. and Mrs. Virginia D. Hales  
Mr. John W. and Mrs. Jody A. Jacobs  
Dr. Sallie Keller and Mr. William Safron  
Dr. Maria P. McGee  
Dr. Stanley J. Osher  
Mrs. Ronald J. and Sharon S. Stern  
Dr. Frederic Y.M. Wan

#### VISIONARIES (\$500-\$999)

Dr. William Coughran  
Mr. Michael J. Hathaway  
Dr. Leland Wilkinson

#### INNOVATORS (\$100-\$499)

Dr. Adrian Albert  
Mr. Robert Baker  
Dr. Allison Chang  
Dr. Maryam Fazel  
Mr. Nicholas and Ms. Nancy Fortis  
Dr. John B. and Mrs. Dolores Garnett  
Ms. Valerie Hajdik  
Mr. Robert D. and Mrs. Maxine A. Halem  
Dr. Bryna Kra  
Dr. Tye Lidman  
Mr. Filip Matejka and Mrs. Zuzana Matejkova  
Mr. Tom Nykiel  
Dr. Jeffrey Saltzman and Ms. Laurel Rogers  
Mr. Charlie and Mrs. Sandy Schwennesen  
Mr. James W. Stevenson  
Dr. Tatiana Toro and Mr. Daniel Pollack

## CORPORATE GIVING

IPAM offers opportunities for corporations to participate in our scientific programs, propose topics for programs, and support activities that promote diversity in math and science. IPAM received gifts from the following companies in the past year:

The Aerospace Corporation	Google	MathWorks
AMD	GumGum	Microsoft
AstraZeneca	HRL Laboratories	Raytheon
Disney Animation Studios	Intel	Symantec

Additional support for IPAM programs came from the Alfred P. Sloan Foundation, J.B. Berland Foundation, Lawrence Livermore National Laboratory, LAPD Foundation, Pacific Journal of Mathematics, National Security Agency, and the USC Shoah Foundation.

For more information on corporate giving, go to [www.ipam.ucla.edu/donate/corporate-giving](http://www.ipam.ucla.edu/donate/corporate-giving).

## UPCOMING PROGRAMS

### 2015 - 2016 LONG PROGRAMS

Mathematical Approaches for  
Traffic Flow Management  
*September 8 - December 11, 2015*

Culture Analytics  
*March 7 - June 10, 2016*

### 2016 WORKSHOPS

Optimization and Equilibrium in  
Energy Economics  
*January 11 - 15, 2016*

Uncertainty Quantification for  
Multiscale Stochastic Systems  
and Applications  
*January 19 - 22, 2016*

Partial Order: Mathematics,  
Simulations and Applications  
*January 25 - 29, 2016*

Shape Analysis and Learning by  
Geometry and Machine  
*February 8 - 12, 2016*

Algebraic Geometry for  
Coding Theory and Cryptography  
*February 22 - 26, 2016*

### 2015 - 2016 OTHER PROGRAMS

IPAM's 15th Anniversary Event  
*October 6, 2015*

Research in Industrial Projects for Students

- Los Angeles, June 20 - August 19, 2016
- Hong Kong, June 6 - August 5, 2016
- Berlin, June 27 - August 19, 2016

### 2016 - 2017 LONG PROGRAMS

Understanding Many-Particle  
Systems with Machine Learning  
*September 12 - December 16, 2016*

Computational Issues in  
Oil Field Applications  
*March 20 - June 9, 2017*

## Stay Connected



# CALL FOR PROPOSALS

IPAM seeks proposals from the mathematical, statistical, and scientific communities for long programs, winter workshops, summer programs, and exploratory workshops. Proposals are reviewed by IPAM's Science Advisory Board (SAB) at its annual meeting in November. To receive full consideration, please send your program idea to the IPAM Director at [director@ipam.ucla.edu](mailto:director@ipam.ucla.edu) by October 1.

### WINTER WORKSHOPS

Winter workshops are typically five days in length, with 20-25 presentations. The proposal should include a short description of the mathematical and scientific content, names of individuals to serve on the organizing committee, and names of individuals that you would like to invite as speakers or participants. The SAB will consider proposals for winter 2017 at the upcoming meeting.

### SUMMER SCHOOLS

Summer schools are generally two or three weeks in length and incorporate both tutorials (a series of 3-4 talks) and research talks illustrating applications. They are directed toward graduate students and postdocs. The requirements for summer school proposals are comparable to those for winter workshops. The SAB will consider proposals for summer 2016 in November.

### LONG PROGRAMS

Long programs generally have two complementary streams: one mathematical and one (or more) from other related scientific disciplines where there is the potential for a fruitful and exciting interaction. Alternatively, this might be an interaction between two disparate branches of mathematics. A long program opens with tutorials, followed by four one-week workshops and a culminating workshop.

The proposal should include a brief description of the topic, names of individuals to serve on the organizing committee, and a preliminary list of faculty, postdocs, graduate students, and representatives of industry and government you would like to invite. A Long Program Proposal Template is available online. Proposals for academic year 2017-2018 will be reviewed at the next SAB meeting.

### EXPLORATORY WORKSHOPS

Exploratory workshops address urgent problems that mathematics may help solve. They are two or three days long, and can be organized in less than a year. The proposal should follow the guidelines for Winter Workshops, above, and will be considered at any time.

## Mark Your Calendars

**October 6, 2015.** Attend IPAM's 15th Anniversary Event!

**October 7, 2015.** Workshop on Advancing Traffic Control through Big Data and Connectivity. This mini-workshop during the Traffic long program includes a field trip to the Los Angeles Regional Transportation Management Center.

**November 12, 2015.** Public lecture by Sadasivan (Sadas) Shankar, visiting lecturer at the Harvard School of Engineering and Applied Sciences, entitled "Missing in Translation – Where are the Innovations?"

**February 14, 2016.** Application deadline for IPAM's Research in Industrial Projects for Students (RIPS) Programs in Los Angeles, Hong Kong, and Berlin.

**May 9-10, 2016.** The 2016 Green Family Lecture Series will feature Ingrid Daubechies, James B. Duke Professor of Mathematics at Duke University.

# Financial Mathematics

(continued from page 2)

Prior to the financial crisis, Carmona notes, regulators, academics, and industry leaders had been concerned about systemic risk in the context of the vulnerability to terrorism – the 9/11 attack had disrupted some of the connections in the complex, interdependent financial network, bringing the system to a temporary halt. After the crisis, the notion of systemic risk shifted to concern about dangers from the inside, creating a major field of study for financial mathematicians. “We have to understand this huge network, and how one default can create a cascade that jeopardizes the health of the entire system,” Carmona explains.

Independent of the crisis, Carmona and his colleagues saw that the tremendous growth in high-frequency trading was not being sufficiently accompanied by the development of mathematics to understand and guide these activities. “As much as 70-80 percent of the trades taking place nowadays are done on electronic platforms, not by ‘open outcry’ or over the phone. Consequently, the traditional definitions of broker-dealers, intermediaries and traders need to be revisited,” Carmona says. “Mathematical models that were successful in the late 70s, 80s and 90s may not be appropriate for today’s algorithmic trading, especially at the microsecond level.”

Yet another development requiring more attention from the research community,

Carmona argues, is the enormous influx of money in commodities as institutional investors seek to diversify their portfolios. This financialization of commodities has led to spectacular booms and busts of crude oil, wheat, and other critically important commodities, and has caused economists and regulators to worry that the pricing of these items is being driven by speculation as opposed to fundamentals such as the equilibrium between supply and demand.

The IPAM program featured four weeklong workshops designed to address these concerns. The first focused on systemic risk and the structure and stability of the networks underlying the financial system, as well as how the system can go awry. The second explored the issue of optimal execution in the high-frequency trading markets. The third looked at the financialization of commodities, including the impact of the regulation of these markets and of the recent moves by investment banks to pull out of the physical-commodity market. The final workshop was more speculative, focusing on the role mathematics could play in analyzing, understanding, and ultimately preventing, major mishaps in the financial industry. Its focus on the analysis of financial data brought together mathematicians, data scientists and regulators from several agencies, with a lecture by the Chairman of the National Transportation Safety Board setting the stage.

“We wanted this program to provide an opportunity for young researchers looking to apply mathematics to the world of finance, and to learn about the state of the art in these emerging sub-fields. Our goal was to help them define what the future of financial mathematics will be, and we are very pleased with the results,” says Carmona. “There is still a lot of interest in the classical financial mathematics we practiced in the 1980s and 1990s, but innovation in financial mathematics and the future of the field may not lie exclusively in these traditional topics. It is vital to the future of our financial system that mathematicians take ownership of the quantitative challenges driven by new trends in the industry, and develop theoretical and computational tools that are needed to understand and control these processes.” ■

## BOARD OF TRUSTEES

David Balaban, *Amgen*  
 Tanya Beder, *SBCC Group Inc.*  
 Tony Chan, *Hong Kong University of Science and Technology*  
 Bill Coughran, *Sequoia Capital*  
 Karina Edmonds, *Caltech*  
 Mark Green, *UCLA*  
 Alfred Hales (Chair), *Center for Communications Research West*  
 Sallie Keller, *Virginia Tech University*  
 Bryna Kra, *Northwestern University*  
 Alan Lee, *AMD*  
 Nancy Potok, *U.S. Census Bureau*  
 Ronald Stern, *UC Irvine*  
 Tatiana Toro, *University of Washington*  
 Leland Wilkinson, *Tableau Software*

## SCIENCE ADVISORY BOARD

Alexei Borodin, *MIT*  
 Robert Calderbank, *Duke University*  
 Emmanuel Candes, *Stanford University*  
 Iain Couzin, *Max Planck Institute for Ornithology*  
 Cynthia Dwork, *Microsoft Research*  
 Peter W. Jones, *Yale University*  
 Yann LeCun, *New York University*  
 David Levermore (Chair), *University of Maryland*  
 Assaf Naor, *Princeton University*  
 Terence Tao, *UCLA*  
 Claire Tomlin, *UC Berkeley*  
 Amie Wilkinson, *University of Chicago*  
 Stephen Wright, *University of Wisconsin*

## IPAM DIRECTORS

Russel Caflisch, *Director*  
 Jorge Balbás, *Associate Director*  
 Christian Ratsch, *Associate Director*  
 Stanley Osher, *Director of Special Projects*

## NEWSLETTER

Stacy Orozco, *Editor/Designer*  
 Stacey Beggs, *Silvia Comelli,*  
 and Dan Gordon, *Contributors*



## **Institute for Pure and Applied Mathematics**

a National Science Foundation Math Institute  
at the University of California, Los Angeles

405 Hilgard Avenue  
Box 957121, 460 Portola Plaza  
Los Angeles, CA 90095  
p: 310-825-4755  
f: 310-825-4756  
[www.ipam.ucla.edu](http://www.ipam.ucla.edu)

math changes everything.

# IPAM LONG PROGRAM: CULTURE ANALYTICS

The explosion in use of the Internet and social media and the low cost of computing power have increased the possibilities for understanding cultural behaviors and expressions. The “digital footprints” that people leave as they access these virtual spaces offer a treasure trove of cultural information, where culture is defined as expressions of the norms, beliefs and values of a group.

In the spring of 2016, IPAM’s long program on Culture Analytics will encourage the exploration of the mathematical opportunities that are emerging in this cultural information space. Many successful approaches to the analysis of cultural content and activities have been developed, yet there is still a great deal of work to be done. The program aims to promote collaboration across disciplines and devise new approaches and novel mathematics to address the issues of culture analytics. IPAM seeks emerging and leading scholars in the social sciences and humanities as well as those in mathematics, engineering, and computer science to participate in this effort. ■

