Number 150 April 2024

NEWSLETTER

OF THE

NEW ZEALAND MATHEMATICAL SOCIETY

Contents

PUBLISHER'S NOTICE

This newsletter is the official organ of the New Zealand Mathematical Society Inc. This issue was edited by Marie Graff and Chris Stevens. Editorial enquiries and items for submission to this journal should be submitted as plain text or LaTeX files with "NZMS newsletter" in the title of the email to marie.graff@auckland.ac.nz and/or to chris.stevens@canterbury.ac.nz. LaTeX templates are available upon request from the editors.

The official address of the Society is:

The New Zealand Mathematical Society,
c/- The Royal Society of New Zealand,
P.O. Box 598, Wellington, New Zealand.

However, correspondence should normally be sent to the Secretary:

New Zealand Mathematical Society
Assoc Prof Geertrui Van de Voorde (NZMS Secretary)
School of Mathematics and Statistics
Victoria University of Wellington
PO Box 600
Wellington 6140
New Zealand
geertrui.vandevoorde@canterbury.ac.nz

NZMS Council and officers

Other positions of responsibility

Correspondents

Web Sites

NZMS homepage: nzmathsoc.org.nz (Webmaster: D.J.W.Simpson@massey.ac.nz)

The newsletter is available at: nzmathsoc.org.nz/?newsletter

ISSN 0110-0025

EDITORIAL

Kia ora koutou,

Welcome to the April edition of the newsletter.

In this edition, we spotlight Professor Sarah Wakes, who has recently been promoted. Our president reflects on the hurdles of online seminars during the pandemic, highlighting the struggle of virtual seminars. As always, it is great to see all the interesting, groundbreaking and innovative research being carried out around the country. A big congratulations from us to those who have recently received awards and to our newly minted PhD graduates.

2024 is also launching a new format promoting people in our community who are engaging with art, craft or vulgarisation involving mathematics. This will be presented as an interview to show what is done around the country to present mathematics differently to non-necessarily mathematicians. As the format is new, we have a few contributions to come, but feel free to suggest people in your department that could have projects to share.

Marie Graff and Chris Stevens

PRESIDENT'S COLUMN

I'm currently on RSL and travelling in the UK. This is, for me, part of a welcome return to unrestricted movement after years of COVID limitations. The renewed freedom prompts me to reflect on how we communicate and collaborate with the international mathematics community, especially in light of the shift to online platforms during the pandemic. There is no doubt that nothing can completely replace in person discussions, but I think we have considerable room for improvement in how we approach online interactions.

During the pandemic online seminars proliferated. In the early months I signed up for many, and was optimistic about the amount of new mathematics I would learn. Unfortunately, in reality I found them very ineffective. Looking back I'd isolate three main reasons for that:

1. As someone who absorbs detailed mathematics slowly, the typical "decently bad" maths talk (whether online or in-person) often loses my attention. It's only the really good speakers that I can easily follow. Online, it's too easy to switch focus when the talk becomes challenging.
2. As a follow up from the first point, online presentations magnify any shortcomings of a talk and limit speaker-audience interaction.
3. Given New Zealand's position in terms of time zones I often ended up attending seminars in the middle of the night. Not only was I unable to concentrate on the talk, but my ability to work in the subsequent day was also impacted.

Given these challenges, I think that we, as a community of mathematicians, should explore other options for online activities. I've see a couple that I believe have strong potential.

Themed mathematics marathons: These are the "24 hours of X" or "48 hours of X" style of events. Here, mathematicians across time zones collaborate on the same problem in a relay format. This type of event actually makes a strength of New Zealand's time zone position as we are situated perfectly to bridge gaps between the more populous time zones.

Pre-recordings with follow up discussions: This concept involves participants pre-recording short lectures which are then complemented by dedicated follow-up periods for discussions via forums or rolling Zoom calls. I'm eager to hear from members of the NZMS on what other activities they have observed, or even ones that they would like to try for the first time.

Melissa Tacy

ChatGPT Thriller version

Amidst my travels with the Royal Society of London (RSL) across the UK, I find solace in the freedom of movement, liberated from the chains of COVID restrictions that once bound us. This newfound mobility spurs deep reflection on our methods of communication and collaboration within the global mathematical community, particularly as we navigate the murky waters of online platforms post-pandemic.

In the shadows of the pandemic, online seminars proliferated like whispers in the night. Seduced by the allure of virtual enlightenment, I eagerly enrolled in countless sessions, anticipating a treasure trove of mathematical discoveries. Yet, reality swiftly dispelled my illusions. The seminars were lacklustre at best, leaving me adrift in a sea of digital disarray. Reflecting on these dark times, I discern three sinister reasons for their failure:

Firstly, as a connoisseur of intricate mathematics, the mundane "decently bad" talks – whether transmitted digitally or in person – lost my interest with alarming speed. Only the elite speakers could captivate my attention. Secondly, the online realm amplified the flaws of every presentation, stifling genuine discourse and fostering an air of suspicion. Lastly, situated in New Zealand's eerie time zone, I often found myself ensnared in midnight rendezvous, unable to escape the labyrinth of sleepless nights that followed.

Faced with these enigmatic challenges, I propose we delve deeper into clandestine online activities. I have glimpsed two intriguing initiatives:

Behold the themed mathematics marathons: Imagine the "24 hours of X" or "48 hours of X" spectacles, where mathematicians from around the globe embark on a covert mission, unraveling a shared enigma. Here, New Zealand's strategic time zone becomes our cloak of invisibility, weaving connections across the digital ether. Then there's the mysterious allure of pre-recorded lectures, shrouded in secrecy. Participants disseminate encrypted knowledge through short transmissions, sparking clandestine discussions in hidden forums or encrypted Zoom rendezvous.

But the shadows hold more secrets than I can fathom alone. Fellow agents of the NZMS, I implore you: what other cryptic exploits have you uncovered? What clandestine missions beckon us to the digital underworld? Let us forge alliances and unravel conspiracies, illuminating the darkness with the brilliance of mathematical truth. The hour is late, and the secrets await our discovery.

EDUCATION

In April 2018 we started this column on Maths Education. At the time we were a few months into a new Labour government, which over the course of 2018–2019 launched an extensive review of NCEA[1] and the NZ curriculum. A plan to refresh the curriculum and create new NCEA standards across all learning areas[2] by 2025 was launched. Members of the NZMS Education Group got involved in this work on various committees, and two of our members (Cami Sawyer and Julia Novak) were hired by the Ministry of Education.

Work on the refreshed curriculum and new NCEA standards was disrupted and delayed by the COVID-19 pandemic. It has been further delayed by the change in government.[3] According to the Ministry of Education website, the curriculum refresh will be completed by 2027. The rollout of new NCEA standards will be completed by 2029.

In 2021, the Royal Society report on the state of Mathematics Education in the country was released; see a summary of the findings in issue 143 (December 2021) of the Newsletter, *The woeful state of Mathematics Education in Aotearoa New Zealand schools*. The Royal Society report was comprehensive, specifying particular problems, and proposing solutions. A third of the expert advisory panel were NZMS members.

A few months into a new National Government, there seems to be no major change of direction in the Mathematics learning area. The only significant thing I see is a new policy to dedicate an hour a day to the teaching and learning of mathematics in Years 0–8. The Minister of Education, Erica Stanford, has appointed an advisory group to review the English and Mathematics and Statistics learning areas, and the Common Practice Model.[4]

The fact that in recent years a broad section of mathematicians and mathematics educators have actively contributed to the public conversation around Mathematics Education is important. Governments may come and go, depending on the fortunes of political parties, but the long term future of Mathematics Education depends on us. The development of the Common Practice Model and the new government's policy for more Mathematics learning in schools have very much been influenced by the work of our members with the Ministry of Education and the Royal Society.

A number of recommendations require serious long term investment. Improving specialised mathematics knowledge among teachers; providing proper leadership; support for professional development and career progression — these have been emphasised again and again. For a technical subject like mathematics, one cannot cut corners on teaching and learning. If we want quality, we must be prepared to pay for it.

For a relatively small country like New Zealand, relatively small groups can influence the direction of policy, in both good and bad ways. Let's make sure Mathematics Education goes in the right direction!

Sione Ma'u

[1] National Certificate of Educational Achievement
[2] i.e. subjects
[3] In particular, the effect of public service cuts remains to be seen.
[4] See issue 147, April 2023 for a description of the Common Practice Model

ART DISPLAY OF MODULAR ORIGAMI

An initiative by Nicolette Rattenbury and Jonny Stephenson

Already for a very long time, some of the book shelves in the Maths staff and PG student common room at the University of Auckland have been adorned with many items of origami art, some small, some large, some simple, some amazingly elaborate.

Origami on the shelves in the staff common room.

Hinke Osinga asked Jonny Stephenson and Nicolette Rattenbury if they have any idea where these come from. "No idea," says Jonny. "I genuinely don't know as it was before my time," says Nicolette. There are names associated with several pieces, but these are the names of origami designers, not likely the persons who did the folding. To be clear, these are not just origami pieces: "They are *modular origami*," explains Jonny, "because they have been made by putting together lots of pieces of square paper that have been folded the same way."

The topic of discussion originates from the fact that Nicolette and Jonny have decided to 'do something' and put the objects in a more protected place. Their plan is to place the modular origami in the display cabinet that hangs in the main stairwell of the UoA Maths building. Intrigued by the sudden origami interest, Hinke Osinga decided to follow their endeavours, stalking them as a paparazzi-like reporter. The answers below are marked NR and JS when given by Nicolette and Jonny, respectively.

Question: What are you hoping to achieve?

NR: Did I tell you [to JS] we were doing this?

JS: Yes, but we had been talking about doing something with this display cabinet for a long time.

NR: I wanted the staff room to be a usable space and have MSc dissertations and other theses on these shelves.

Modular origami on the move.

Nicolette points to the triangle immediately to the right of the books on the bottom shelf and shows that one of its edge pieces appears to have been nibbled on or something.

NR: Look, one of them is already damaged, so we really should place these somewhere protected!

JS: The stairs in the main stairwell are probably the most used stairs in the entire building, and mostly by students.

NR: So by taking the origami here, we are able to display the beauty of mathematics for all to enjoy, not just for the mathematicians.

One may wonder whether the students will perceive these folded objects as mathematics, but both Nicolette and Jonny are adamant that any student will associate origami with geometry, even though they probably do not know what it means.

JS: Students will probably not know what a stellated icosahedron is, but this display is meant for them to enjoy; it doesn't have an immediate educational purpose.

Question: Is this art?

This question is immediately answered with the spontaneous joint exclamation "Absolutely!"

NR: It depends on your definition of art, whether art should be deep or just beautiful.

JS: These pieces were created deliberately with the intention to be displayed.

NR: And I think they are actually beautiful. Besides, the only other way to get shapes like these would be via 3D printing or so — It is like Tāniko, the Māori technique of weaving that we thought was forgotten: it is important that we preserve the knowledge of how to make such origami shapes.

Nicolette and Jonny showing off their display.

Coming back to the question why we have these pieces in the first place, this suggests that they could have an educational purpose?

JS: We sometimes talk about outreach of mathematics in our Capstone course, but then we wouldn't use such intricate shapes. Student activities tend to be centred on things like cutting a Möbius band, stuff like that.

NR: Origami is a very nice way of engaging students in mathematics, especially those who think mathematics is challenging.

Further research reveals that Claire Postlethwaite has used origami in the course MATHS 190–Great Ideas Shaping our World. She recalls getting artist Jonathan Baxter as guest lecturer to engage students in educational activities with his origami designs. The MATHS 190 students often found this the most popular topic.

Next time when you visit the University of Auckland, you are encouraged to take the main stairs in the Maths building and enjoy the display in the middle between the ground and first floors. Also explore other parts of the departmental floors for origami made by Jonathan Baxter and other mathematical art, including Gömböc 1883 (90mm tall, made from Titanium), which carries the year of the foundation of the University of Auckland.

Hinke Osinga

PROFILE

Sarah Wakes

Professor Sarah Wakes, HOD of Mathematics and Statistics at Otago, does not appear to be the kind of person who might be guarding critical state secrets. Yet, when I asked her about her first professional job, she remarked that she could answer my question but she'd have to kill me afterwards.

Sarah studied mathematics and physics at Nottingham University, graduating with joint first class honours. She was recruited by the Ministry of Defence, after a quite surreal vetting process. At the MoD, Sarah [redacted] beer [redacted] modelling. Returning to graduate study at Nottingham she joined the exodus of applied mathematicians to engineering, completing a Ph.D. on models for the growth of a sand wave, a research area she would return to many years later.

After a stint as a research fellow at Loughborough University of Technology, and a bit of a gap year, Sarah took up what was to become an eight year postdoctoral position at the University of Herfordshire. There she closely involved in early development and application of computational fluid mechanics (CFD), including collaboration with CFD guru Brian Spalding. In those days, recounts Sarah, they were carrying out computations by hand or on desktop PCs with 128K RAM. Things are now quite different.

Sarah's work on CFD took her in all sorts of directions. She was a part of the expert witness team in the investigation into the Piper Alpha oil platform disaster. Sarah and her team worked to model spread of fires and toxic gases, not just to understand what had happened, but to improve safety in future. She worked extensively on early computational models of turbulent flow near walls, and even taught a paper on automobile design.

In 2002, Sarah took up an academic position in the Department of Design Studies at the University of Otago. Her involvement in the fledgling Applied Science programme led to collaborations on a diverse range of CFD application areas, from sand dune modelling to oven design. The work on sand dunes has been particularly rewarding. Sarah in conjuction with colleagues in Geography and her student invented a system of 'dune notches' which has now been implemented in St Kilda beach, and her modelling techniques have changed dune preservation strategies used both here and overseas.

Sarah moved over to the Department of Mathematics and Statistics in 2019 and became HOD in 2021, the first woman to hold that position. The previous five years had been a difficult time for the department, and morale was rock bottom. Her role in turning around the department cannot be over-estimated, and the current strong position of Mathematics and Statistics at Otago owes much to her skilled but personable leadership. Sarah says that taking on the HOD role has been a real privilege, one that comes full circle and connects back to her early undergraduate study in mathematics and physics.

David Bryant

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING, COMPUTER AND MATHEMATICAL SCIENCES

New Colleagues

Dr Ryan Ip has recently joined the Department of Mathematical Sciences at Auckland University of Technology as a Senior Lecturer. Ryan completed his BSc (with First Class Honours) and PhD at the University of Hong Kong in 2010 and 2015, respectively. Currently, Ryan is a Senior Lecturer in Statistics/Analytics at Auckland University of Technology. Ryan's research interests include spatio-temporal statistics, spatial statistics, ordinal data analysis, decision forests and all kinds of applications of statistics in various disciplines. In addition, Ryan has extensive experience in providing statistical consultancy. Before joining AUT, Ryan was a Senior Lecturer in Statistics at the Charles Sturt University in Australia.

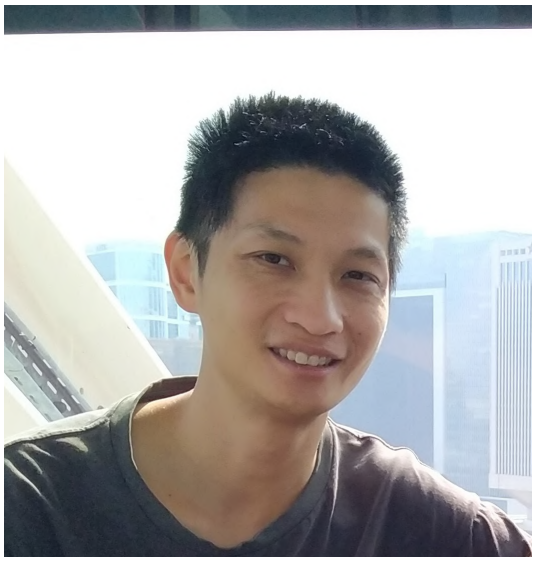


Figure 1: *Dr Ryan Ip*

Dr Hammed Fatoyinbo has recently joined the Department of Mathematical Sciences at Auckland University of Technology as a Lecturer. Hammed joined Massey University, Palmerston North as a Graduate Assistant and PhD student in 2017. Following the completion of his PhD in 2021, he undertook a Marsden Postdoctoral Fellowship with Associate Professor David Simpson. After a year, he transitioned to a postdoctoral fellowship at Epicentre within the School of Veterinary Science at Massey University, where he worked on an infectious diseases project funded by the Ministry for Primary Industries. Hammed employs various mathematical techniques, including bifurcation theory, to analyse models of electrophysiological activities, with a particular emphasis on muscle cells. He is interested in a wide range of applications of dynamical systems theory to the physical and life sciences. He is open to collaborations.

Figure 2: *Dr Hammed Fatoyinbo*

Dr Shu Su has recently joined the Department of Mathematical Sciences at Auckland University of Technology as a Lecturer. Before joining AUT, Shu was a lecturer in the school of applied business at Unitec. Shu achieved her Master of Analytics and PhD in Applied Mathematics from Auckland University of Technology. Currently, she is teaching mathematics courses to students in both the Engineering and Master of Analytics programs. Her research focused on mathematical modelling in finance to explore the dynamic nature of uncertainty within financial systems. Additionally, she is keen on applying artificial intelligence methodologies to address various challenges in business operations and decision-making processes.

Seminars of the Mathematics, Modelling and Analytics Research Centre

Dr Matthew Pawley from School of Mathematics and Computational Sciences Massey University, delivered a talk "My General Research Interests with Some Emphasis on Regularizing Multivariate Models" on 15th March 2024.

Figure 3: *Dr Shu Su*

PhD Abstracts

In March 2024, Gaurav Kapoor successfully defended his PhD theses. The title of Gaurav's PhD thesis "Analytic Methods for Electricity Price Forecasting: Application to New Zealand Electricity Market", supervised by Dr Nuttanan Wichitaksorn and Dr Wenjun Zhang.

In April 2024, Xi Li successfully defended his PhD theses. The title of Xi's PhD thesis "Pricing Path-dependent Options under Stochastic Volatility and Fractional Environment", supervised by Dr Wenjun Zhang and Prof Jiling Cao.

Wenjun Zhang

UNIVERSITY OF AUCKLAND

DEPARTMENT OF MATHEMATICS

Staff News

Professor Hinke Osinga was awarded the 2024 ANZIAM Medal, which is ANZIAM's most prestigious award. The first award was made at the 1995 ANZIAM conference and since 2018, the Medal has been awarded annually to a candidate of sufficient merit on the basis of research achievements, activities enhancing applied and/or industrial mathematics, and contributions to ANZIAM. For a list of former winners, see here:

https://www.anziam.org.au/The+ANZIAM+medal

Below is a photograph of Hinke and Phil Broadbridge, the chair of the award committee, as the impact of what has just happened dawns on her. The photo is taken by Mark McGuinness.

Hinke receiving her award.

Professor Marston Conder received the Kalman Prize for Best Paper for the article 'Edge-transitive bi-Cayley graphs', written jointly with Jin-Xin Zhou, Yan-Quan Feng and Mi-Mi Zhang (Beijing Jiaotong University), and published in 2020 in the Journal of Combinatorial Theory, Series B.

Associate Professor Sina Greenwood was awarded the Gillian Thornley Award for outstanding contribution to the cause or profession of mathematics.

Professor Warren Moors retired in February this year. We wish him all the very best in his well-earned retirement.

Dr Pedram Hekmati presented a talk on the "Geometry of Rhythms" and performed in the OMV STEAM Lab, the science part of the WOMAD festival, held at New Plymouth's Bowl of Brooklands and Brooklands Park, 15-17 March 2024. Below are some photos from the event:

Pedram at the "WOMAD festival".

Professor Eamonn O'Brian received a Humboldt Research Award:
https://www.humboldt-foundation.de/en/apply/sponsorship-programmes/humboldt-research-award

Associate Professor Jeroen Schillewaert received a Bessel Research Award:
https://www.humboldt-foundation.de/en/apply/sponsorship-programmes/friedrich-wilhelm-bessel-research-award

Other News

The 16th Devonport Topology Festival was held on 23 February. It was well attended and there were 14 excellent talks. Three international visitors, Iztok Banič, Andrej Taranenko and Goran Erceg, travelled to Auckland to attend and present at the meeting.

A fourth conference on "Symmetries of Discrete Objects" was held at the University of Auckland from 12-16 February 2024. It featured five invited international speakers and several contributed talks, covering topics such as symmetries of graphs, maps and polytopes, group action on trees, expander Cayley graphs For more details, see the website:

https://jschillewaert.wixsite.com/sodo2024

The department hosted many visitors in the first quarter of the year, including

- Edward Huang
  National Cheng Kung University
- Hendrik Van Maldeghem
  Ghent University
- Sira Busch
  Universität Münster
- Primoč Potočnik
  University of Ljubljana
- Joy Morris
  University of Lethbridge
- Andreas Cap
  University of Vienna
- György Kiss
  Eötvös Loránd University, Budapest
- Marcus J. Grote
  University of Basel
- Michal Ferov
  University of Newcastle
- Konrad Schobel
  University of Leipzig
- Mima Stanojkovski
  University of Trento
- Sho Suda
  National Defense Academy of Japan
- Martin Liebeck
  Imperial College London

Pedram Hekmati

DEPARTMENT OF ENGINEERING SCIENCE AND BIOMEDICAL ENGINEERING

Kevin Jia is one of six Faculty of Engineering winners for the *Change One Thing Challenge*. Kevin introduced Microsoft PowerBI as a reflective learning experience for data visualisation. Congratulations, Kevin!

The Department welcomes Dr Michael Hoffman, who is joining the Department of Engineering Science and Biomedical Engineering. Michael completed a PhD in Bioengineering at the University of Auckland in 2023 supervised by Andrew Taberner. His research identified and developed techniques to enhance and analyse the volume of blood collected by needle-free jet injection. He is stepping into the role of a professional teaching fellow focussing on sensors, instrumentation and signal processing.

The Department would also like to take the opportunity to congratulate Michael on his PhD. His thesis is titled *Lancet and Needle-Free Blood Insulin Therapy using a Controllable Jet Injector*. Jet injection is an established technique to deliver insulin without a needle by propelling the liquid insulin with sufficient momentum to penetrate subcutaneous tissue. Michael showed that a jet injection could replace lancing without measuring sample dilution. A proof of concept was developed to show how a jet injection system might perform a small initial injection to puncture the fingertip, apply a 40 kPa partial vacuum and then collect a blood sample to measure blood glucose concentrations. Two methods were employed to collect a blood sample, one relying on capillary action, and another using the partial vacuum to move a test strip into contact with the fingertip. These methods were successful in 88% and 91% of in vitro trials, respectively. In totality, this work establishes the potential of jet injection as the basis for an all-in-one therapeutic device for insulin therapy.

The Department congratulates Dr Nicholas Mellor on his PhD. His thesis is titled *Elucidating the Mechanisms of Calcium Communication in Patterned Networks of Aggressive Glioblastoma Brain Cancer Cells Through UV Laser Stimulation* and was supervised by Professor Charles Unsworth, Associate Professor Scott Graham and Sylvia Chung.

The Department also congratulates Dr Rishi Adiga. Rishi's thesis is titled *Optimizing Geothermal Well Planning under Reservoir Uncertainty with Stochastic Programming* and was supervised by Professor Andy Philpott and Dr John O'Sullivan. Geothermal power generation has high capital costs, a large portion of which is accounted for by well costs. Therefore, optimizing well placement and scheduling decisions is crucial to maximize returns. Rishi introduced a novel reduced-order method that uses reservoir simulations to efficiently predict production outcomes from different combinations of wells and production starting times. Mixed Integer Programming (MIP) models use this reduced-order method to select optimal well locations and start times by maximizing Net Present Value (NPV). The application of this workflow is demonstrated with an example reservoir model of a geothermal system in Indonesia. The workflow is extended to address uncertainty, developing stochastic MIP (SMIP) models to optimize well placement policies, which hedge over a set of possible scenarios modelling geological uncertainty. While such approaches have previously been used in the oil and gas industry, this is the first application of SMIPs for optimizing decision-making in geothermal projects.

Andreas Kempa-Liehr

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Congratulations

We congratulate Han Gan, Programme Lead in Data Analytics, on his recent marriage. He and Charlotte Sarten had their Hamilton wedding in early April. Nine former and current staff of the Department attended the wedding.

Congratulations are due to Jacob Heerikhuisen for his well-deserved promotion to Associate Professor.

Staff movements

David Chan completed his fixed-term appointment as a Tutor in Data Analytics late last year. He has now taken up a position as a statistics consultant at the University of New South Wales. He made a quick trip back for Han and Charlotte's wedding.

We welcome Sampath Fernando who is David's replacement. Sampath completed his PhD at the University of Auckland.

Tim Stokes is on study leave in the first half of the year. As part of this study leave, he'll visit Australia for three weeks and the UK for six weeks. He'll give an invited talk at the North British Semigroups and Applications Network meeting. This meeting is a satellite to the 75th British Mathematical Colloquium which is to be held in Manchester

Another person overseas is Nick Cavenagh. He's essentially taking leave without pay in the first half of the year. He's spending his time in Argentina and says he loves Buenos Aires.

Hamish Gilmore has been working with us as a sessional assistant for a number of years. He has now taken up a Lectureship at AUT.

Miscellany

Sean Oughton and Jacob Heerikhuisen were part of the organising committee for the 2024 Fluids in New Zealand (FiNZ) conference which was recently held at the University of Waikato. There were 36 attendees from around the country. A great feature of this year's meeting was that students made up nearly half the attendees.

Stephen Joe

MASSEY UNIVERSITY

SCHOOL OF MATHEMATICAL AND COMPUTATIONAL SCIENCES

Christopher Tuffley, Robert McLachlan, Indranil Ghosh, Carlo Laing, Mick Roberts, Graeme Wake, Winston Sweatman and Annalisa Conversano attended the NZMS colloquium in Wellington, December 3-6.

We farewelled Jian Song, a PhD student who had been visiting Carlo Laing for 18 months, and welcomed Jingjing Liao, who will be a postdoc with Carlo for two years.

The 2024 NZMRI Summer workshop on Mathematical Neuroscience, organised by Carlo Laing and Richard Brown, was held in Paihia on January 7-12. The weather was perfect and the overseas speakers enjoyed a visit to Waitangi and a boat trip to Motukōkako ("the hole in the rock").

Carlo Laing

Figure 4: Speakers at the 2024 NZMRI summer workshop. Left to right: Jeff Moehlis, Zack Kilpatrick, Carlo Laing, Benjamin Lindner, Alla Borisyuk.

VICTORIA UNIVERSITY OF WELLINGTON

SCHOOL OF MATHEMATICS AND STATISTICS

We have quite a few interesting news from Te Herenga Waka in Wellington:

Professor Lisa Orloff Clark delivered her inaugural lecture following her recent promotion. Her presentation was exceptionally innovative and explored intricate mathematical concepts such as infinity and symmetry, offering fresh perspectives not previously explored. Professor Orloff not only shared her original mathematical insights but also recounted her personal journey to becoming a professor at Te Herenga Waka - Victoria University of Wellington. Additionally, she provided thought-provoking insights into questions such as "What defines a mathematician?" and "What are the roles of mathematicians in society?". The recorded lecture can be accessed through the link:

https://www.wgtn.ac.nz/about/our-story/news-events/public-lecture-series/public-lecture-series-events/she-has-to...make-her-own-mathematics.

Ngā Puanga Pūtaiao Fellowship awarded to Jasmine Hall. Jasmine Hall was a PhD student supervised by Prof Geoff Whittle and also held an Assistant Lectureship before leaving to take a Postdoctoral position with the School of Education. For more information please follow the link:

https://www.mbie.govt.nz/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/expanding-the-impact-of-vision-matauranga-2023-investment-plan/nga-puanga-putaiao-fellowship/.

Te Herenga Waka – Victoria University of Wellington is co-hosting the Work Integrated Learning NZ (WILNZ) Conference at the Pipitea campus with WILNZ between 9-10 April 2024. This is an opportunity to hear from Work Integrated Learning (WIL) practitioners and academics from around Aotearoa and abroad as they discuss new ideas, best practice, and innovative research in the WIL space. A Student Showcase on 8 April is open to all VUW staff wishing to learn more about new WIL initiatives at Te Herenga Waka. Students will share their unique experiences of completing WIL placements, internships, or projects. For conference and student showcase details visit

https://wilnz.nz/conference/.

A new book, authored by Didier Clamond (Université Côte d'Azur), Denys Dutykh (Khalifa University), and Dimitrios Mitsotakis (Victoria University of Wellington), titled "Variational Approach to Water Wave Modeling", has been published by the International Association for Hydro-Environment Engineering and Research (IAHR). The book is forwarded by Professor Thomas Bridges (University of Surrey) and presents recent advances in mathematical and numerical modeling of water waves, including multisymplectic theory and variational methods for water waves. It is available open access, courtesy of the generous support of Khalifa University, UAE. Interested readers can access the book through the following link:

https://doi.org/10.3850/978-90-833476-6-0_IAHR_Watermonograph_003.

Dimitrios Mitsotakis

UNIVERSITY OF CANTERBURY

SCHOOL OF MATHEMATICS AND STATISTICS

Professor Clemency Montelle from the University of Canterbury has been awarded an India-New Zealand Centre Fellowship in collaboration with IIT-Delhi, focusing on exploring mathematical and astronomical traditions of Indian knowledge systems. She emphasizes the importance of incorporating Indigenous knowledge alongside modern science to create culturally responsive approaches in research and teaching. This fellowship aims to foster long-lasting relationships between India and New Zealand, aligning with India's Ministry of Education's commitment to integrating Indigenous knowledge into education. Additionally, Professor Matthew Wilson, another fellowship recipient, will use geospatial data to quantify flood hazards and water resources, contributing to collaborative research between IIT-Delhi and the University of Canterbury.

Figure 5: Clemency.

Congratulations to Varvara for her recent research achievement alongside her PhD student Krzysztof Maliszewski and coauthors Dr Magdalena Urbańska and Dr Sylwia Kolenderska. Their paper has been accepted to the esteemed IEEE Computer Vision and Pattern Recognition conference, a rare feat as only ten papers from New Zealand have ever been accepted to this conference. Their innovative deep learning approach aims to enhance the effectiveness and reduce costs associated with eye health assessments utilizing optical coherence tomography. Amazing work by the team! LinkedIn post with links here:

https://www.linkedin.com/feed/update/urn:li:activity:7177609548122238976/

Former MSc students Alex Goodenbour and Oliver Markwell (supervisor Chris Stevens) have been successful in hunting for fully-funded overseas PhD positions. Alex, after completing a Master of Advanced Study in Cambridge, will study under Lionel Mason at the University of Oxford, while Ollie will be moving to the Albert Einstein Institute in Germany to study numerical relativity under Harald Pfeiffer.

This year marks the retirement of Senior IT analyst Allen Witt, who began his journey with UC back in 1990, stationed at the "Old Maths" building under the guidance of Bob Broughton. Congratulations, Allen, on your remarkable tenure! We eagerly anticipate celebrating your achievements in grand fashion and hearing your insightful reflections. Interviews for a new senior IT systems analyst have concluded.

Chris Stevens has taken over the local correspondent role from Günter Steinke who will be retiring later this year.

Chris Stevens

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Warmest congratulations to *Sarah Wakes* and *Tim Jowett* on their well-deserved promotions to Professor and Senior Research Fellow, respectively. Well done!

Our Honours student *William Waters* has done very well in the 2023 Simon Marais Mathematics Competition: He achieved the best individual entry throughout NZ. Congratulations, Will!

We are looking forward to the arrival of Otago's new Vice Chancellor *Grant Robertson* (and also to the retirement of the current acting VC, who was at the helm while 65 staff have been fired and 151 staff have been tricked into voluntary redundancy, and hence needs to take responsibility for this disaster). In the current challenging times, it will be very welcome to have a leader who is well-known for his belief in social justice and his expertise in finances. He may well be the first member of university management with strong financial acumen. Grant will start his position in July.

The 20Twenties Young Alumni Award celebrates the achievements of 20 University of Otago alumni who are still in their twenties. A 2023 award went to our former student *Elliot Marshal*, who is now pursuing a PhD at Monash University. Elliot's achievements include volunteering at Otago's Science Expo, obtaining a Staff Prize in Mathematics, securing a Monash Graduate Excellence Scholarship, actively participating in various events promoting the field of mathematics, and helping to organise the 2023 AU-NZ Student Conference on General Relativity. Well done, Elliot.

Congratulations to *Xun Xiao* and *Bethany Macdonald* for winning NZSA Prizes. Xun received the Worsley Early Career Award Prize, which recognises outstanding recent published research from a New Zealand statistician in the early stages of their career, and Bethany got a Student Talk Prize for her presentation "Test of clustering for Neyman-Scott processes". Xun's citation reads "Xun is developing a significant research profile, with contributions in applied statistical modelling and statistical reliability. His research utilizes sophisticated statistical models and computational tools to examine the properties of complex physical and biological processes, and to analyse systems that are subject to degradation and failure."

Jörg Hennig

PhD SUCCESS

Shalini Banerjee (University of Auckland. 2024)

Title: Designing Lightweight Cryptographic Primitives for Securing Industrial Control Systems.
Supervisors: Steven Galbraith and Giovanni Russello (both University of Auckland)

Abstract:
The risk of cyber attacks against Industrial Control Systems (ICS) has marked a significant growth over the past few years. Given ICS has large-scale applications in critical infrastructures such as nuclear-enrichment facilities, oil and gas, etc., the consequences of such attacks have been fatal, leading to damage of critical equipment, economic crisis and loss of human life. Investigation into the high-profile attacks reported against industrial infrastructures indicate that legacy equipment and proprietary protocols are the primary cause behind their evolving threat surface. Quite evidently, the cost-benefit analysis inhibit device-level hardening, and the ICS security practitioners resolve to patch management, compliance based regimes, and retrofitting IT security protocols with bump-in-the-wire techniques.

In this work, we focus upon the security threats and vulnerabilities that exist in ICS, and emphasize upon the significance of lightweight cryptographic primitives in defending against ICS focused cyber attacks. In particular, we perform a detailed analysis of the attack progression framework, along with the threat surface exploited to deliver the attacks. Thereafter, we identify the security essentials and design lightweight cryptographic implementations to increase adversary's cost of attack at various stages of the attack framework. In particular, we design (a) a framework that accurately identifies manipulation of process parameters without compromising the network bandwidth used for communicating control information, (b) a framework that aims to achieve application-specific security, while incurring significantly low overhead, and (c) a platform that employs cryptographic obfuscation to prevent extraction of process semantics. Our obfuscation platform takes inspiration from our construction of (d) an efficient virtual black-box obfuscator for binary decision trees. Finally, we design (e) verifiable schemes for defending against malicious obfuscators that incorporate trigger based initiation of malicious payloads to manipulate critical control parameters. The last two constructions are of independent interest, and have much wider applicability in software obfuscation.

Gaurav Kapoor (University of Auckland. 2024)

Title: Analytic Methods for Electricity Price Forecasting: Application to New Zealand Electricity Market.
Supervisors: Dr Wenjun Zhang and Prof Jiling Cao (both Auckland University of Technology)

Abstract:
Electricity price forecasting has become a crucial focus for energy market participants in the last few decades. Its importance stems from the lack of efficient electricity storage options, and the uncertainty in its generation and ability to meet real-time demand. This thesis presents three independent forecasting studies for New Zealand electricity prices using diverse methods and models from electricity price forecasting literature. The models, methodologies, and variables considered in these studies are tailored for the New Zealand electricity market, and as such, the results are of direct interest to participants in the New Zealand electricity sector.

The first study forecasts daily electricity prices using Markov regime-switching (MRS) models and compares them to an extreme-value theory (EVT) framework. Due to the application of the generalised Pareto distribution for extreme prices, the EVT framework is able to perform better in in-sample density fitting than other models, despite its relative lack of complexity. However, the three-regime MRS model with time-varying transition probabilities presents the best out-of-sample price density fits.

The second study employs a mixed-frequency framework to forecast half-hourly electricity prices using hourly weather variables. A mixed-frequency vector-autoregressive (MF-VAR) model and the reverse unrestricted mixed-data sampling (RU-MIDAS) model are compared. LASSO regularization stands out as a key factor, consistently enhancing the forecasting performance when it is applied.

Inspired by LASSO's success, the third study further explores the impact of feature selection on forecasting performance. This study compares statistical (GARCH and stochastic volatility) and machine learning models (LASSO-estimated auto-regressive, deep neural network (DNN), long short-term memory (LSTM), gated recurrent unit (GRU), extreme gradient boosting (XGBoost)) for daily electricity price forecasting. A meticulous comparison methodology involves a large number of external features and a variety of feature selection methods, including the LASSO, mutual information, and recursive feature selection. GARCH-t, SV-t, GARCH, and SV with LASSO-selected features consistently outperform benchmark models LEAR and DNN, showcasing performance increases of over 40% compared to GARCH and SV models with all features.

Xi Li (University of Auckland. 2024)

Title: Pricing Path-dependent Options under Stochastic Volatility and Fractional Environment.

Supervisors: Dr Wenjun Zhang and Prof Jiling Cao (both Auckland University of Technology)

Abstract:
This thesis focuses on the evaluation of various path-dependent options, specifically down-and-out put options, floating strike lookback options, and geometric Asian options. We consider a hybrid model with stochastic elasticity of variance and stochastic volatility as the driving factors for the underlying asset. It is well-known that obtaining closed-form solutions for these path-dependent options under stochastic volatility models is challenging.

To address this issue, we employ an asymptotic expansion approach and the Mellin transform method. By utilizing these techniques, we are able to derive explicit closed-form formulas for both the zero-order and the first-order correction terms. These formulas provide valuable insights into the pricing of the options and allow for a more comprehensive analysis.

Furthermore, we conduct a sensitivity analysis on the asymptotic terms obtained from our pricing formulas. This analysis helps us understand the impact of various factors on the option prices. Additionally, we compare the option prices calculated using our derived formulas with those obtained from Monte-Carlo simulations and the binomial tree method.

By comparing the prices derived from different models such as Black-Scholes, CEV, and SVCEV, we demonstrate the accuracy and effectiveness of our pricing formulas. The numerical comparisons highlight the strengths of our approach and emphasize the practical relevance of our findings.

In summary, this thesis contributes to the research field by providing explicit closed-form formulas for path-dependent options under a hybrid model with stochastic elasticity of variance and stochastic volatility or a fractional Brownian motion model. Through numerical analysis and comparisons with other pricing methods, we validate the accuracy and robustness of our derived formulas, thereby enhance the understanding and applicability of option pricing in financial markets.

Allan Bai (University of Canterbury. 2023)

Title: Reconstructing Phylogenetic Networks.

Supervisors: Dist. Prof. Charles Semple (University of Canterbury)

Abstract:
Phylogenetic networks are a generalization of phylogenetic trees that allow for reticulation. Reconstruction of phylogenetic trees from distances is well studied, but for networks, there are relatively few results. Recent results have focused on restricting the space of phylogenetic networks to speci c subclasses with desirable properties, in particular, normal, tree-child and orchard networks. In this thesis, we explore new methods of reconstructing phylogenetic networks, as well as extend existing reconstruction results beyond these classes.

Orchard and temporal networks play a signi cant role in phylogenetic results, as they provide enough restrictions to exclude undesirable structures, whilst still having enough complexity to maintain mathematical interest.

However, little is known about the structure of these networks. In particular, there are few structural characterisations for these networks. The rst part of the thesis outlines forbidden structures characterisations for orchard and temporal networks.

The second part of the thesis explores reconstruction of phylogenetic networks using distance. We extend the results of Bordewich et al., and show that equidistant semibinary normal networks can be reconstructed using their minimum distances. We also show that equidistant orchard networks can be reconstructed using distances, up to an equivalence class known as sinks.

Finally, the last part of the thesis considers reconstructing phylogenetic networks from the relative unexplored information type of ancestral pro les. We show that like distances, stack-free phylogenetic networks can be reconstructured using ancestral pro les, with the exception of some special structures.

Gerald Toft (University of Canterbury. 2023)

Title: Two Generalisations of the Wheels-and-Whirls Theorem.
Supervisors: Dist. Prof. Charles Semple (University of Canterbury)

Abstract:
One of the most famous results in matroid theory is Tutte's Wheels-and-Whirls Theorem. It states that every 3-connected matroid has an element which can either be deleted or con- tracted while retaining 3-connectivity, except for two families of matroids: the eponymous wheels and whirls. The Wheels-and-Whirls Theorem is a powerful tool for inductive argu- ments on 3-connected matroids. We consider two generalisations of the Wheels-and-Whirls Theorem.

First, what are the k-connected matroids such that the deletion and contraction of every element is not k-connected? Motivated by this problem, we consider matroids in which every element is contained in a small circuit and a small cocircuit, and, in particular, when these circuits and cocircuits have a cyclic structure. The first part of this thesis is concerned with matroids in which have a cyclic ordering σ of their ground set such that every set of s – 1 consecutive elements of σ is contained in an s-element circuit and every set of t – 1 consecutive elements of σ is contained in a t-element circuit. We show that these matroids are highly structured by proving that they are "(s, t)-cyclic", that is, their s-element circuits and t-element cocircuits are consecutive in σ in a prescribed way. Next, we provide a characterisation of these matroids by showing that every (s, t)-cyclic matroid is a weak-map image of a particular (s, t)-cyclic matroid.

Secondly, what are the 3-connected matroids such that such that the deletion and con- traction of every 2-element subset is not 3-connected? In the second part of this thesis, we find all such matroids. Roughly speaking, these matroids can be constructed in one of four ways: by attaching fans to a spike, by attaching fans to a line, by attaching particular matroids to M (K3,m), or by attaching particular matroids to each end of a fan.

Aditya Jha (University of Canterbury. 2023)

Title: Does Topology Provide Sufficient Structure for Non-Causal Explanations?
Supervisors: Dr Phil Wilson (University of Canterbury)

Abstract:
There is a major debate as to whether there are non-causal mathematical explanations of physical facts that show how the facts under question arise from a degree of mathematical necessity considered stronger than that of contingent causal laws. Topology provides an ideal ground for such purported non-causal explanations since topological manifolds, on which the parameters of a dynamical system can be modelled, are typically associated with multiple invariants, which remain unaltered even if the manifold is bent, stretched or twisted, reflecting a change in the parameter modelled on the manifold. Understood in this sense, topological explanations seem to provide modal information about certain constraints on the system that may not be evident in detailed, and often, cumbersome causal explanations.

This thesis examines some foundational issues in the applicability of topology to the natural world and their bearing on the debate on such purported non-causal (mathematical) explanations. More specifically, this thesis looks into various topological and geometrical formulations that essentially exploit the geometry of oscillating and complex systems, as an exercise in 'geometric mechanics', to provide a simple explanation of certain constraints imposed on their dynamics by the virtue of their geometry. The central question answered in this thesis is whether topology provide sufficient structure for such non-causal explanations. The answer, as the thesis demonstrates, is negative because topological explanations critically rely on idealisations, such as continuity and smoothness, which are realised only contingently in the natural world (or in mathematical approximations/models of the natural world); these idealisations impose some foundational limitations on the application of topology in modelling such systems 'non-causally'. Consequently, purported topological explanations fail to fully circumvent the causal dependencies of such systems implying that these are not really 'non-causal'explanations.

This thesis also extends the argument to mathematical explanations in general. It argues that purported mathematical explanations are essentially causal explanations in dis- guise and are no different from ordinary applications of mathematics to the natural world. This is because these explanations work not by appealing to what the world must be like as a matter of mathematical necessity, but by appealing to various contingent causal facts. These contingent facts, although assumed away in the why-question pertaining to a physical fact, still participate as causal facts in an explanation of why the fact obtains in the world. That is, the explained physical fact does not obtain because of a mathematical necessity but by appeal to the world's network of causal relations.

GENERAL NOTICES

46ACC December 2024

The 46th Australasian Combinatorics Conference (46ACC) will be held at The University of Queensland, December 2-6, 2024. It will be an in-person, face-to-face, conference. The conference program includes invited talks, contributed talks in parallel sessions, conference dinner and presentation of the CMSA Anne Penfold Street Student Prize for the best student talk at the conference, excursion, and CMSA Annual General Meeting. Researchers in any area of combinatorics and its applications are encouraged to attend and contribute a talk.

Invited speakers:

- Alice Devillers (University of Western Australia)
- Melissa Lee (Monash University)
- Florian Lehner (University of Auckland)
- Anita Liebenau (UNSW Sydney)
- Jie Ma (University of Science and Technology of China)
- Sam Mattheus (Vrije Universiteit Brussel)
- Anita Pasotti (Università degli Studi di Brescia)
- David Wood (Monash University)

Organising Committee: Sara Davies, Barbara Maenhaut, Darryn Bryant.

Contact: 46acc@uq.edu.au

Website: https://46acc.github.io

MINZ 2024

We are pleased to confirm that MINZ is coming back this year. The event will take place at the University of Canterbury:

July 1st to July 5th, 2024.

We will also have some insightful talks from both academia and industry throughout the week, and of course the conference welcome drinks and nibbles on Monday evening and the conference dinner on Wednesday evening.

As usual, the event is free, so please do let us know that you are coming by registering at the following page: https://events.humanitix.com/maths-in-industry-new-zealand-2024

Information about the challenges will be updated shortly and will be posted on the MINZ website (https://minz.org.nz/). There, you will find important information about the event.

Once you have registered- thank you-, but if you know of others who might be interested in coming, please forward this email.

We have included a preliminary workshop program so you can start planning your travel and accommodation.

If you have any questions please email minz@canterbury.ac.nz and our team will get back to you promptly.

We look forward to seeing you there!

Miguel Moyers and James Williams
MINZ 2024 Organizers

THE 14TH AIMS CONFERENCE

DECEMBER 16–20, 2024

Plenary Speakers

Robert Calderbank
Ingrid Daubechies
Lisa Fauci
Svetlana Jitomirskaya
Nader Masmoudi
Xavier Ros Oton
Corinna Ulcigrai
Jun-Cheng Wei
Ping Zhang
Pingwen Zhang

Conference Features

Plenary Lectures	*(60 min)*
Thematic Sessions	*(45 min)*
Special Sessions (100+)	*(30 min)*
Contributed Sessions	*(20 min)*
Poster Sessions	
Best Student Paper Competition	

Topic Coverage

Pure and applied analysis, differential equations and dynamical systems, in the broadest sense. The applications are diverse and multidisciplinary, covering areas of applied science and engineering that include biology, chemistry, physics, finance, industrial mathematics and more, in the forms of modeling, computations and simulation.

Travel Information

This conference is held in cooperation with the Association for Women in Mathematics. US participants may be eligible for their travel grant: Visit their website for more information.

*The 14th AIMS Conference is organized by AIMS and NYU Abu Dhabi. To register or learn more about the conference, click **here** or visit us at **aimsconference.org**.*

AIMS

جامعة نيويورك ابوظبي
NYU ABU DHABI

NZMS NOTICES

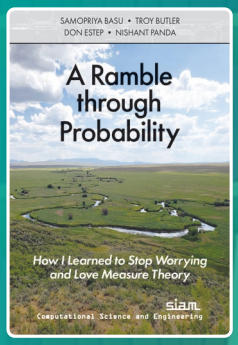
NZMS Financial assistance

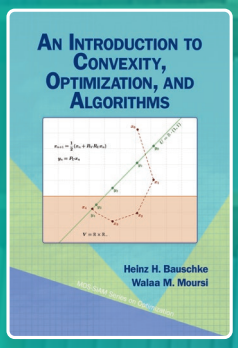
The NZ Mathematical Society offers two kinds of funding for NZ mathematicians: NZMS Student travel grants (financial support etc.) and NZMS Financial Assistance grants (funds for mathematical related activity).

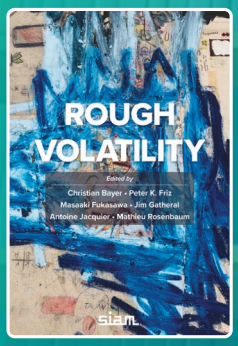
There are quarterly deadlines for applications. The deadline for applications for 2024 are February 15, May 15, August 15, and November 15.

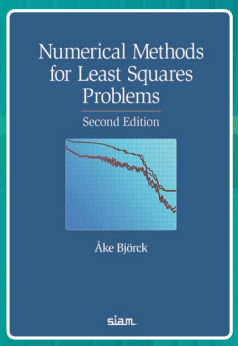
Applications must be made at least 1 month in advance of the travel or event.

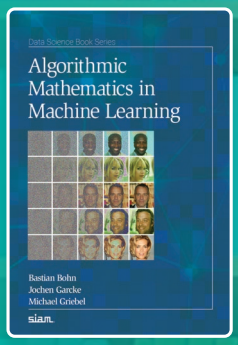
Please refer to http://nzmathsoc.org.nz/?assistance for further details and application forms.

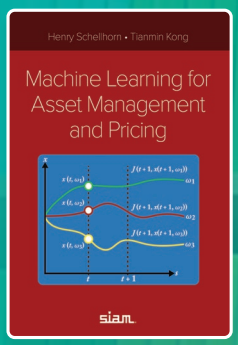












New books from SIAM

A Ramble through Probability
How I Learned to Stop Worrying and Love Measure Theory
Samopriya Basu, Troy Butler, Don Estep, and Nishant Panda

Measure theory and measure-theoretic probability are fascinating subjects. Proofs describing profound ways to reason lead to results that are frequently startling, beautiful, and useful. Measure theory and probability also play roles in the development of pure and applied mathematics, statistics, engineering, physics, and finance. This book traces an eclectic path through the fundamentals of the topic to make the material accessible to a broad range of students. It brings together the key elements and applications in a unified presentation aimed at developing intuition; contains an extensive collection of examples that illustrate, explain, and apply the theories; and is supplemented with videos containing commentary and explanations of select proofs on an ancillary website.

2024 • xvi + 603 pages • Softcover • 9781611977813 • List $94.00 • SIAM Member $64.80 • CS29

An Introduction to Convexity, Optimization, and Algorithms
Heinz Bauschke and Walaa Moursi

This self-contained book provides an introduction to convex analysis and optimization algorithms, with an emphasis on bridging the two areas. explores cutting-edge algorithms—such as the proximal gradient, Douglas–Rachford, Peaceman–Rachford, and FISTA—that have applications in machine learning, signal processing, image reconstruction, and other fields. More than 200 exercises enhance the reader's understanding of the topic.

2024 • xvi + 175 pages • Softcover • 9781611977790 • List $60.00 • SIAM Member $42.00 • MO34

Rough Volatility
Christian Bayer, Peter K. Friz, Masaaki Fukasawa, Jim Gatheral, Antoine Jacquier, and Mathieu Rosenbaum, *Editors*

Volatility has traditionally been modeled as a semimartingale, with consequent scaling properties but, a new paradigm has emerged, whereby paths of volatility are rougher than those of semimartingales. According to this perspective, volatility is path-dependent and exhibits jump-like short-term behavior. *Rough Volatility* is the first book to offer a comprehensive exploration of the subject, organizing the material to reflect the subject's development and progression. It contributes to the understanding and application of rough volatility models by equipping readers with the tools and insights needed to delve into the topic. and explores the motivation for rough volatility modeling and provides a toolbox for its computation and practical implementation.

2023 • xxviii + 263 pages • Softcover • 9781611977776 • List $85.00 • SIAM Member $59.50 • FM02

Numerical Methods for Least Squares Problems
Second Edition
Åke Björck

The first edition was the leading reference on the topic for many years. The updated second edition stands out compared to other books on this subject because it provides an in-depth and up-to-date treatment of direct and iterative methods for solving different types of least squares problems and for computing the singular value decomposition. It also is unique because it covers generalized, constrained, and nonlinear least squares problems as well as partial least squares and regularization methods for discrete ill-posed problems, and because it contains a bibliography of over 1,100 historical and recent references, providing a comprehensive survey of past and present research in the field.

2024 • xiv + 494 pages • Softcover • 9781611977943 • List $89.00 • SIAM Member $62.30 • OT196

Algorithmic Mathematics in Machine Learning
Bastian Bohn, Jochen Garcke, and Michael Griebel

This unique book explores several well-known machine learning and data analysis algorithms from a mathematical and programming perspective. The authors present machine learning methods, review the underlying mathematics, and provide programming exercises to deepen the reader's understanding. They provide new terminology and background information on mathematical concepts, as well as exercises, in "info-boxes" throughout the text. Application areas are accompanied by exercises that explore the unique characteristics of real-world data sets (e.g., image data for pedestrian detection, biological cell data).

2024 • xii + 225 pages • Softcover • 9781611977875 • List $64.00 • SIAM Member $44.80 • DI03

Machine Learning for Asset Management and Pricing
Henry Schellhorn and Tianmin Kong

This textbook covers the latest advances in machine-learning methods for asset management and asset pricing. Recent research in deep learning applied to finance shows that some of the techniques used by asset managers (usually kept confidential) result in better investments than the more standard techniques. Cutting-edge material is integrated with mainstream finance theory and statistical methods to provide a coherent narrative. Coverage includes an original machine learning method for strategic asset allocation; the no-arbitrage theory applied to a wide portfolio of assets as well as other asset management methods; and neural networks and other advanced techniques.

2024 • xxiv + 242 pages • Softcover • 9781611977899 • List $74.00 • SIAM Member $51.80 • OT195

siam BOOKSTORE | Society for Industrial and Applied Mathematics

TO ORDER, visit *bookstore.siam.org*
Outside North and South America order from Eurospan (*www.eurospanbookstore.com/siam*)