

Annual Report 2022-23

NSF Award DMS-1929348 Covering activity between June 1, 2022 and May 31, 2023

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1. Overview

This is the 2022-23 annual report for the Institute for Mathematical and Statistical Innovation, funded by NSF grant DMS-1929348. It covers activities of the Institute which took place between June 1, 2022 and May 31, 2023.

The Institute for Mathematical and Statistical Innovation (IMSI) is a mathematical sciences research institute hosted by the University of Chicago, and operated in partnership with Northwestern University, the University of Illinois at Chicago, and the University of Illinois at Urbana-Champaign.

1.1 Mission

The mission of IMSI is to bring rigorous mathematics and statistics to bear on complex urgent problems of significant scientific and social importance, and to spur transformational change in the mathematical sciences and the mathematical sciences community. There are three primary pillars to this mission: scientific activity, a focus on diversity and broadening participation in the mathematical sciences, and a focus on effective communication about mathematical science research to a variety of audiences.

IMSI is committed to first-rate interdisciplinary research in areas of great societal interest and impact where the mathematical sciences have the potential to contribute. It aims to make a difference in ways that are scientifically and socially important. The institute will focus the bulk of its scientific activity during the period of the current grant on six themes: Climate and Sustainability, Data and Information, Health and Medical Care, Materials Science, Quantum Computing and Information, and Uncertainty Quantification. These areas embody significant challenges for society at large, and meaningful progress in these areas will in many cases require engagement from researchers and decision makers across a variety of sectors, including academia, national labs, government, and the private sector, and will highlight the important and expanding role played by the mathematical sciences across these sectors.

A crucial factor in addressing these scientific challenges is the diversity of those engaged in research and activity at IMSI. The challenges with which we intend to engage will require perspectives and insight from a number of directions in order to make progress. As suggested above, these insights and perspectives must emerge from interactions among researchers from multiple disciplines and employment sectors. At the same time, there is often a need for research to usefully inform policy and decision making, which requires expanding conversation and engagement beyond the realm of basic research. Moreover, the broad social impacts of these challenges implies that effective engagement with them will often require the participation of a community of researchers who can collectively bring an understanding of how these challenges are experienced across human society as a whole. This points to a need for broad participation in the mathematical sciences. The third pillar in IMSI's mission is an emphasis on effective communication and, beyond that, effective collaboration and engagement. An important aspect of scientific progress is that the insights it generates must propagate and land with those who can make effective use of them. This often requires communicating and collaborating across differences arising from boundaries between intellectual disciplines, research cultures, employment sectors and roles, career and education stages, positions in society, and more. Scientific research often defaults to a mode of experts speaking to experts who emerge from similar research cultures. IMSI aims to encourage scientific research that does not remain confined to this mode, and to provide ways for researchers in the mathematical sciences to build skills in communicating across differences.

1.2 Overview of the Year

IMSI's level of activity this year reached what is expected to be its steady state. IMSI hosted two long programs: Confronting Global Climate Change in the fall of 2022, and Mathematics, Statistics, and Innovation in Medicine and Health Care in the spring of 2023, with a combined total of 10 embedded workshops. In addition, IMSI hosted six topical research workshops outside the framework of long programs; these included workshops on methods of assessing the value of data and the functioning of data markets, the mathematics of quantum hardware, recent developments in the study of Gaussian processes, randomness in topology and its applications, and modeling the economic and environmental consequences of climate change, as well as a reunion workshop for our fall 2021 long program on Distributed Solutions to Complex Societal Problems. IMSI also hosted a month-long research collaboration workshop on Interdisciplinary and Critical Data Science Motivated by Social Justice, which involved teams of researchers working on two data science problems related to small town policing and flooding along the Woonasquatucket Watershed in Rhode Island. Other activities included IMSI sponsorship of the 8th International Conference on Computational Social Science, the 2022 AI+Science Summer School (hosted in collaboration with the Data Science Institute at the University of Chicago), and the 2022 BRING MATH workshop for undergraduates organized in collaboration with the Mathematics and Computer Science Division at Argonne National Laboratory.

IMSI continued its support for outreach and workforce development programs including a summer internship program for Ph.D. students in mathematics and enrichment programs for K-12 students and Chicago public school teachers. In addition, it launched new public outreach initiatives including a new podcast (*Carry the Two*) and a new blog (MathStat Bites) which explains research in mathematics and statistics for a general audience.

COVID-19 had minimal impact on in-person participation in IMSI activities this year.

2. Participant Demographics

2.1 List of Activities

IMSI Activities 2022-2023

Title	Dates
Data Value: Assessment and Evolution	June 6-8, 2022
Mathematical Methods for Quantum Hardware	July 11-15, 2022
8th International Conference on Computational Social Science	July 19-22, 2022
AI+Science Summer School	August 8-12, 2022
Expressing and Exploiting Structure in Modeling, Theory, and Computation with Gaussian Processes	August 29 - September 2, 2022
Confronting Global Climate Change	September 19 - December 9, 2022
Climate Model Evaluation and Uncertainty	September 19-23, 2022
Climate and Weather Extremes	October 3-7, 2022
Summit on AI	October 13-15, 2022
Detection and Attribution of Climate Change	October 17-21, 2022
Machine Learning for Climate and Weather Applications	October 31 - November 4, 2022
BRING MATH	November 11, 2022
Remote Sensing for Climate Analysis	November 30 - December 2, 2022
Economic Impacts of Climate Change	December 7-9, 2022
Interdisciplinary and Critical Data Science Motivated by Social Justice	January 9 - February 3, 2023
QuantCrit and Social Justice Research	January 10, 2023
Driving the Justice Agenda Forward: Work Outcomes and Next Steps	February 2, 2023
Distributed Solutions to Complex Societal Problems Reunion Workshop	February 20-23, 2023
Randomness in Topology and its Applications	March 20 — 24, 2023
Mathematics, Statistics, and Innovation in Medical and Health Care	March 27 - June 2, 2023

Assessing the Economic and Environmental Consequences of Climate Change: Incorporating Uncertainty and Quantifying Its Importance	March 31 — April 1, 2023
Analytics for Improved Healthcare	April 3 — 6, 2023
Machine Learning and Artificial Intelligence for Personalized Medicine	April 17 — 20, 2023
Predictive Analytics, Business Modeling and Optimization in Healthcare Operations Management	May 1 — 4, 2023
Technological Innovation in Health Care Delivery	May 15 — 17, 2023

2.2 Demographics by Type of Activity

Demographics by Activity

Activity		Research Workshops '22-'23	Programs '22-'23	BRING MATH '22
Total Number of Participants (Includes all participants, speakers, and organizers)				
	Female	374	24	17
	Male	749	26	10
	Nonbinary	4	1	1
Gondor	I identify as:	0	0	0
Gender	Prefer not to self-identify	41	0	0
	Do not wish to provide	2	0	0
	Other	0	3	0
	Unknown	15	2	0

Activity		Research Workshops '22-'23	Programs '22-'23	BRING MATH '22
Total Number of Participants (Includes all participants, speakers, and organizers)				
	American Indian or Alaskan Native	7	2	1
	Asian	423	11	4
	Black or African American	34	3	4
Race	Native Hawaiian or Other Pacific Islander	0	0	1
	White	537	32	16
	Do Not Wish to Provide	174	5	4

Unknown 22 2 0				
	Unknown	22	2	0

Activity		Research Workshops '22-'23	Programs '22-'23	BRING MATH '22
Total Number of Participants (Includes all participants, speakers, and organizers)				
	Hispanic or Latino	52	6	10
Ethnicity	Not Hispanic or Latino	910	41	16
Ethnicity	Do not wish to provide	191	5	2
	Unknown	31	3	0

Activity		Research Workshops '22- '23	Programs '22-'23	BRING MATH '22
Total Number of Participants (Includes all participants, speakers, and organizers)				
	Faculty Member or Academic Administrator	524	35	3
	Graduate Student	360	9	1
	Non-academic Employment	111	4	0
Employment/Educational	Postdoctoral Associate	133	4	0
Status	Retired / Not Employed / Self-employed	18	1	0
	Undergraduate Student	38	2	24
	High School Student	0	0	0
	Unknown	0	0	0

Activity		Research Workshops '22-'23	Programs '22-'23
Total Number of Participants (Includes all participants, speakers, and organizers)			
	Mathematics	393	24
	Statistics	366	16
Field(s) of Expertise*	Physics / Astronomy	100	3
	Chemistry	2	0
	Materials Science	4	0
	Computer Science / Information Science	182	10

Engineering	108	6
Life Sciences	16	3
Medicine	37	3
Geosciences	131	4
Economics	92	3
Social Sciences	26	5
Education or Learning Research	5	2
Other	104	9

*Participants were able to indicate more than one field of expertise. Those that selected multiple fields of expertise are represented in the totals more than once.

2.3 Demographics for Research Workshops

The following demographic information includes participants, organizers, speakers, facilitators, and panelists. Some individuals may be reflected more than one time if they participated in more than one workshop. This category of activity includes the following events:

- Data Value: Assessment and Evolution
- Mathematical Methods for Quantum Hardware
- Expressing and Exploiting Structure in Modeling, Theory, and Computation with Gaussian Processes
- Climate Model Evaluation and Uncertainty
- Climate and Weather Extremes
- Detection and Attribution of Climate Change
- Machine Learning for Climate and Weather Applications
- Remote Sensing for Climate Analysis
- Economic Impacts of Climate Change
- QuantCrit and Social Justice Research
- Driving the Justice Agenda Forward: Work Outcomes and Next Steps
- Distributed Solutions to Complex Societal Problems Reunion Workshop
- Randomness in Topology and its Applications
- Assessing the Economic and Environmental Consequences of Climate Change: Incorporating Uncertainty and Quantifying Its Importance
- Analytics for Improved Healthcare
- Machine Learning and Artificial Intelligence for Personalized Medicine
- Predictive Analytics, Business Modeling and Optimization in Healthcare Operations Management
- Technological Innovation in Health Care Delivery



Research Workshops 2022-2023 - Participants by Gender

Note: Participants could select multiple genders. Some individuals may be reflected in this chart more than once.

Research Workshops 2022-2023 - Participants by Race



Note: Participants could select multiple races. Some individuals may be reflected in this chart more than once.



Research Workshops 2022-2023 - Participants by Ethnicity



Research Workshops 2022-2023 - Participants by Employment/Educational Status



Note: Participants were able to indicate more than one field of expertise. Those that selected multiple fields of expertise are represented in the totals more than once.

Research Workshops 2022-2023 - Participants by Employer/School Location (United States)



Research Workshops 2022-2023 - Participants by Employer/School Location (United States)					
State	Number of Participants	State	Number of Participants		
Alabama	4	Montana	0		
Alaska	0	Nebraska	4		
Arizona	7	Nevada	0		
Arkansas	0	New Hampshire	6		
California	100	New Jersey	25		
Colorado	31	New Mexico	15		

Connecticut	10	New York	62
Delaware	1	North Carolina	37
District of Columbia	0	North Dakota	2
Florida	11	Ohio	19
Georgia	6	Oklahoma	0
Hawaii	0	Oregon	0
Idaho	0	Pennsylvania	16
Iowa	5	Rhode Island	6
Illinois	242	South Carolina	17
Indiana	19	South Dakota	0
Kansas	4	Tennessee	4
Kansas Kentucky	4	Tennessee Texas	4 47
Kansas Kentucky Louisiana	4 0 1	Tennessee Texas Utah	4 47 3
Kansas Kentucky Louisiana Massachusetts	4 0 1 61	Tennessee Texas Utah Vermont	4 47 3 0
Kansas Kentucky Louisiana Massachusetts Maryland	4 0 1 61 10	Tennessee Texas Utah Vermont Virginia	4 47 3 0 17
Kansas Kentucky Louisiana Massachusetts Maryland Maine	4 0 1 61 10 0	Tennessee Texas Utah Vermont Virginia Washington	4 47 3 0 17 11
Kansas Kentucky Louisiana Massachusetts Maryland Maine Michigan	4 0 1 61 10 0 35	Tennessee Texas Utah Vermont Virginia Washington West Virginia	4 47 3 0 17 11 0
Kansas Kentucky Louisiana Massachusetts Maryland Maine Michigan Minnesota	4 0 1 61 10 0 35 4	Tennessee Texas Utah Vermont Virginia Washington West Virginia Wisconsin	4 47 3 0 17 11 0 32
Kansas Kentucky Louisiana Massachusetts Maryland Maine Michigan Minnesota Mississippi	4 0 1 61 10 0 35 4 2	Tennessee Texas Utah Vermont Virginia Washington West Virginia Wisconsin Wyoming	4 47 3 0 17 11 0 32 0

Research Workshops 2022-2023 - Participants by Employer/School Location (Country)



Research Workshops 2022-2023 - Participants by Employer/School Location			
Country	Number of Participants	Country	Number of Participants
Argentina	1	Korea, South	4
Australia	5	Mexico	2
Austria	4	Morocco	1
Belgium	3	Netherlands	2
Brazil	1	New Zealand	1
Canada	44	Nigeria	1
Chile	4	Norway	3
China	19	Pakistan	1
Czech Republic	1	Philippines	1
Egypt	1	Poland	1
France	40	Portugal	4
Germany	10	Saudi Arabia	7

Ghana	1	Senegal	4
Hong Kong	1	Spain	2
Iceland	1	Sri Lanka	1
India	16	Sweden	3
Indonesia	2	Switzerland	7
Iraq	1	Taiwan	14
Ireland	3	Turkey	6
Israel	8	Ukraine	1
Italy	9	United Kingdom	57
Japan	2	United States	884

2.4 Demographics for Programs

The following demographic information includes research members who were in residence during a program.

- Fall 2022 Long Program: Confronting Global Climate Change
- Winter 2023 Research Collaboration Workshop: Interdisciplinary and Critical Data Science Motivated by Social Justice
- Spring 2023 Long Program: Mathematics, Statistics, and Innovation in Medical and Health Care

Programs 2022-2023 - Participants by Gender



Note: Participants could select multiple genders. Some individuals may be reflected in this chart more than once.

Programs 2022-2023 - Participants by Race



Note: Participants could select multiple races. Some individuals may be reflected in this chart more than once.



Programs 2022-2023 - Participants by Ethnicity



Programs 2022-2023 - Participants by Employment/Educational Status



Note: Participants were able to indicate more than one field of expertise. Those that selected multiple fields of expertise are represented in the totals more than once.

Programs 2022-2023 - Participants by Employer/School Location (United States)



Programs 2022-2023 - Participants by Employer/School Location (United States)			
State	Number of Participants	State	Number of Participants
Alabama	0	Montana	0
Alaska	0	Nebraska	0
Arizona	0	Nevada	0
Arkansas	0	New Hampshire	1
California	5	New Jersey	0
Colorado	0	New Mexico	0
Connecticut	0	New York	4

Delaware	0	North Carolina	4
District of Columbia	0	North Dakota	0
Florida	0	Ohio	1
Georgia	0	Oklahoma	0
Hawaii	0	Oregon	0
Idaho	0	Pennsylvania	1
Iowa	0	Rhode Island	3
Illinois	9	South Carolina	1
Indiana	1	South Dakota	0
Kansas	0	Tennessee	0
Kentucky	0	Texas	3
Louisiana	0	Utah	1
Massachusetts	5	Vermont	1
Maryland	0	Virginia	0
Maine	1	Washington	0
Michigan	3	West Virginia	0
Minnesota	1	Wisconsin	0
Mississippi	0	Wyoming	0
Missouri	0		

Programs 2022-2023 - Participants by Employer/School Location (Country)



Programs 2022-2023 - Participants by Employer/School Location			
Country Number of Participants Country Number of Participants			
Israel	1	Turkey	1
Japan	1	United Kingdom	6
Serbia	1	United States	45

2.5 Demographics for BRING MATH



BRING MATH 2022 - Participants by Gender

Note: Participants could select multiple genders. Some individuals may be reflected in this chart more than once.

BRING MATH 2022 - Participants by Race



Note: Participants could select multiple races. Some individuals may be reflected in this chart more than once.

BRING MATH 2022 - Participants by Ethnicity





BRING MATH 2022 - Participants by Employment/Educational Status

BRING MATH 2022 - Participants by Employer/School Location (United States)



BRING MATH 2022 - Participants by Employer/School Location (United States)			
State	Number of Participants	State	Number of Participants
Alabama	0	Montana	0
Alaska	0	Nebraska	1
Arizona	0	Nevada	0
Arkansas	0	New Hampshire	0
California	4	New Jersey	0
Colorado	0	New Mexico	0
Connecticut	0	New York	0

Delaware	0	North Carolina	0
District of Columbia	0	North Dakota	0
Florida	2	Ohio	0
Georgia	0	Oklahoma	0
Hawaii	0	Oregon	0
Idaho	0	Pennsylvania	0
Iowa	0	Rhode Island	0
Illinois	16	South Carolina	0
Indiana	3	South Dakota	0
Kansas	0	Tennessee	0
Kentucky	0	Texas	2
Louisiana	0	Utah	0
Massachusetts	0	Vermont	0
Maryland	0	Virginia	0
Maine	0	Washington	0
Michigan	0	West Virginia	0
Minnesota	0	Wisconsin	0
Mississippi	0	Wyoming	0
Missouri	0		

3. Description of Activities

For each activity, organizers, speakers, panelists, and other presenters are listed. Full participant lists are included in an appendix.

3.1 Fall 2022 Long Program: Confronting Global Climate Change

IMSI hosted a long program on *Confronting Global Climate Change* from September 19 through December 9, 2022. The Long Program workshops are described in greater detail below.

Climate change is already seriously impacting our lives in many ways. Threats to human and natural systems will increase as our planet continues to warm. This program explored mathematical, statistical, and computational strategies to better understand both the changes to the climate system and the associated impacts. A series of workshops focused on climate models, detection and attribution of climate change, extreme weather and climate events, remote sensing, machine learning, and the economic consequences of climate change.

Organizers	Affiliation & Department
Dimitris Giannakis	Dartmouth College, Mathematics
Vera Mikyoung Hur	University of Illinois at Urbana-Champaign, Mathematics
Bo Li	University of Illinois at Urbana-Champaign, Statistics
Robert Lund	University of California, Santa Cruz (UCSC); Statistics
Robert Rosner	University of Chicago; Astronomy and Astrophysics, Physics
Ryan Sriver	University of Illinois at Urbana-Champaign, Atmospheric Sciences
Michael Wehner	Lawrence Berkeley National Laboratory, Computational Research

IMSI hosted 13 participants for this long program, seven of whom were organizers.

Here are some quotes from final reports of research members:

- I would say such a connection [with another Long Program participant, not previously a collaborator] would not be possible without this IMSI program.
- One of my Ph.D. students has benefited a lot from participating this long program. She was able to network with researchers from different areas at different career stages. During her IMSI visits, she was able to finish one of her research projects and had received very valuable feedback.
- I also submitted a conference session proposal entitled "The IMSI Confronting Global Climate Change Program" to the joint statistical meetings (JSM) next year that will take place in Toronto, to highlight some of research activities in this IMSI program.
- The talks, the discussions during and after the talks, and the networking with participants are the most valuable experience to me. I appreciate IMSI very much for organizing those wonderful workshops and the greatest support the staff members provided.
- Meeting [another Long Program participant] and spending a lot of time was amazing. He is a great bridge between climate and statistics. We are now writing several papers.
- A post-doc gave a talk that told me how to do something that I didn't know how to do before. [This post-doc and two other participants] will also be on the project.
- Being put in the same room with climatologists and other like-minded statisticians paid dividends.

- The interdisciplinary nature of the long program was very important since climate science needs to be co-produced by the different fields to be the most useful. As an early career researcher, it was incredibly helpful to be able to discuss ideas with other researchers especially given that this was the first year of in-person conferences since the pandemic.
- While at IMSI, I have completed a collaborative work on a new Bayesian statistical method for the analysis of large-scale environmental data. This novel method is the first of its kind to have theoretical guarantees in terms of its ability to approximate a Gaussian Process. The article has been submitted to Biometrika.
- We made considerable progress on multiple research fronts, including planning for future proposals with co-organizers and workshop participants, and preliminary discussions of a white paper on economic impacts of climate change.
- I made significant progress in both theoretical and applied works. The drafts of manuscripts are prepared and will be submitted soon. I also had a discussion about the initiation of new works.
- The great location of IMSI allowed me to interact with many researchers in the Midwest area. The office and campus environment are great for productive work.
- The workshop was well organized and highly productive in comparison with my participation in similar programs.

The embedded workshops for the long program were as follows.

Workshop 1: Climate Model Evaluation and Uncertainty, September 19-23, 2022

Climate models are important tools for understanding past, current and future global climate variability, yet they exhibit key uncertainties that limit their applicability to fine scale analysis and future projections. Some key sources of uncertainty include coarse grid resolution, inadequate representation of relevant physics and interactions, overfitting from downscaling and bias-correction, lack of observations to calibrate and evaluate models, uncertain model parameters, different model structures, and so on. In addition, coupled climate models are computationally expensive and thus difficult to use for uncertainty analysis, while reduced complexity models are fast and flexible but are highly parameterized and lack physics. These computational tradeoffs pose major challenges for evaluating/comparing model results, constructing reliable projections, and quantifying relevant uncertainties. The workshop brought together researchers from multi-disciplinary fields to highlight new mathematical and statistical methods for climate model evaluation and uncertainty quantification across spatial and temporal scales, and to advance our understanding about the physical processes leading to model errors, biases, and uncertainty. In addition to the numerous talks, the workshop included a poster session.

The workshop was attended by 81 unique participants, including speakers and organizers.

Organizers	Affiliation & Department
Bo Li	University of Illinois at Urbana-Champaign, Statistics

Cristi Proistosescu	University of Illinois at Urbana-Champaign, Atmospheric Sciences
Ryan Sriver	University of Illinois at Urbana-Champaign, Atmospheric Sciences
Speakers	Affiliation & Department
Peter Craigmile	Ohio State University, Statistics
Noah Diffenbaugh	Stanford University, Earth System Science
Dorit Hammerling	Colorado School of Mines, Applied Mathematics and Statistics
Trevor Harris	Texas A&M University, College Station; Statistics
Patrick Heimbach	University of Texas, Austin; Computational Science and Engineering
Matthias Katzfuss	Texas A&M University, College Station; Statistics
Linda Mearns	National Center for Atmospheric Research (NCAR)
Douglas Nychka	Colorado School of Mines, Applied Mathematics and Statistics
Steve Sain	Jupiter Intelligence
Gavin Schmidt	NASA Goddard Institute for Spacer Studies
Tapio Schneider	California Institute of Technology
Chris Smith	University of Leeds, Earth and Environment
Chris Wikle	University of Missouri, Columbia; Statistics
Poster Presenters	Affiliation & Department
Matthew Bonas	University of Notre Dame, Statistics
Samuel Gailliot	Texas A&M University, College Station; Statistics
Eva Murphy	Clemson University
Kellin Rumsey	Los Alamos National Laboratory (LANL); Statistics
Widodo Samyono	Jarvis Christian University, Mathematics
Adrean Webb	Tokyo Institute of Technology, Physics

Workshop 2: Climate and Weather Extremes, October 3-7, 2022 Weather and climate extremes profoundly impact human society and the natural environment across the globe. Recent years have seen an increase in economic losses due to climate and weather extremes, particularly from extremes in different variables that occur simultaneously in space and time, so called compound extremes. Researchers typically study climate and weather extremes from different perspectives. The statistics and applied math communities have focused on theory and methods for extreme values. In contrast, atmospheric scientists have focused on quantifying changes in extremes and understanding the mechanism behind them. Both approaches are crucial for understanding and mitigating the frequency and magnitude of extremes. This workshop brought together researchers from both communities in order to advance our understanding of the mechanisms causing climate and weather extremes and to find novel approaches to mitigate climate change and its impacts.

The workshop was attended by 69 unique participants, including speakers and organizers.

Organizers	Affiliation & Department
Bo Li	University of Illinois at Urbana-Champaign, Statistics
Tiffany Shaw	University of Chicago, Geophysical Sciences
Richard Smith	University of North Carolina, Chapel Hill; Statistics
Speakers	Affiliation & Department
Jane Baldwin	University of California Irvine, Earth System Science
Freddy Bouchet	École normale supérieure de Lyon
Michael Byrne	University of St Andrews, Earth & Envirnomental Sciences
Suzana Camargo	Columbia University, Lamont-Doherty Earth Observatory
Daniel Clarkson	Lancaster University, Statistics
Dan Cooley	Colorado State University, Fort Collins; Statistics
Justin Finkel	University of Chicago, Committee on Computational and Applied Mathematics
Matt Huber	Purdue University, Geography
Raphael Huser	King Abdullah Univ. of Science and Technology (KAUST), Statistics
Marianna Linz	Harvard University, Environmental Science & Engineering
Luke Madaus	Jupiter Intelligence
Reetam Majumder	North Carolina State University, Applied Ecology
Karen McKinnon	University of California, Los Angeles (UCLA); Statistics

Noboru Nakamura	University of Chicago, Geophysical Sciences
Paul O'Gorman	Massachusetts Institute of Technology (MIT), Earth, Atmospheric, and Planetary Sciences
Chris Paciorek	University of California, Berkeley (UC Berkeley); Statistics
Brook Russell	Clemson University, Mathematical and Statistical Sciences
Ben Shaby	Colorado State University, Fort Collins, Statistics
Michael Stein	Rutgers University, Statistics
Likun Zhang	Lawrence Berkeley National Lab
Zhengjun Zhang	University of Wisconsin, Madison; Statistics

Workshop 3: Detection and Attribution of Climate Change, October 17-21, 2022

Detection and attribution of climate change refers to the procedures used in assessing whether climate is changing, and if so, how to pinpoint the causes of any identified changes. Quantification of the uncertainty in attribution statements is of critical importance. Detection and attribution methods inform mankind's current influence on climate and increase confidence in projections of future climate change. Detection and attribution studies aid climate policy decisions and suggest techniques for adaptation and/or remediation where needed. This research workshop focused on current issues related to climate change detection and attribution, including changes in extreme events and the attribution of individual storms and other weather events and their impacts.

The workshop was attended by 57 unique participants, including speakers and organizers.

Organizers	Affiliation & Department
Dorit Hammerling	Colorado School of Mines, Applied Mathematics and Statistics
Robert Lund	University of California, Santa Cruz (UC Santa Cruz); Statistics
Michael Wehner	Lawrence Berkeley National Lab
Speakers	Affiliation & Department
Kristi Ebi	University of Washington, Global Health
Nathan Gillett	Environment and Climate Change Canada
Angel Hsu	University of North Carolina, Chapel Hill; Public Policy

Whitney Huang	Clemson University, Mathematical and Statistical Sciences
Kate Marvel	Columbia University and NASA Goddard Institute for Space Studies
Karen McKinnon	University of California, Los Angeles (UCLA); Statistics
Phillippe Naveau	Centre National de la Recherche Scientifique (CNRS)
Mark Risser	Lawrence Berkeley National Laboratory
Bruno Sanso	University of California, Santa Cruz (UC Santa Cruz); Statistics
Richard Smith	University of North Carolina, Chapel Hill; Statistics
David Stephenson	University of Exeter, Mathematics
Simon Wang	Utah State University, Plants, Soils, and Climate
Michael Wehner	Lawrence Berkeley National Laboratory
John Woody	Mississippi State University, Mathematics and Statistics

Workshop 4: Machine Learning for Climate and Weather Applications, October 31-November 4, 2022

The Earth's climate system is a classical example of a multiscale, multiphysics dynamical system with an extremely large number of active degrees of freedom, exhibiting variability on scales ranging from micrometers and seconds to thousands of kilometers and centuries. Machine learning approaches present a timely opportunity to leverage the information content of large datasets generated by observational systems and models to improve scientific understanding and prediction capability of weather and climate dynamics. This workshop brought together an interdisciplinary group of researchers in applied mathematics, climate science, and data science to discuss recent advances and future perspectives on machine learning for weather and climate applications, including feature extraction, subgrid-scale modeling, and statistical prediction. The workshop also included a poster session.

The workshop was attended by 81 unique participants, including speakers and organizers.

Organizers	Affiliation & Department
Dimitris Giannakis	Dartmouth University, Mathematics
Vera Mikyoung Hur	University of Illinois at Urbana-Champaign, Mathematics
Jonathan Weare	Courant Institute of Mathematical Sciences - New York University, Mathematics
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Speakers	Affiliation & Department
Dorian Abbot	University of Chicago, Geophysical Sciences
Elizabeth Barnes	Colorado State University, Fort Collins
Tom Beucler	University of Lausanne, Institute of Earth Surface Dynamics
Freddy Bouchet	Centre National de la Recherche Scientifique (CNRS)
Noah Brenowitz	NVIDIA
Nan Chen	University of Wisconsin, Madison; Mathematics
Oliver Dunbar	California Institute of Technology, Geological and Planetary Sciences
Justin Finkel	Massachusetts Institute of Technology (MIT); Earth, Atmospheric, and Planetary Sciences
Gary Froyland	University of New South Wales, Mathematics
Auroop Ganguly	Northeastern University, Engineering
Pierre Gentine	Columbia University, Earth and Environmental Engineering
Ian Grooms	University of Colorado, Boulder; Applied Mathematics
Pedram Hassanzadeh	Rice University, Mechanical Engineering
Karthik Kashinath	NVIDIA and Lawrence Berkeley National Laboratory
Valerio Lucarini	University of Reading, Mathematics and Statistics
Peetak Mitra	Xerox Palo Alto Research Center, Computer Science
Di Qi	Purdue University, Mathematics
Themistoklis Sapsis	Massachusetts Institute of Technology (MIT)
Aditi Sheshadri	Stanford University, Earth System Science
Maike Sonnewald	Princeton University, Computer Science
Minah Yang	New York University, Courant Institute of Mathematical Sciences
Janni Yuval	Massachusetts Institute of Technology (MIT), Earth, Atmospheric, and Planetary Sciences

Poster Presenters	Affiliation & Department
James Franke	University of Chicago, Geophysical Sciences
Takuya Kurihana	University of Chicago, Computer Science
Elena Orlova	University of Chicago, Computer Science
Ivan Sudakow	The Open University, Mathematics and Statistics
Claire Valva	New York University, Applied Mathematics, Courant Institute of Mathematical Sciences
Yinling Zhang	University of Wisconsin, Madison, Mathematics

Workshop 5: Remote Sensing for Climate Analysis, November 30-December 2, 2022

Remote sensing plays a critical role in many aspects of climate science, including realtime and long-term monitoring, forecast initialization, model verification, and statistical analysis. Remote sensing records now span multiple decades and provide information on multiple processes in the climate system. The ever-changing Earth-observing satellite constellation and the development and deployment of new remote sensing capabilities, including NASA's planned Earth System Observatory and ESA's Sentinel missions, present a timely opportunity to make advances in these areas, motivating the development of new techniques to analyze and assimilate large volumes of data with high spatial and temporal resolution. This workshop brought together researchers from the remote sensing, data analysis, and climate science communities to explore applications of current- and next-generation remote sensing products and data analysis techniques to climate analysis and modeling.

The workshop was attended by 29 unique participants, including speakers and organizers.

Organizers	Affiliation & Department
Dimitris Giannakis	Dartmouth College, Mathematics
Jon Hobbs	Jet Propulsion Laboratory, California Institute of Technology
Monica Martinez Wilhelmus	Brown University, Engineering
Speakers	Affiliation & Department
Amy Braverman	Jet Propulsion Laboratory, California Institute of Technology
Ellen Buckley	Brown University, Engineering

Momme Hell	Brown University, Institute at Brown for Environment & Society
Chris Horvat	University of Auckland, Physics
Scott Martin	University of Washington, School of Oceanography
Monica Martinez Wilhelmus	Brown University, Engineering
Lettie Roach	Columbia University, Center for Climate Systems Research
Helene Seroussi	Dartmouth College, Thayer School of Engineering
Joao Teixeira	Jet Propulsion Laboratory, California Institute of Technology

Workshop 6: Economic Impacts of Climate Change, December 7-9, 2022

Climate change poses serious financial, health and property risks both to major industrial sectors and to the public. Characterizing the economic impacts, and quantifying relevant risk-based uncertainties, are critical for establishing resilient and equitable strategies for the future. This workshop brought together students, researchers, and stakeholders from diverse disciplinary areas to address economic impacts of climate and weather across a wide range of temporal and spatial scales. Participants explored new ideas and approaches to connecting academic research with stakeholder and private sector interests, in particular using applied mathematical, statistical, and econometric methods. This workshop also included a poster session.

The workshop was attended by 39 unique participants, including speakers and organizers.

Organizers	Affiliation & Department
Laura Appenzeller	University of Illinois at Urbana-Champaign, Research Park
Tamma Carleton	University of California, Santa Barbara (UCSB); Economics
Ryan Sriver	University of Illinois at Urbana-Champaign, Atmospheric Sciences
Speakers	Affiliation & Department
lan Bolliger	BlackRock
Marshall Burke	Stanford University, Doerr School of Sustainability
Frances Davenport	Colorado State University, Fort Collins, Civil & Environmental Engineering

Christian Franzke	Pusan National University, Climate Physics
Lars Hansen	University of Chicago, Economics
Andrew Hultgren	University of Illinois at Urbana-Champaign
Robert Kopp	Rutgers University, Earth and Planetary Sciences
Adam Sobel	Columbia University, Applied Physics and Applied Mathematics, and Earth & Environmental Sciences
Poster Presenters	Affiliation & Department
Christian Franzke	Pusan National University, Climate Physics
Kevin Schwarzwald	Columbia University, Lamont–Doherty Earth Observatory
Chris Smith	University of Leeds, Earth and Environment

3.2 Winter 2023 Research Collaboration Workshop: Interdisciplinary and Critical Data Science Motivated by Social Justice, January 9 – February 3, 2023

IMSI hosted its first Research Collaboration Workshop (RCW) on Interdisciplinary and Critical Data Science Motivated by Social Justice from January 9 through February 3, 2023. This RCW partnered with the Institute for the Quantitative Study of Inclusion, Diversity and Equity (QSIDE), a non-profit 501(c)(3) organization that sits at the intersection of social science, humanities research, data science, and social justice. A hallmark of QSIDE's work is interdisciplinary teamwork, which fosters collaboration between data scientists, social scientists, and community experts. The RCW convened interdisciplinary expertise to focus on applications data science for social good, specifically with the goals to 1) explore new statistical, computational, and qualitative approaches for analyzing social justice data, 2) to incorporate current scholarship on critical digital and data, and 3) to create infrastructure for and document these interdisciplinary collaborative efforts. The RCW opened with a public minisymposium on critical data science practices and introduced data science for social justice work. The participants then identified projects within our goal areas and created research teams. Throughout the program, participants engaged in discussions on the interdisciplinary and critical data science process and invited guest speakers related to the context areas of our explorations and/or to the methodologies they used. The end of the program concluded with a closing minisymposium during which participants presented their work, future directions, and open problems for the community.

IMSI hosted 17 participants, two of whom were organizers.

Organizers	Affiliation & Department
Carrie Diaz Eaton	Bates College, Computer Science
Jude Higdon-Topaz	QSIDE Institute and Bennington College

Workshop 1: QuantCrit and Social Justice Research, January 10, 2023

This workshop introduced participants to a wide range of quantitative research methods that have been used to investigate a range of social justice problems and questions. The workshop featured two speakers who discussed their particular applications of quantcrit applied to social justice issues: Phillip Boda (University of Illinois, Chicago Department of Special Education) spoke on "Community-Policy Participatory Partnerships: Advancing Analyses of Environmental Justice by Design. Jack Jen Gieseking (Five College Women's Studies Research Center) spoke on "Queer Feminist Trans DataViz Care: Methods of Visualizing the 'Invisible' and the Hypervisible.

Organizers	Affiliation & Department
Carrie Diaz Eaton	Bates College, Computer Science
Jude Higdon-Topaz	QSIDE Institute and Bennington College
Speakers	Affiliation & Department
Phillip Boda	University of Illinois at Chicago, Special Education
Jack Jen Gieseking	Five College Women's Studies Research Center

Workshop 2: Driving the Justice Agenda Forward, February 2, 2023

During this workshop, RCW participants presented their research areas, current lines of inquiry, and ways to get involved in future research including continuing work from the RCW. The workshop featured two presentations: Team members from Nuevas Voces talked about their community activism and data-driven environmental justice. Team members from QSIDE SToPA Lab described the app they are developing that provides access to policing data and tools to extract inferences from these data that can be used to hold local law enforcement agencies accountable.

Organizers	Affiliation & Department
Carrie Diaz Eaton	Bates College, Computer Science
Jude Higdon-Topaz	QSIDE Institute and Bennington College

Here are some quotes from the final reports of the RCW members:

- The in-person collaboration made the experience unique and develop faster than I ever thought it ever could. Knowing people personally and talking "outside of the project" made me understand better the teams' point of view on project topics, learn what their expertise was, how they liked to work. Especially when we had to debate over difficult concepts, being in person made the experience more enriching.
- [W]hile I was at IMSI I also finished off and submitted two papers with my colleagues (each paper included others at IMSI and not at IMSI) but having the in person time did help get it out the door, wrote a blog for MAA about chatGPT, and met about another paper with an IMSI colleague. I also worked with communications on the workshops and podcast ideas. Finally, I met with several local colleagues in a variety of capacities to get some leads on project ideas, to mentor junior colleagues, and to explore possible collaborations.
- [Our RCW project] went from idea to reality. We were excited that we got a tangible piece of the product out there for beta testing with the community.
- As a recent high school graduate and incoming college freshman, it is very rare for me to find opportunities where I may work on projects dealing with social justice activism in the mathematical sciences. My visit to IMSI bolstered my aspirations in the data sciences and gave me an opportunity to more soundly prepare for undergraduate statistical research.
- The focus on communication, especially Sadie's sessions, were a true highlight and very impactful.
- IMSI has been incredibly supportive of this kind of work involving working directly with and for community partners, which is eschewed by most parts of the mathematics establishment.
- [T]he communication workshops were particularly valuable and worked well with our community-based work. I am now inspired to incorporate good storytelling techniques in all of my communications.

3.3 Spring 2023 Long Program: Mathematics, Statistics, and Innovation in Medical and Health Care

IMSI hosted a long program on *Mathematics, Statistics, and Innovation in Medical and Health Care* from March 27 through June 2, 2023. The Long Program workshops are described in greater detail below.

The quantification of medical and health care has brought a revolution to our lives with strong and long-lasting social and economic positive impact. This quantification stems from an exemplary synergy among mathematics, statistics, data science, medicine, machine learning (ML) and artificial intelligence (AI) and has been prompting the creation of new interdisciplinary areas across the various fields. While there has been an unprecedented growth and development in many scientific directions, there is a continuing need to further develop existing areas and set the foundations for new ones, as the underlying issues and challenges are evolving in rather complex and interlinked ways. Indeed, creating new therapies has experienced a fast growth already but efficiently

funding such innovations and, in turn, making them available at large-scale has its own distinct challenges and demand for new business models and novel decision-making mechanisms. Furthermore, personalized medicine is rapidly becoming a main component of medical care, but many issues directly related to the patients' attitude, risk communication and individual treatment decisions have not been neither extensively studied nor quantified.

The long program created an interdisciplinary platform for knowledge exchange and debate among the various stakeholders: mathematicians, statisticians, physicians, economists, computer scientists, policy makers and researchers in decision science, data science, ML, AI, business, operations research and engineering. The focus was on newer interdisciplinary themes like risk management, funding and R&D of biomedical innovation, health care system design, health care delivery, insurance coverage, personalized diagnostics and treatments, telemedicine, medical cyber-physical systems and others.

Organizers	Affiliation & Department
Donald Berry	University of Texas MD Anderson Cancer Center
Dimitris Bertsimas	Massachusetts Institute of Technology, Sloan School of Management
Jing Dong	Columbia University, Decision, Risk, and Operations Division
Andrew Lo	Massachusetts Institute of Technology, Sloan School of Management
Agni Orfanoudakis	University of Oxford, Saïd Business School
Mihaela van der Schaar	University of Cambridge, Machine Learning, AI, and Medicine
Thaleia Zariphopoulou	University of Texas, Austin, Mathematics

IMSI hosted 25 research members, 7 of whom were organizers.

Here are some quotes from final reports of research members:

- It was really useful having an extended amount of time to sit and work in the same office as [one of the organizers], and we made great progress on the structure of [a new project].
- I also chatted with a couple different potential future collaborators about ideas for [a new research track].
- I learned about a graduating student that I am eager to hire into my research group.
- It goes without saying that the content of the workshop, the primary motivation for my attendance, was itself of great value. Beyond that, however, in a world where remote meetings are nearly the default, it was especially valuable to meet people

in person, including in my own research group with whom I had previously interacted solely on Zoom calls.

- I met a wide range of researchers in my field in an intimate arrangement that is much more conducive for research discussions, compared to large conferences that are common in my field. In particular, the ability of the IMSI long program to bring together interdisciplinary researchers from different departments in my field has enabled me to quickly start new research directions and advance my research agenda, as evidenced in my new research collaborations answered above.
- IMSI also provided excellent facilities throughout my long program stay, including well maintained office facilities, an external monitor for laptops (that was extremely helpful for productivity), and regular refreshments/snacks in common areas.
- The staff at the IMSI are also extremely kind and helpful, providing me with all the information I need throughout my stay, and helping me navigate through difficulties when needed.
- It was particularly valuable to meet and engage with the Operations Research field at IMSI: I am new to the field, and engaging with so many academics at once was phenomenal in brin[g]ing me up to speed with the diversity of research topics. I've also made research connections that will last a lifetime across the states – which is particularly valuable as a European who is not often exposed to research this side of the pond!
- During the IMSI visit, I initiated a promising collaboration with two program participants from [two other universities].
- The IMSI visit allowed me to meet a diverse cohort of exceptional researchers that are based at leading academic institutions across the world. We had the chance to exchange ideas regarding our current research projects and discover valuable synergies in our work.
- Progress whilst in IMSI was dramatic. For me, [one of] the most valuable aspects of my experience [was] the close proximity I had with my research team, in a vibrant, intellectually stimulating environment, surrounded by other experts of the field.

The embedded workshops for the long program were as follows.

Workshop 1: Analytics for Improved Health Care, April 3-6, 2023

Analytics has the potential to harness the growing availability of data and propel the development of cutting-edge models that improve the quality and efficiency of medical and health care. This workshop focused on how different sources of healthcare data, including electronic medical records and clinical trial results, can be leveraged to fundamentally change modern organizations by improving not only healthcare operations but also patient outcomes. In addition, topics related to decision making for macro-scale healthcare policies were discussed. This workshop included a poster session.

This workshop had 80 unique participants, including speakers and organizers.

Organizers Affiliation & Department

Dimitris Bertsimas	Massachusetts Institute of Technology, Sloan School of Management
Agni Orfanoudaki	University of Oxford, Saïd Business School
Speakers	Affiliation & Department
Dan Adelman	University of Chicago, Booth School of Business
Oguzhan Alagoz	University of Wisconsin, Madison, Engineering
Jackie Baek	New York University, Stern School of Business
Hamsa Bastani	University of Pennsylvania, Operations Information and Decisions
Bob Batt	University of Wisconsin, Madison, Business
Justin Boutilier	University of Wisconsin, Madison, Industrial and Systems Engineering
Leo Celi	Massachusetts Institute of Technology, Medical Engineering & Science
Carri Chan	Columbia University, Decision, Risk, and Operations Division
Timothy Chan	University of Toronto, Mechanical and Industrial Engineering
Martin Copenhaver	Massachusetts General Hospital, Healthcare Systems Engineering, and Harvard Medical School
Jing Dong	Columbia University, Decision, Risk, and Operations Division
Andrew Li	Carnegie Mellon University, Tepper School of Business
Nan Liu	Boston College, Carroll School of Management
Elisa Long	University of California, Los Angeles, Management
Agni Orfanoudaki	University of Oxford, Saïd Business School
Georgia Perakis	Massachusetts Institute of Technology, Sloan School of Management
Andrew Schaefer	Rice University, Applied Mathematics
Cong Shi	University of Michigan, Industrial and Operations Engineering
Hummy Song	University of Pennsylvania, Wharton School of Business
Barry Stein	Hartford HealthCare
Poster Presenters	Affiliation & Department
Rebecca Alcock	University of Wisconsin, Madison, Industrial and Systems Engineering

Arielle Anderer	University of Pennsylvania, Operations Management
Minje Park	Columbia University, Decision, Risk, and Operations
Hossein Piri	University of Calgary, Haskayne School of Business
Jinglong Zhao	Boston University, Questrom School of Business
Yueyang Zhong	University of Chicago, Booth School of Business
Odhran O'Donoghue	Oxford University, Engineering
Panos Tsimpos	Oxford University, Mathematics

Workshop 2: Machine Learning and Artificial Intelligence for Personalized Medicine, April 17-20, 2023

This workshop focused on cutting-edge advances in ML and AI applied to personalized medicine and prognostic care for treatments of diseases like cancer, cardiovascular conditions and diabetes. These treatments target the needs of the individual patient on the basis of genetic, biomarker and phenotypic characteristics. ML advances used to improve other aspects of personalized care through eliciting patients' preferences, identifying behavioral characteristics and individual decision-making patterns, and in turn use this information to improve personalized care in its entirety, were also presented. This workshop included a poster session.

This workshop had 85 unique participants, including speakers and organizers.

Organizers	Affiliation & Department
Agni Orfanoudaki	University of Oxford, Saïd Business School
Mihaela van der Schaar	University of Cambridge, Machine Learning, AI, and Medicine
Speakers	Affiliation & Department
Dimitris Bertsimas	Massachusetts Institute of Technology, Sloan School of Management
Kyra Gan	Harvard University, Statistics
Yair Goldberg	Technion – Israel Institute of Technology, Industrial Engineering and Management
Xin Guo	University of California, Berkeley, Applied Mathematics
Chris Holmes	Oxford University, Statistics; The Alan Turing Institute

Nathan Kallus	Cornell University, Operations Research and Information Engineering
Michael Kosorok	University of North Carolina, Chapel Hill, Biostatistics
Eric Laber	Duke University, Statistics
Michael Lingzhi Li	Harvard University, Technology and Operations Management
Yuan Luo	Northwestern University, Preventive Medicine
Antonis Margonis	Memorial Sloan Kettering Cancer Center
Charlene Ong	Boston University, Chobanian and Avedesian School of Medicine
David Page	Duke University Medical Center, Biostatistics & Bioinformatics
Pengyi Shi	Purdue University, Applied Mathematics
Cristian Tomasetti	City of Hope, Computational and Quantitative Medicine
Mihaela van der Schaar	University of Cambridge,nMachine Learning, AI, and Medicine
Stefan Wager	Stanford University, Operations, Information, and Technology
Adam Yala	University of California, Berkeley (UC Berkeley) and University of California, San Francisco (UCSF)
Anru Zhang	Duke University, Biostatistics & Bioinformatics
Jiwei Zhao	University of Wisconsin, Madison, Biostatistics and Medical Informatics
Poster Presenters	Affiliation & Department
Carolina Carvalho Manhães Leite	University of Illinois at Urbana-Champaign, Industrial Enterprise Systems Engineering
Violet Chen	Stevens Institute of Technology, School of Business
Yongyi Guo	Harvard University, Statistics
Tianchun Li	Purdue University, Computer Science
Jinglong Zhao	Boston University, Questrom School of Business

Workshop 3: Predictive Analytics, Business Modeling and Optimization in Health Care Operations Management, May 1-4, 2023

The advancement of statistical learning techniques and the growing availability of medical data stimulate the development of cutting-edge predictive models for various

patient and population characteristics. This workshop focused on predictive analytics and stochastic modeling for applications in healthcare operations management like among others, ER design and operation, hospital budgeting, nursing care availability, supplies procurement, services and planning, and other components of health care systems.

Organizers	Affiliation & Department
Jing Dong	Columbia University, Decision, Risk, and Operations Division
Pengyi Shi	Purdue University, Applied Mathematics
Speakers	Affiliation & Department
Mor Armony	New York University, Stern School of Business
Mohsen Bayati	Stanford University, Mathematics
John Birge	University of Chicago, Booth School of Business
Ebru Bish	University of Alabama, Tuscaloosa, Information Systems, Statistics, and Management Science
Margret Bjarnadottir	University of Maryland Robert H. Smith School of Business, Decisions, Operations and Information Technology
Tinglong Dai	Johns Hopkins University, Carey Business School
Brian Denton	University of Michigan, Industrial and Operations Engineering
Yue Hu	Columbia University, Business
Jonas Jonasson	Massachusetts Institute of Technology, Operations Management
Sanjay Mehrotra	Northwestern University, Industrial Engineering and Management Sciences
Jean Pauphilet	London Business School, Management Science and Operations
Kamalini Ramdas	London Business School, Management Science and Operations
Soroush Saghafian	Harvard University, Public Impact Analytics Science
Vahid Sarhangian	University of Toronto, Mechanical and Industrial Engineering
Steven Shechter	University of British Columbia, Sauder School of Business
John Silberholz	University of Michigan, Technology and Operations

This workshop had 84 unique participants, including speakers and organizers.

Tolga Tezcan	Rice University, Jones Graduate School of Business
Holly Wiberg	Flatiron Health
Galit Yom-Tov	Technion – Israel Institute of Technology, Data and Decision Sciences
Christos Zacharias	University of Miami, Management Science
Jinglong Zhao	Boston University, Questrom School of Business

Workshop 4: Technological Innovation in Health Care Delivery, May 15-17

There have been many recent innovations in healthcare development and delivery that have the potential to greatly improve patient care and outcomes. Examples include breakthroughs in life-saving therapies, electronic healthcare records, telemedicine, artificial intelligence and blockchain applications. This creates the need to build new business models and analyze emerging risk management problems to improve the affordability and accessibility of healthcare. It also highlights the need to study systemic risk issues in the healthcare ecosystem and public policy decision making that balances medical needs with economic and financial incentives. The aim of the workshop was to provide a platform to present these multifaceted problems and discuss the associated modeling and quantitative approaches.

Organizers	Affiliation & Department
Jing Dong	Columbia University, Decision, Risk, and Operations Division
Thaleia Zariphopoulou	University of Texas, Austin, Mathematics
Speakers	Affiliation & Department
Radek Bukowski	University of Texas, Austin, Women's Health
Rama Cont	Oxford University, Mathematics
Giorgio Ferrari	Universität Bielefeld, Mathematical Finance
Xin Guo	University of California, Berkeley (UC Berkeley), Applied Mathematics
Shane Henderson	Cornell University, Operations Research and Information Engineering
Anjum Khurshid	Harvard Pilgrim Health Care Institute and Harvard Medical School
Steven Kou	Boston University, Finance

This workshop had 46 unique participants, including speaker and organizers.

Joan LaRovere	Boston Children's Hospital and Harvard Medical School, Pediatric Cardiovascular Critical Care
Retsef Levi	Massachusetts Institute of Technology, Sloan School of Management
Andrew Lo	Massachusetts Institute of Technology, Sloan School of Management
Susan Lu	Purdue University, Mitchell E. Daniels, Jr. School of Business
Luca Maini	Harvard Medical School, Health Care Policy
Ryan McDevitt	Duke University, Economics
Alex Mills	Baruch College, Management
Rema Padman	Carnegie Mellon University, Heinz College of Information Systems and Public Policy
Sze-chuan Suen	University of Southern California (USC), Industrial and Systems Engineering
Howard Thom	University of Bristol, Health Economics
Mark Van Oyen	University of Michigan, Industrial and Operations Engineering
Renyuan Xu	University of Southern California, Industrial and Systems Engineering
Ozge Yapar	Indiana University, Operations and Decisions Technology
Spyros Zoumpoulis	INSEAD

3.4 Topical Workshops

IMSI held six research workshops during the reporting period which were outside the framework of long programs. These are described in this section.

Data Value: Assessment and Evolution, June 6-8, 2022

IMSI hosted the workshop *Data Value: Assessment and Evolution*, June 6-8, 2022. Data and data--driven artificial intelligence are impacting virtually every aspect of society including commerce, science, medicine, government, finance, and education. Data drives value in all these various domains, but we know surprisingly little about how value accrues to data as it progresses through its lifecycle — collection, wrangling and integration, modeling and analysis, decision making, and curation.

Data value arises through its ability to foster new products and business models and to enable new discoveries across science, engineering, and humanities. However, as a society we are also starting to become aware of the many harms data can bring and their associated risks. When used to inform decisions that affect individuals, for example, data can perpetuate or emphasize existing biases. Combining data from disparate sources can enable previously unseen insights but can also expose private information, either intentionally or unintentionally. Untrustworthy data can also wreak havoc on society, negatively impacting individual lives or putting democracy at risk.

Thus, a challenge we face today is to design systems and data--driven organizations that maximize data's positive impact while minimizing the negative effects. But we cannot do this without understanding how data contributes to both good and bad outcomes: the crux of the problem is to understand what the value of data is and how does that value change over time, through various processing steps, and when being used in changing contexts. The aim of this 3--day workshop was to explore these questions about data value and to discuss approaches to answering them. Speakers approached the questions from different angles: economic theory, statistics, data semantics, privacy, data markets and software platforms, to name a few. In addition to the talks by more senior researchers, the workshop included sessions with contributed talks by students and postdocs, and a panel with companies that are building data markets.

Organizers	Affiliation & Department
Raul Castro Fernandez	University of Chicago, Computer Science
Michael Franklin	University of Chicago, Computer Science
Jason Hartline	Northwestern University, Computer Science
Speakers	Affiliation & Department
Dean Allemang	data.world
Dirk Bergemann	Yale University, Economics
Jay Bhankharia	Databricks
Yiling Chen	Harvard University, Computer Science
Munther Dahleh	Massachusetts Institute of Technology, Computer Science
Sylvie Delacroix	University of Birmingham, Law
Robert Grossman	University of Chicago, Computer Science
Nicole Immorlica	Microsoft Research
Nick Jordan	Narrative I/O
Emir Kamenica	University of Chicago, Business

This workshop had 89 unique participants, including speakers and organizers.

Paris Koutris	University of Wisconsin, Madison, Computer Science
Denis Nekipelov	University of Virginia, Economics
Jian Pei	Simon Fraser University, Statistics and Actuarial Science
Matt Prewitt	RadicalxChange Foundation
James Rhodes	Morningstar
Juan Sequeda	data.world
Haifeng Xu	University of Virginia, Computer Science
Ce Zhang	ETH Zürich, Computer Science
James Zou	Stanford University, Biomedical Data Science

Participant comments on the workshop included the following:

- The workshop was wonderfully put together, and you could tell a lot of effort was put into getting different groups of researchers to converse with each other. However, I feel the workshop highlighted, if anything, how distant the value-of-data mathematics is from how industry and systems people think about it. That said, I think that speaks more to how much of an emerging field this is, and how tough this field is, rather than being any reflection on how the workshop was organized.
- I think the field of "Data economics" is quickly moving and the community is still relatively small and lacking sufficient interactions. I think a yearly workshop on this topic at IMSI would be extremely valuable to the community.
- Establish a center/institute on data economics? Not sure whether this is doable, but definitely cool to have!

Mathematical Methods for Quantum Hardware, July 11-15, 2022

IMSI hosted the workshop, *Mathematical Methods for Quantum Hardware*, July 11-15, 2022. Quantum information science has made significant progress in recent decades. The performance of quantum hardware still remains a major bottleneck that prevents us from benefiting from the full quantum power. As we gain better control over the quantum hardware, it is crucial to use appropriate mathematical models, systematically calibrate higher order perturbative effectives, develop robust quantum control and reservoir engineering schemes, and improve numerical methods to reliably simulate complicated quantum systems. This workshop identified the underlying challenges and developed novel mathematical tools to solve these open questions.

This workshop had 75 unique participants, including speakers and organizers.

Organizers	Affiliation & Department
Aash Clerk	University of Chicago, Pritzker School of Molecular Engineering
Liang Jiang	University of Chicago, Pritzker School of Molecular Engineering
Mazyar Mirrahimi	INRIA
Pierre Rouchon	PSL Research University, École Nationale Supérieure des Mines de Paris, Centre Automatique et Systèmes
Speakers	Affiliation & Department
Josh Combes	University of Colorado Boulder, Electrical, Computer & Energy Engineering
Mark Dykman	Michigan State University, Physics
Luke Govia	IBM Research
Jérémie Guillaud	Alice&Bob
Archana Kamal	University of Massachusetts Lowell, Physics
Jens Koch	Northwestern University, Physics and Astronomy
Anja Metelmann	Karlsruhe Institute of Technology, Inst. For Theoretical Condensed Matter Physics
Kyungjoo Noh	Amazon Web Services, Center for Quantum Computing
Alexandru Petrescu	École Nationale Supérieure des Mines de Paris, Centre Automatique et Systèmes
Shruti Puri	Yale University, Physics
Hugo Ribeiro	University of Massachusetts Lowell, Physics
Lorenza Viola	Dartmouth University, Physics and Astronomy

Participant comments on the workshop included the following:

 I appreciated the choice to only have morning sessions and allow for ample discussion time. I spent all of my afternoons in discussions. The venue was perfect. I think that the workshop attracted the right mix of academics and academics-inindustry and that there was a wide range of talks covering mathematical methods used in the analysis of quantum hardware. I would definitely love to be involved with the organization of, or participate in, future iterations of this workshop.

- A very well organized workshop, with a diverse group of scientists. Very productive and inspirational.
- I would definitely like to see a longer-term workshop or series of workshops. The University of Chicago is a key player in the quantum condensed matter / information, with the potential to gather experts from all fields.

Expressing and Exploiting Structure in Modeling, Theory, and Computation with Gaussian Processes, August 29 – September 2, 2022

IMSI hosted the workshop, *Expressing and Exploiting Structure in Modeling, Theory, and Computation with Guassian Processes*, August 29 – September 2, 2022. Gaussian processes are widely used for prior modeling in data-centric applications including regression, classification, interpolation of computer output, and Bayesian inverse problems. However, despite their wide-spread adoption, practical and efficient ways of specifying flexible Gaussian processes are still lacking, particularly in the nonstationary case. In addition, Gaussian process methodology suffers from pressing computational challenges concerning their scalability to large datasets and high dimensional settings.

A related but distinct challenge facing Gaussian process methodology is its computational scalability to large datasets. This tractability challenge, which stems from the need to compute the Cholesky factorization of a dense covariance matrix, has been at the forefront of researcher's minds for decades, resulting in methods such as circulant embedding, Vecchia approximations, and the use of sparse representations. In recent times, new classes of approximation have appeared - including Hutchinson estimators for dealing with the trace terms of the likelihood and hierarchical off-diagonal low rank approximation of the covariance matrix which exploit the smoothness of the covariance kernel between well separated regions — that have the potential to vastly extend the scalability of Gaussian processes. These and other recent computational developments have facilitated the use of Gaussian processes with larger datasets and have also prompted a renewed interest in employing Gaussian processes in several classical scientific computing tasks such as numerical solution of partial differential equations, dimension reduction, and experimental design. However, a full understanding of the error caused by such computational techniques is still missing, and their scalability to highdimensional settings needs further investigation.

This workshop brought together computational and applied mathematicians, statisticians and subject matter researchers to push the field beyond its present practices, and in particular to investigate (a) new models that go beyond what, even under stationarity, are very narrow classes of stationary covariance functions; (b) how to express and understand the structure in the modeled process and exploit it in the computation phase; (c) novel application of Gaussian processes in classical scientific computing tasks; and (d) rigorous error analysis of the associated methodology. The workshop also included a poster session for graduate students and postdocs.

This workshop had 122 unique participants, including speakers and organizers.

Organizers	Affiliation & Department
Mihai Anitescu	Argonne National Laboratory
Daniel Sanz-Alonso	University of Chicago, Statistics
Michael Stein	Rutgers University, Statistics
Speakers	Affiliation & Department
Francois Bachoc	Institut de Mathématiques de Toulouse
David Bolin	King Abdullah Univ. of Science and Technology (KAUST)
Connor Duffin	University of Cambridge, Engineering
Robert Gramacy	Virginia Polytechnic Institute & State University (Virginia Tech), Statistics
Mengyang Gu	University of California, Santa Barbara (UCSB), Statistics
Mamikon Gulian	Sandia National Laboratories
Emily Kang	University of Cincinnati, Mathematics
Matthias Katzfuss	Texas A&M University, College Station; Statistics
Kristin Kirchner	Delft University of Technology, Applied Mathematics
Finn Lindgren	University of Edinburgh, Mathematics
Douglas Nychka	Colorado School of Mines, Applied Mathematics and Statistics
Houman Owhadi	California Institute of Technology
Matt Plumlee	Northwestern University, Engineering
Maziar Raissi	University of Colorado Boulder, Applied Mathematics
Arvind Saibaba	North Carolina State University, Mathematics
Suhasini Subba Rao	Texas A&M University, College Station; Statistics
Aretha Teckentrup	University of Edinburgh, Mathematics
Yimin Xiao	Michigan State University, Statistics and Probability
Ruiyi Yang	Princeton University, Applied and Computational Mathematics
Poster Presenters	Affiliation & Department

Matthew Bonas	University of Notre Dame, Statistics
Jian Cao	Texas A&M University, College Station; Statistics
Moses Chan	Northwestern University; Industrial Engineering and Management Sciences
Haoyuan Chen	Texas A&M University, College Station
Debangan Dey	NIH - National Institutes of Health
Youssef Fahmy	Cornell University, Statistics
Haoxiang Feng	Michigan State University, Statistics
Christopher Geoga	Rutgers University, Statistics
Whitney Huang	Clemson University, School of Mathematical and Statistical Sciences
Felix Jimenez	Texas A&M University, College Station; Statistics
Yoonbae Jun	Iowa State University, Statistics
Myeongjong Kang	Texas A&M University, College Station; Statistics
Charles Kulick	University of California, Santa Barbara (UCSB); Mathematics
Didong Li	Princeton University, Biostatistics
Kaiyu Li	University College London, Statistical Science
Xubo Liu	University of California, Santa Barbara; Statistics
Mary Salvana	University of Houston, Mathematics
Annie Sauer	Virginia Polytechnic Institute & State University, Statistics
Julia Walchessen	Carnegie-Mellon University, Statistics
Stephen Walsh	Virginia Polytechnic Institute & State University, Statistics
Lu Zhang	University of Southern California Medical School, Population and Public Health Sciences
Shifan Zhao	Emory University, Mathematics
Yingchao Zhou	Iowa State University, Statistics

Participant comments on the workshop included the following:

- I enjoyed the talks. It was good that the speakers had diverse backgrounds (applied math, statistics, computer science), and focused on different aspects of research with Gaussian processes.
- I had never been to a workshop before and this helped me feel like part of a greater research community.

- I was able to brainstorm with multiple people about research ideas that could give rise to future collaborations. In several cases I was even able to write a small stub of an article.
- My biggest take away from the workshop was that I was able to experience and gain more knowledge in the field of Statistics. Most of the speakers were great statisticians.
- The level of attendance and participation among younger researchers was also a strong positive.

Distributed Solutions to Complex Societal Problems Reunion Workshop, February 20-23

This is a follow up to the long program on <u>Distributed Solutions to Complex Societal</u> <u>Problems</u>, which took place in the Fall of 2021, to discuss progress and new directions.

Organizers	Affiliation & Department
Pierre Cardaliaguet	Université Paris Dauphine, Mathematics
Rene Carmona	Princeton University, Operations Research and Financial Engineering
Takis Souganidis	University of Chicago, Mathematics
Speakers	Affiliation & Department
Yves Achdou	Université Paris Cité, Mathematics
Erhan Bayraktar	University of Michigan, Mathematics
Charles Bertucci	L'École Polytechnique, Mathematics
Alekos Cecchin	Università degli Studi di Padova, Mathematics
Annalisa Cesaroni	Università degli Studi di Padova, Mathematics
Marco Cirant	Università degli Studi di Padova, Mathematics
Samuel Daudin	Université Paris Dauphine, Mathematics
Gökçe Dayanikli	Columbia University, Statistics
Dena Firoozi	HEC Montréal, Decision Sciences
Wilfrid Gangbo	University of California, Los Angeles, Mathematics
Jameson Graber	Baylor University, Mathematics

This workshop had 90 unique participants, including speakers and organizers.

Joe Jackson	University of Texas at Austin, Mathematics	
Mathieu Lauriere	New York University Shanghai, Mathematics and Data Science	
Pierre-Louis Lions	Collège de France, Mathematics	
Alpár Mászáros	Durham University, Mathematical Sciences	
Nikiforos Mimikos- Stamatopoulos	University of Chicago, Mathematics	
Sebastian Munoz	University of Chicago, Mathematics	
Marcel Nutz	Columbia University, Statistics	
Ben Seeger	University of Texas at Austin, Mathematics	
Mete Soner	Princeton University, Operations Research and Financial Engineering	
Ludovic Tangpi	Princeton University, Operations Research and Financial Engineering	
Daniela Tonon	Università degli Studi di Padova, Mathematics	
Nizar Touzi	L'École Polytechnique, Applied Mathematics	
Antonios Zitridis	University of Chicago, Mathematics	

Participant comments on the workshop included the following:

- Recent progress on the analysis of MFGs, particularly on the master equation. I also heard talks about works I didn't know although they are related to my own works. So the diversity of speakers was very nice.
- I could meet my colleagues working on same areas as me and interact with them. The presentations were excellent.
- Got lots of new ideas after listening to the talks.

Randomness in Topology and its Applications, March 20-24, 2023

Recent years have seen an enormous growth in the applications of topology to other disciplines from the biological sciences to materials science, and from dynamical systems to cosmology and engineering. Many of these are factored through "topological data analysis" (TDA), but not all, with notable exceptions among those from dynamics and from engineering. All of these applications are due to topology's capacity to define precise invariants from imprecise data: topological invariants (like the winding number of a curve around a point) are usually discrete and have some stability properties (here, to arbitrary perturbations that don't move points as much as their distance to that point) that make them attractive.

However, topological stability is quite different from ordinary statistical stability. A single outlier can completely change the apparent topology of a space. One of the ways of dealing with this, persistence, has had numerous applications within pure math in recent years (in differential geometry, group theory, and approximation theory, to name three). The study of topology of random processes, and how the randomness perturbs topology is thus arising as an important scientific issue with potentially very wide significance. This workshop brought together workers who have been dealing with this in different settings and in different ways, which should lead to progress in both application domains, and in the longer run, on the fundamental problems. The workshop included a poster session.

Organizers	Affiliation & Department
Sayan Mukherjee	University of Leipzig, Computer Science; Max Planck Institute for Mathematics in the Sciences; Duke, Statistics
Katharine Turner	Mathematical Sciences Institute and the Australian National University
Shmuel Weinberger	University of Chicago, Mathematics
Speakers	Affiliation & Department
Omer Bobrowski	Technion – Israel Institute of Technology
Frédéric Chazal	INRIA, Mathematics
Lorin Crawford	Microsoft Research
Herbert Edelsbrunner	ISTA – Institute of Science and Technology Austria, Mathematics
Teresa Heiss	ISTA – Institute of Science and Technology Austria, Mathematics
Matthew Kahle	Ohio State University, Mathematics
Facundo Mémoli	Ohio State University, Mathematics
Washington Mio	Florida State University, Mathematics
Konstantin Mischaikow	Rutgers University, Mathematics
Anthea Monod	Imperial College London, Mathematics
Elizabeth Munch	Michigan State University, Computational Mathematics, Science and Engineering; Mathematics

This workshop had 105 unique participants, including speakers and organizers.

Takashi Owada	Purdue University, Statistics
Daniel Perez	École normale supérieure – ENS, Mathematics
Vanessa Robins	Australian National University, Physics
Benjamin Schweinhart	George Mason University, Mathematical Sciences
Primoz Skraba	Queen Mary University of London, School of Mathematical Sciences and Jozef Stefan Institute, Slovenia
Alex Strang	University of Chicago, Statistics
Jonathan Taylor	Stanford University, Statistics
Sarah Tymochko	University of California, Los Angeles, Mathematics
Bei Wang	University of Utah, Computer Science
Yusu Wang	University of California, San Diego, Data Science Institute
Erin Wolf- Chambers	St. Louis University, Computer Science
Poster Presenters	Affiliation & Department
Mishal Assif P K	University of Illinois at Urbana-Champaign, Electrical Engineering
Gisela Charó	University of Buenos Aires, Applied Mathematics
Juan Carlos Díaz- Patiño	Instituto de Neurobiología, Conductual and Cognitive Neurobiology
Mario Gomez Flores	Ohio State University, Mathematics
Shengli Jiang	University of Wisconsin, Madison, Chemical and Biological Engineering
Shu Kanazawa	Kyoto University, Institute for Advanced Study
Nkechi Nnadi	Wayne State University, Mathematics
Osman Okutan	Max Planck Institute for Mathematics in the Sciences
Sarah Percival	Michigan State University, Mathmatics
Chun Yin Siu	Cornell University, Center for Applied Mathematics
Živa Urbančič	Swansea University, Mathematics

Xinyi Wang Michigan State University, Applied Mathematics

Participant comments on the workshop included the following:

- One moment that stands out is when a chemical engineer approached me after my talk to tell me about an interesting model he had defined. It turned out to be closely related to a mathematical structure that I had independently discovered. We plan to collaborate to study these systems in the future.
- Personally, I feel very invigorated and refreshed as a burnt-out grad student. This gave me a glimpse of academic life outside the lab.
- Meeting PhD students working in similar fields probably is the best one. We are now connected and open for future meetings or collaborations.

Assessing the Economic and Environmental Consequences of Climate Change: Incorporating Uncertainty and Quantifying Its Importance, March 31 – April 1, 2023

This workshop convened leading researchers from diverse disciplines to explore the development of better and more credible models of the dynamic interactions of climate change and economic activity. The workshop leveraged advances from a variety of fields to explore novel and revealing forms of uncertainty quantification pertinent to the design of prudent policies related to climate change. Advanced computational methods are an essential tool for solving and analyzing dynamic models under broad-based formulations of uncertainty at the required levels of spatial and temporal granularity. This workshop brought together world-renowned experts in the areas of climate science, computational methods, geosciences, statistics, and economics to explore synergies that will lead to modeling improvements in the future. This workshop was organized in collaboration with the <u>Macro Finance Research Program</u>.

Organizers	Affiliation & Department
Lars Peter Hansen	University of Chicago, Economics
Esteban Rossi- Hansberg	University of Chicago, Economics
Rebecca Willett	University of Chicago, Statistics
Speakers	Affiliation & Department
Anastasios N. Angelopoulos	University of California, Berkeley, Electrical Engineering and Computer Science
Michael Barnett	Arizona State University, Finance
Adrien Bilal	Harvard University, Economics

This workshop had 46 unique participants, including speakers and organizers.

Harrison Hong	Columbia University, Economics
Ruimeng Hu	University of California, Santa Barbara, Mathematics, Statistics and Applied Probability
Joseph Huang	University of Pennsylvania, Economics
Karthik Kashinath	NVIDIA
Felix Kubler	University of Zurich, Financial Economics
Simon Scheidegger	University of Lausanne, Economics
Jose Scheinkman	Columbia University, Economics
Duncan Watson-Parris	University of California, San Diego, Oceanography
Poster Presenters	Affiliation & Department
Ghassane Benmir	London School of Economics and Political Science
Aditya Bhandari	University of Chicago, Economics
Thomas Bourany	University of Chicago, Economics
Juanma Castro-Vincenzi	Princeton University, Economics
Joanna Harris	University of Chicago, Economics
Ruoxi Jiang	University of Chicago, Computer Science
Christian Kontz	Stanford Graduate School of Business
Haokun Liu	University of Chicago, Computer Science
Peter Lu	University of Chicago, Data Science Institute
Simon Oh	University of Chicago, Financial Economics
Elena Orlova	University of Chicago, Computer Science
Jordan Rosenthal-Kay	University of Chicago, Economics
Raphael Rossellini	University of Chicago, Statistics
Marco Thalhammer	RWTH Aachen University, Economics

Participant comments on the workshop included the following:

• There are so many opportunities to use tools from other fields such as climate science, math/statistics and computer science to improve my research. It is

absolutely worth it to invest the time to learn about these techniques and models because they have the potential to make my research both more interesting and more impactful.

- Some computational scientists, climate scientists, statisticians and economists are speaking a common language, that will help advance knowledge in climate economics.
- I think interdisciplinary workshops like this one are really great and I would love to attend similar ones in the future.

3.5 Special Events

8th International Conference on Computational Social Science (IC2S2), July 19-22, 2022

The International Conference for Computational Social Science (IC2S2) was held at the Harper Center of the Booth School of Business at the University of Chicago, July 19-22, 2022. IC2S2 has emerged as the dominant conference at the intersection of social and computational science, bringing together researchers from around the world in economics, sociology, political science, psychology, cognitive science, management, computer science, statistics, and the full range of natural and applied sciences committed to understanding the social world through large-scale data and computation. Unlike other important social computing and associated computer science conferences, the IC2S2 community actively balances and maintains a conversation between social and computational scientists which integrates technological advances and opportunities with social scientific rigor and insight.

The conference began with a one-day set of tutorials in a range of social and computational methods, and also a "datathon" for students and scientists to collaborate and compete on a complex, data- and computation-driven research challenge. This was followed by a three-day conference featuring research and researchers from around the world, across a broad range of relevant fields, and working on all areas of computational social science to advance its many frontiers.

IMSI was a co-sponsor for the conference, and provided funding to support registration fees for 114 datathon participants.

Al+Science Summer School, August 8-12, 2022

The AI + Science summer school was jointly sponsored by IMSI and the <u>Data Science</u> <u>Institute (DSI)</u> at the University of Chicago. It was hosted in IMSI space and applications were managed through IMSI's website, but no NSF funding was used to support participants.

The goal of the summer school was to introduce a new generation of diverse interdisciplinary graduate students and researchers to the emerging field of AI + Science, with the hope of building community and spurring new research directions focused on AI-

enabled scientific discovery across the physical and biological sciences. The school focused on four core themes at the heart of this emerging paradigm of scientific discovery: Al uncovering new laws of nature, Al guiding scientific measurement, physics-informed machine learning, and scientific discovery advancing Al frontiers.

Organizers	Affiliation & Department
Yuxin Chen	University of Chicago, Computer Science
Aaron Dinner	University of Chicago, Chemistry
lan Foster	University of Chicago. Computer Science, and Argonne, MCS
Eric Jonas	University of Chicago, Computer Science
Yuehaw Khoo	University of Chicago, Statistics
Risi Kondor	University of Chicago, Computer Science and Statistics
David W. Miller	University of Chicago, Physics, and Enrico Fermi Institute
Brian Nord	University of Chicago, Astronomy & Astrophysics and KICP, and Fermilab
Suri Vaikuntanathan	University of Chicago, Chemistry
Rebecca Willett	University of Chicago, Computer Science and Statistics
Speakers	Affiliation & Department
Camille Avestruz	University of Michigan, Physics
Roman Garnett	Washington University in St. Louis, Computer Science and Engineering
Eric Jonas	University of Chicago, Computer Science
Risi Kondor	University of Chicago, Computer Science and Statistics
Romit Maulik	Argonne National Laboratory and Illinois Institute of Technology
Christoph Ortner	University of British Columbia, Mathematics
Samantha Riesenfeld	University of Chicago, Molecular Engineering and Genetic Medicine
Claudia Solis- Lemus	University of Wisconsin-Madison, Plant Biology and Wisconsin Institute for Discovery
Miles Stoudenmire	Flatiron Institute

Bring MATH: Bridges for the Next Generation: Mathematical Science Research and Out Future, November 11, 2022

BRING MATH (**BRI**dges for the **N**ext **G**eneration: **MATH**ematical Science Research and Our Future) was a one-day conference for undergraduates interested in the mathematical sciences. It was a collaboration between IMSI and the <u>Mathematics and Computer</u> <u>Science Division at Argonne National Laboratory</u>, and was hosted at Argonne, which is located in Lemont, Illinois.

BRING MATH had multiple purposes: 1) expose students and faculty to research in the mathematical sciences at Argonne, and to help them understand its real world applications, 2) increase students' interest in the mathematical sciences and broaden their access to opportunities to pursue that interest, 3) diversify the mathematical science community, 4) educate students about summer opportunities available to them, and 5) help students learn about career opportunities in the mathematical sciences and how to pursue them.

BRING MATH included the following activities: 1) dedicated sessions on topics such as climate change, data & information, and quantum computing & information, 2) tours of Argonne facilities such as the Advanced Photon Source, the Center for Nanoscale Materials, Argonne's data visualization center, and Argonne's supercomputing center, 3) networking opportunities with researchers at Argonne, and 4) a panel on career paths in the mathematical sciences.

IMSI supported 28 participants.

Participant comments on the conference included the following:

- I thoroughly enjoyed all aspects of the conference, including the breakout sessions, tours, and final panel- but if I had to choose one- I would say the tour of the facilities because our guides were extremely knowledgeable and answered all my questions. However, I also really enjoyed the final panel discussion, as it truly inspired me to consider graduate school and possibly becoming a researcher.
- My favorite experience was getting to network with other grads and undergrads in applied math, as well as see some state of the art equipment!
- The quantum computing presentation was one of the most exciting lectures I've had in a long time.
- I realized that becoming a researcher and pursuing Math and Computer Science research is definitely possible after completing undergraduate studies. I never knew that there were so many opportunities, and as mentioned, this conference has definitely been inspiring.
- My biggest takeaway from the conference was that I realized how mathematics is applicable to atmospheric science, biochemistry, and chemistry. In addition, I also

gained a better understanding of the variety of career paths available to mathematicians.

- I can absolutely end up in a career in mathematics researching subjects that can enhance the world of mathematical sciences!
- My biggest takeaway is that applied math has lots more career opportunities than meets the eye!

3.6 Summer Internship Program

The IMSI Internship program is a workforce development effort to accelerate the preparation of PhD students in the mathematical sciences for careers in interdisciplinary and translational research, in industry, and in government laboratories by providing them with broadening professional experiences. Five interns (three women and two men) were selected from a national pool of over 100 applicants from PhD programs in mathematics, statistics, and related mathematical sciences.

The interns began with two weeks of intensive training participating in the IMSI Data Science Bootcamp, offered online via Zoom May 27 – June 10, 2022. The bootcamp was led by an expert in data science and engineering. The training was a full time, interactive experience with lecture material available in advance, hands-on daily group work, and group instruction with the opportunity to interact with other interns. The aim was to provide highly capable PhD student interns with a jump start into data science, machine learning, modeling, and analysis to enhance success in their interdisciplinary internship appointments. In anonymous surveys following the boot camp, interns indicated a high degree of satisfaction with the relevance, range of topics, and their overall experience. They felt they received a level of material that was not available in their academic training, and they enjoyed the experience of coming together to work with different members of the group.

The internship placements were for 8 weeks (about 2 months) duration. Interns were placed individually or in teams depending on the scope of host projects and their mentorship capacity. Interns completed necessary onboarding for the host and were embedded in labs or groups at the host institution with a lead investigator as their direct supervisor and project mentor. Upon completion of the internship, participants authored brief technical reports in the format of a scientific paper to describe their project. Hosts expressed enthusiasm for the work the interns were able to do for them. In some cases, the laboratories had not previously engaged graduate students from the mathematical sciences and were pleased with what they were able to accomplish for them. At least one intern reported that their project was leading to ongoing collaboration, and another reported that their industry internship was extended by the company through the next academic year. Post-internship surveys indicated strong agreement with the statement, "I would recommend the IMSI internship program to future interns."; in fact, every participant chose "strongly agree" with that statement.

Participant home institutions and graduate degree programs:

Participant Home Institution	Participant PhD Degree Program
Northwestern University	Statistics
University of California, Berkeley	Statistics
University of Florida	Applied Mathematics
University of Notre Dame	Mathematics
University of Pennsylvania	Mathematics

Internship host organizations:

Internship Host Organization	Area
University of Illinois Urbana-Champaign Microbiology (x2)	Functional identification of proteins in cytotoxic necrotizing factors
University of Illinois Veterinary Medicine	Modeling animal behavior using socioecological models
Wolfram Alpha	Developing calculus infrastructure in the Wolfram Alpha programming language
Wolfram Research	Development of statistical packages

3.7 Education Outreach

Education Outreach Programs at UChicago

IMSI supports and provides partial funding for three education outreach programs run out of the UChicago Math Department: the Young Scholars Program (focused on pre-college students), and the Polk Bros & SESAME programs (targeted at math teachers, mainly grades 3-8).

Polk Bros.

The Polk Bros. program has as its mission the improvement of the teaching of mathematics in the Chicago Public Schools (CPS). This is accomplished by giving classes to CPS teachers at all grade levels, but primarily grades k-8. Starting the last week of June 2022 and running for five weeks, Monday through Thursday, a class which covers a modern method of teaching mathematics is given from 9:00am to noon. Starting at the same time, a class on mathematical content is given Monday through Thursday 1:30pm to 4:30pm. This class runs for four weeks, and in the fifth week, a new class

begins on another content topic. This past year the first topic was precalculus/calculus-an extremely gentle approach assuming almost no prior knowledge of mathematics. The second course, starting the final week of the summer session, was based on geometry. This second topics course adds ten sessions running 4:30pm to 7:00pm on Mondays during the academic year that are selected for the convenience of the participants. This past year, all courses were taught remotely. The methods course was taught by Professor John Boller, a celebrated teacher and the Co-Director of Undergraduate Studies from our department. The content courses are taught by UChicago math professor Bob Fefferman.

The numbers for 2022 are as follows: 120 participating teachers and the demographics of the teachers were as follows: African American 30; Asian 8; LatinX 40; White 36; Other 5; No Response 1

Some quotes from our evaluations by the teachers are given below:

- I looked forward to attending class each day knowing that I was about to "have my mind blown" by the materials that were printed with such passion and joy by Dr. Boller. I have never loved math as much as I have loved math during the weeks that i attended this class. I was not alone in this conversion. The other participants also marveled at the beauty and order of mathematics as presented by the professor.
- The teacher was very passionate about math and it showed through his teaching. His teaching methods for methods are great and it helped me to see and understand clearly what was being taught. He was very engaging and we were allowed to collaborate with our peers every class. This was a great methods class and I really enjoyed Professor Boller's class. I learned a lot and had fun learning.
- Professor Boller was a fantastic presenter and teacher! I enjoyed how much this course stretched my thinking about math. I am excited to try serval of the games and skills presented in this class!
- Mr. Fefferman is an amazing professor. He explained topics with great knowledge and patience. The classes were very engaging and interactive. Challenging at times, but a great experience.
- Another great feature of this course was the professor's high-level of mathematical knowledge and the support given to me as a student. There were times I felt the content was overwhelming, but when I asked questions, Professor Fefferman "unpacked" the content and explained the concept various ways until I was comfortable applying the concept myself. He was always patient and made me feel my questions were helping other people in the class. He wouldn't stop working with you until you understood.
- The best feature of this activity could be summed up by one word: access. The incredible opportunity afforded to CPS teachers through the generous grant from Polk Brothers makes the work of equity in the classroom more attainable. The participants reflected the wonderful diversity of students we teach in the classrooms, and Dr. Fefferman modeled mutuality and intellectual curiosity which are instrumental in establishing a culturally responsive learning environment.

SESAME

In 2022-23, the SESAME program continued to operate by offering virtual classes that made up part of the Algebra Initiative project in collaboration with the Chicago Public Schools (CPS), DePaul University, and the University of Illinois at Chicago (UIC). The Algebra Initiative is a program through which teachers take courses from the University partners so as to be able to offer a 9th grade algebra course to qualified students in the 8th grade. It includes teacher training as well as a qualifying exam. Students who then take a year-long course from a qualified teacher take an exit exam, and if they pass, they are not required to take an Algebra I course in 9th grade.

In the Autumn, Winter, and Spring Quarters at the University of Chicago, respectively, the Algebra I, II, and III courses were offered, with total enrollments of 19, 19, and 14, by quarter. In each of the Winter and Spring Quarters, 3 of the enrollments were students in the University of Chicago UTEP Master's program, with the remainder in all three quarters being full-time CPS teachers.

Young Scholars Program

In the Summer of 2022, the Young Scholars Program (YSP) returned to an in-person format after two years of a virtual program. YSP is a four-week summer program for mathematically talented 7th through 12th graders, divided into three grade-level cohorts: 7-8, 9-10, and 11-12. Each cohort had two associated faculty instructors who taught classes and a number of undergraduate counselors who ran break-out sessions. In 2022, we had a grand total of 47 students who participated, the vast majority of whom attend the Chicago Public Schools. They divided into cohorts of 24, 10, and 13, respectively. We had 7 faculty instructors (two combined to teach a single course 9-10 course) and 12 undergraduate counselors. The theme for 2022 through all of the cohorts was number theory.

Education Outreach Programs at the University of Illinois at Chicago

In 2022, the Young Scholars Program at UIC ran in two sessions of two weeks each. The first session was on "Mathematical Modeling" and the second on "Classic Theorems and Proofs in Mathematics". In the first session, lecture topics included random sampling and simulation, Benford's Law and fraud detection, and the principles of modeling and statistical analysis. In the second session topics included geometry, prime numbers, irrationality, and cryptography. The daily schedule included a morning lecture, guided exercise sessions based on the day's lecture, a lunch break, work on group projects, and either a guest lecture or a special large group activity. The two-week sessions allowed for substantial student projects, completed in self-selected groups, which could be on any topic the students were excited about. The final day of each session featured students displaying posters on the work they'd done on their projects as well as presentations to the group. These student projects were very impressive, and the students were very proud to share the ideas and work they'd done.

There were 110 participants, approximately 40% female, and 40% from underrepresented groups. Students came from high schools all around the city, both public and private, but the vast majority were from CPS schools. The program was completely free to participate in, lunches were provided, and UIC is easily accessible by public transport which made the program accessible for many students around the city. Additionally, there were no mathematical prerequisites to participate; the lectures, exercises, and group projects were designed to be approachable and interesting to students with a wide variety of mathematical backgrounds. Students could choose which exercises to pursue and the direction of their group projects, and the graduate student instructors did a great job of making the program exciting and enriching for all the students.

In 2022, the YSP program partnered with Math Circles of Chicago to reach a wider audience of students across the city. Students who participated in a Math Circles program during the school year could register for the YSP from their Math Circles account, and Math Circles publicized the program to their students and teachers in the spring. Around 30% of the participants registered through Math Circles, with 70% registering directly through the YSP website. The YSP summer program complemented Math Circles summer programs which focused on middle school students, and together the two summer programs offered opportunities to all Chicago students from 5th grade through graduating seniors.

3.8 Communication and Engagement

ComSciCon

On September 17-18th, IMSI hosted ComSciCon-Chicago. ComSciCon-Chicago is a workshop designed to empower graduate students to communicate complex concepts arising in science, engineering, and other technical fields to diverse audiences. Over the course of the weekend, graduate student attendees interacted with leaders in science communication, expert journalists, communication researchers, and fellow scientists. The workshop hosted 21 attendees, 15 invited speakers and experts, and 7 organizers.

IMSI Communications Bootcamps

Concept

As part of our mission to improve communication within the mathematical and statistical fields, IMSI offers several bootcamps to help early career researchers develop their communication skills. The bootcamps, offered online and in person, build skill sets applicable to academic careers and individuals' broader communication goals. When participants complete all three bootcamps, they qualify for recognition of their work through a LinkedIn badge.

Set of Topics Covered

Storytelling & Narrative Structure:

Storytelling isn't just for fiction writers. In order to write a successful grant application or a compelling teaching statement, one must use a narrative structure that pulls the reader along. This workshop teaches the scientific literature on why narratives are so compelling for the human brain, followed by hands-on work developing narrative structure in a written

piece of the attendee's choice (teaching statement, diversity statement, grant proposal, science reporting, etc).

How to Write for a General Audience:

Have you ever wondered how a scientific paper is picked up and covered in news outlets like The New York Times or the Washington Post? This workshop teaches attendees about the process of how journal articles are translated into press releases and how those releases are picked up and made into news stories. Attendees learn to evaluate what makes a scientific finding newsworthy and practice a hands-on writing exercise to refine a press release based on their work.

Job Talks & Stage Presence:

No matter how exciting a researcher's work is or how well they've rehearsed their slides for a talk, stage presence is key. Knowing how to use the surrounding space, how to recover from a mistake, and how to project vocally so that even those in the back of the room can hear are key to a successful talk. This workshop develops attendees' presentation skills, so they're comfortable during their next presentation.

Current Impact

As of the end of the Spring 2023 quarter, we had 47 attendees take part in the Communications Bootcamps over the past year. Of those, 13 attendees completed all three topics offered and earned the LinkedIn Badge.

MathStatBites

Concept

MathStatBites is a mathematical and statistical research blog, written by early career researchers and students in those fields to translate peer-reviewed journal articles for a general audience. There is significant interest from early career researchers who want to learn how to write accessible summaries of research for their peers and colleagues who are not experts in a particular area of research, as well as for broader audiences outside the fields of mathematics and statistics. This educational blog, MathStatBites, provides translations of research into digestible "bites," and gives early career researchers (ie, graduate students, postdocs, and junior faculty) an opportunity to hone their writing skills.

Current Impact

As of the end of May, we had 14 writers publish posts on MathStatBites. Six of our writers committed serving as our regular contributors and publishing a post every other month for a total of five posts across the year.

In addition to our writers, we worked with undergraduate students to serve as editors and provide feedback as to whether we were clearly communicating the research for an undergraduate audience. Nine students participated as editors across the year.

Carry the Two Podcast

Concept

As part of IMSI's goal to broaden participation and interest in mathematics and statistics, we are creating a podcast called **Carry the Two**. Our basic premise is that each podcast episode is a conversation between two hosts, with one leading the other through a discussion of math research that shows how the field is interesting, applicable to our everyday lives. Each episode integrates excerpts from a separate conversation with an expert mathematician or statistician on that episode's topic. Through this podcast, we show that math is everywhere, relevant, and useful for navigating the complexities of everyday life.

Current Impact

Carry the Two is currently on its second season, having published 28 episodes as of the end of May. Each episode averages around 2000 downloads, with over 54,000 downloads overall.

On August 8th, *Carry the Two* was featured on NPR's daily science podcast, Short Wave. NPR host Aaron Scott interviewed Sadie Witkowski about the goals of Carry the Two and how the podcast tells stories around mathematics and statistics. After the episode aired, titled Carry the Two: Making Audio Magic with Math, the podcast saw 1747 downloads the following day. Additionally, NPR re-aired the episode which then led to 2376 downloads the next day.

Carry the Two also hosted a collaborative season two with the American Geophysical Union's podcast, *Third Pod from the Sun*. For six episodes that were published on a weekly basis, *Carry the Two* and *Third Pod* covered research by mathematicians who presented at the IMSI long program Confronting Global Climate Change. The podcast crossover was called <u>Solving for Climate</u> and helped grow the listenership by cross promoting between the podcasts.

4. Preparation for Future Activity

The institute will host two long programs in 2023-24: *Algebraic Statistics and Our Changing World* (September 18-December 15, 2023) and *Data-Driven Materials Informatics* (March 4-May 24, 2023). The Scientific Committee recommended moving forward with these programs during its September 2022 meeting, at which point work with the organizing committees for both programs began. Potential participants were identified and invited to apply, workshop schedules were finalized, and workshop organizing committees were formed. Applications for both programs opened in the fall, and were announced through a number of channels, including advertisements in *SIAM News* and *Amstat News* and an announcement in the Mathematical Opportunities section of the *AMS Notices*. In addition, the fall 2023 program was announced through the Meetings Calendar of the Institute for Mathematical Statistics.

The IMSI Scientific Committee met in October 2022 and April 2023. The Committee recommended three proposals for long programs in 2023-24: *The Architecture of Green*
Energy in summer of 2024, *Statistical Methods and Mathematical Analysis for Quantum Information Science* in fall of 2024, and *Uncertainty Quantification and AI for Complex Systems* in spring of 2025. It is atypical for IMSI to host a summer long program, but it was felt that the opportunity was sufficiently exciting that it would be worthwhile to pursue it. Work with both organizing committees for develop plans for all three programs has been ongoing.

In addition, a discussion was initiated between IMSI and the Math Alliance to collaborate on a *Career Paths in the Mathematical Sciences* conference for students and mentors in their Facilitated Graduate Admissions Program (F-GAP) for the 2023-24 academic year. The conference is planned for June 2023. Finally, planning among the mathematical sciences research institutes for the next cycle of MSIDI activities (2023-2028) was initiated.

5. Governance

IMSI has two principal governing boards.

The IMSI **Board of Advisors** provides guidance to the Director on Institute activities, operations, and strategic planning. In addition, it plays a role in the search for and appointment of the Director. The Board has dedicated seats for one institutional member from each of the partner institutions (Northwestern University, the University of Chicago, the University of Illinois at Chicago, and the University of Illinois at Urbana-Champaign), with the remaining seats allocated to general and *ex officio* members. Members serve four-year terms, except in the case of *ex officio* members. The current institutional and general members of the Board of Advisors are as follows.

Board of Advisors	Affiliation
Laura Appenzeller	University of Illinois Research Park and the University of Illinois at Urbana-Champaign
Chid Apte	IBM Thomas J. Watson Research Center
C. Allen Butler	Daniel H. Wagner Associates, Inc.
T. Tony Cai	University of Pennsylvania
Adrian Coles	Bristol Myers Squibb
Juan de Pablo	University of Chicago and Argonne National Laboratory
Lee DeVille	University of Illinois at Urbana-Champaign
Darrell Duffie	Stanford University
Tamara G. Kolda	MathSci.ai

Pierre-Louis Lions	Collège de France
Brooke Shipley	University of Illinois at Chicago
Suzanne L. Weekes	Society for Industrial and Applied Mathematics (SIAM) and Worcester Polytechnic Institute
Karen Willcox	University of Texas at Austin
Patrick Wolfe (Chair)	Purdue University
Eric Zaslow	Northwestern University

The **Scientific Committee** provides guidance on the overall direction for scientific activity at the Institute and evaluates proposals for specific activities. Terms for members are typically three years in length. The current members of the Scientific Committee are as follows.

Scientific Committee	Affiliation
Alicia Carriquiry	Iowa State University
René Carmona	Princeton University
Andrew Childs	University of Maryland Institute for Advanced Computer Studies
Emil Constantinescu	Argonne National Laboratory and the University of Chicago
Amir Dembo	Stanford University
Sandrine Dudoit	University of California, Berkeley (UC Berkeley)
Bjorn Engquist (Chair)	University of Texas at Austin
Thomas Grandine	The Boeing Company (retired)
Larry Hedges	Northwestern University
Jacqueline Hughes-Oliver	North Carolina State University
Claude Le Bris	École des Ponts and INRIA
Claudia Tebaldi	Joint Global Change Research, PNNL
Joseph Tribbia	National Center for Atmospheric Research (NCAR)
Rebecca Willett	University of Chicago

6. Evaluation

IMSI works with East Main Evaluation and Consulting (EMEC) to evaluate its programs and activities. EMEC offers consulting and evaluation services with expertise in science and mathematics education and technology. The proposed effort will be managed by Barbara P. Heath, Ph.D. Dr. Heath founded EMEC in 2004 and has evaluated over 30 STEM focused programs including CyVerse (formerly iPlant), multiple Math and Science Partnerships, and various informal education efforts.

This year, post-activity surveys were deployed for the following programs and events:

Data Value: Assessment and Evolution		
Mathematical Methods for Quantum Hardware		
Expressing and Exploiting Structure in Modeling, Theory, and Computation with Gaussian Processes		
Confronting Global Climate Change		
Climate Model Evaluation and Uncertainty		
Climate and Weather Extremes		
Detection and Attribution of Climate Change		
Machine Learning for Climate and Weather Applications		
BRING MATH		
Remote Sensing for Climate Analysis		
Economic Impacts of Climate Change		
Interdisciplinary and Critical Data Science Motivated by Social Justice		
QuantCrit and Social Justice Research		
Randomness in Topology and its Applications		
Mathematics, Statistics, and Innovation in Medical and Health Care		
Assessing the Economic and Environmental Consequences of Climate Change: Incorporating Uncertainty and Quantifying Its Importance		
Analytics for Improved Healthcare		

Machine Learning and Artificial Intelligence for Personalized Medicine

Predictive Analytics, Business Modeling and Optimization in Healthcare Operations Management

Technological Innovation in Health Care Delivery

The surveys were designed to gauge the nature of participant experience during each activity, to measure the degree to which participants thought the specific goals for each activity were achieved, and to gather feedback about possible future directions. Surveys were typically deployed a few days after the end of the activity, and participants were given two weeks to respond. A reminder was typically sent a week after the initial deployment of each survey.

7. External Funding

IMSI receives substantial in-kind support from the University of Chicago. This support includes a full teaching release and administrative supplement for the Director, an administrative supplement for the Scientific Adviser, and the full salary of the Executive Director. In addition, the University covered the cost of the renovation of the space IMSI occupies and its ongoing maintenance.

The University of Illinois at Urbana-Champaign provided support through a partial teaching release for the Associate Director.

Other Funding Support

University of Chicago Provost	\$92,000.00
University of Chicago Physical Sciences Division Dean	\$73,541.61
University of Chicago Macro Finance Research Program	<u>\$15,000.00</u>
Total	\$180,541.61

8. Director Biographies

Kevin Corlette, Director

Kevin Corlette was appointed as the Director of IMSI on August 1, 2020. He has been a faculty member of the Department of Mathematics at the University of Chicago since 1987. He served as chair of the department from 2001-2007, and again from 2017-2020. In addition, he served as director of the Master's Program in Financial Mathematics from 2012-2015. His research lies in differential and algebraic geometry, and has touched on areas such as non-Abelian Hodge theory, rigidity of lattices in Lie groups, and representations of fundamental groups of Kähler manifolds. He was a recipient of an NSF Postdoctoral Fellowship, a Sloan Research Fellowship, and a Presidential Young

Investigator Award. He was an invited speaker at the 1994 International Congress of Mathematicians.

Douglas Simpson, Associate Director (until December 31, 2022)

Douglas Simpson was appointed as the Associate Director of IMSI on August 1, 2020. He has been a faculty member of the Department of Statistics at the University of Illinois at Urbana-Champaign since 1985, serving as chair of the department from 2000-2019. In addition, he served as director of the department's statistical consulting center 1995-2000. His research areas include applied and computational statistics, robust statistical methods, machine learning, and functional data methodology for quantitative image analysis. He was a recipient of an NSF Mathematical Sciences Postdoctoral Research Fellowship. He has served on NSF review panels and as a regular member of the NIH Biostatistical Methods and Research Design study group. He is a fellow of the American Association for the Advancement of Science, the American Statistical Association, and the Institute for Mathematical Statistics.

Dibyen Majumdar, Associate Director (January 1, 2023 to Present)

Dibyen Majumdar was appointed Associate Director of IMSI on January 1, 2023. He is Professor of Mathematics, Statistics, and Computer Science at the University of Illinois at Chicago, where he assumed the position of Assistant Professor in 1982. From 2009 to 2011 he was the Associate Dean of Research and Space of the College of Liberal Arts and Sciences, and from 2011 to 2022, the Executive Associate Dean of the College. Prior to that he was an Associate Head of Mathematics, Statistics, and Computer Science from 2004 to 2007, and the Director of the Statistical Consulting Lab from 1991 to 2005. He is a statistician whose main area of research is design of experiments, and it also includes the theory and methodology of linear and nonlinear models, and applications of statistics in biomedical research, especially design and analysis of clinical trials. His work on supersaturated design won the Shewell Award in 2013.

Takis Souganidis, Scientific Adviser

Takis Souganidis is Professor of Mathematics and Member of the Committee in Computational and Applied Mathematics at the University of Chicago. He works in deterministic and stochastic partial differential equations, and is interested in applied mathematics. He was a recipient of a Sloan Research Fellowship, and a Presidential Young Investigator Award. He was an invited speaker at the 1994 International Congress of Mathematicians and the 2019 International Congress on Industrial and Applied Mathematics. He is a Fellow of the AAAS, AMS, and SIAM.

Philip W. Hammer, Executive Director

Philip (Bo) W. Hammer was appointed Executive Director of IMSI on January 1, 2021. Hammer comes to IMSI after 10 years at the American Institute of Physics, where he was the founding and interim Executive Director of the AIP Foundation. He also led AIP's major antiracism initiative that addressed underrepresentation of African Americans in physics and astronomy. Hammer received his BS in Physics from Humboldt State University and his PhD in Physics from the University of Oregon. From 1991-93, Hammer was an ONR Postdoctoral Fellow at the Naval Surface Warfare Center in Silver Spring, MD. Hammer spent the '93-'94 year as an APS Congressional Science Fellow working on the staff of the Subcommittee on Science in the US House of Representatives. He worked at AIP from 1994-2000, and was Director of the Society of Physics Students and Sigma Pi Sigma. From 2000-2008, Hammer was a vice president of The Franklin Institute Science Museum in Philadelphia. Hammer is a Fellow of the American Physical Society.